



Wind Tunnel Models, Balances and Support Hardware Fabrication Capabilities



GT-13: Wind Tunnel Models, Balances, and Support Hardware Fabrication Capabilities

2:00pm - 4:00pm
Mon, Jun 25

Dunwoody

Location: Dunwoody

Panelists will highlight the crucial skill area for wind tunnel testing of test hardware design and fabrication in terms of state of the art, industry direction and associated strategies, and strengths and challenges. Panelists will make 15 minute presentations followed by moderated discussion of key points from the presentation and from the the audience.

Moderator: John Micol

Panelists:

Chris Atheide, Director of New Business, Tri-Models

R. David King, Design Engineer Manager, Force Measurement Systems, Calspan

Kenneth Sullivan, President/CEO, Micro Craft, Inc.

Ray Rhew, Branch Head, Aeronautics Systems Engineering, NASA Langley Research Center

Co-Chair: Steven Dunn (Jacobs)



Overview of Panel Questions



➤ Critical Skills/Capabilities

- Hands-on design and fabrication experience
 - Much of which is a “home-grown” skillset
 - Combination of conventional and computer-aided
- Familiarity with many techniques and ability to develop test articles from sketches, drawings, discussions, concurrent engineering and fabrication, etc.
- Understanding of testing objectives/needs – help in translating into real practical hardware solutions with efficient operational capabilities
 - For tunnel models, understanding how data is taken, models are mounted, quick and easy reconfiguration of models (plug and play – quick swap out of flaps, ailerons, etc.)
- Pushing the SOA in design taking advantage of emerging production methods and materials
 - Additive – emerging to include additive methods of instrumentation
 - Plastics and composites
- Teaming and communication skills within and outside the organization

➤ Challenges

- Recruiting and retaining new talent (aging workforce)
- Learning from current experts across the disciplines
- Capturing current experts knowledge
- Volume of requests to ensure all across capability have opportunities to retain and advance the capabilities
- OK to try and fail with emerging workforce and technologies – advance learning
- Getting too excited about new technologies (FEA, Additive) when conventional works well and is faster.
(Reminder – “old school” methods can be quick and efficient)



➤ Wind Tunnel Model, Balance and Support Hardware

- Engineering and Research Directorates
- In-house and contract capabilities
 - Design/Analysis: ~12 CS/on-site contractors
 - Fabrication (Metals, composites, plastics, wax): ~100 CS/on-site contractors
 - RECOM contract – ATI, Microcraft
 - BPA – 20 fabrication companies with varying capabilities
 - FMSS contract
- Design through analysis and fabrication

NASA Langley Wind Tunnel Models and Balances

Capabilities Summary

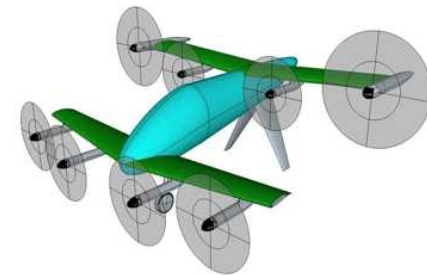
Design and development of experimental hardware/systems and balances to simulate aerospace concepts for aerodynamic and structures research.



G550 Wind Tunnel Model
System Development



Dynamically-Scaled UAS
Development



Small UAS Wind Tunnel and
Flight Concept Development





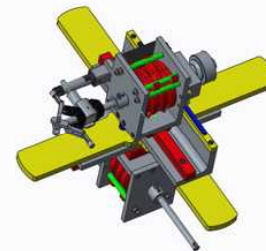
Examples of Current/Recent Model Activities and Future Trends



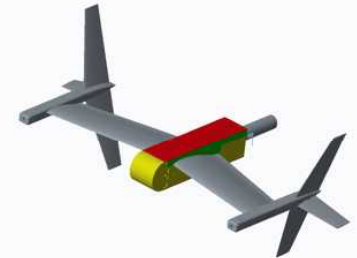
- Model Systems Engineers – ensure all wind tunnel models comply with safety standards
- 14x22 “C3” bay ceiling, 360° rotating IR window
- RECOM Contract COR – 5 years ~ \$10M
- Active Flow Control actuator design
- RAPIDPACT – wind tunnel and UAS model design and development
- CLASACT – flexible antenna for large UAV comm
- MSHELLS – structural battery concept
- Common Research Model (CRM) - semi-span
- Space X Ground Wind Loads Models (NESC sponsored)
- MBSE Pathfinder 3
- Rotorcraft – Army models, test beds and facility IR window
- ARMD OCE Detail 1/2 time
- Tail Cone Thruster Model Development – subsonic X-plane concept development
- Juncture Flow Model – currently testing in 14x22
- Space: Next Step 2 and Talisman
- Mars Electric Flyer model hardware
- Liner Test Facility Test Section
- Vibration Damper – TDT and sounding rockets



Juncture Flow Model in 14x22



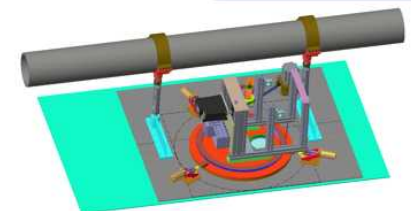
Vibration Damper



MERF Mounting Adapter



General Rotor Model System Mods - Army



14x22 Rotating IR Window Design



Examples of Current/Recent Balance Activities and Future Trends

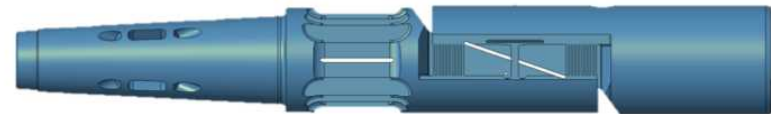


➤ On-going balance design and fabrication

- LRC-1016-7K-2.50A – Unifying Balance Design
- Balance design visualization tool (summer intern project)
- Knowledge capture activity
- SLS Test at 14x22 (highlight)
- Rotating balances
- In-Situ Load System Applications

➤ Future Trends

- Flow-through balances for powered & actuated models
- Propulsion integration, boundary layer ingestion
- High load capacity with high Drag sensitivity
- Blunt body re-entry vehicles with high drag and roll and yaw sensitivity
- Dynamic force measurement for aeroelasticity and multi-body testing
- Rapid balance production capability (& new design space)



LRC-1016-7K-2.50A



SLS Test at
14x22
(highlight)



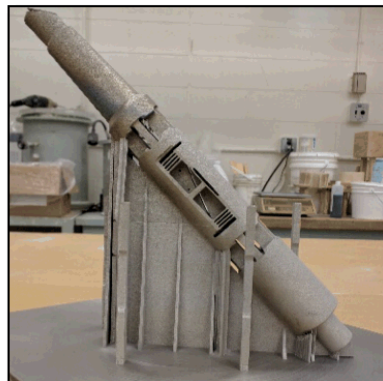
0.75 inch dia. Balance produced
from 17-4 using ADM

- **Status quo: Researchers are normally constrained to select measurement resolution based on available balances due to schedule and cost**
 - Sub-optimal measurement resolution
- **Integrating Design and Fabrication Methods for Rapid Conventional (Subtractive) and Additive Fabrication**
- **Targeting 10x reduction in cost and schedule**

Conventional (Subtractive)
50 hours in Production



Additive
~30 hours in Phase 1 Production





Space X Falcon 9 and Dragon Ground Wind Load Model

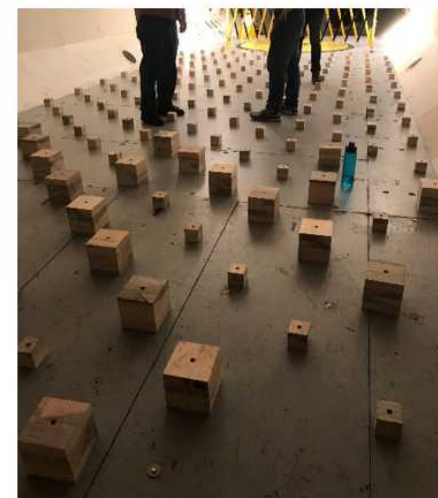


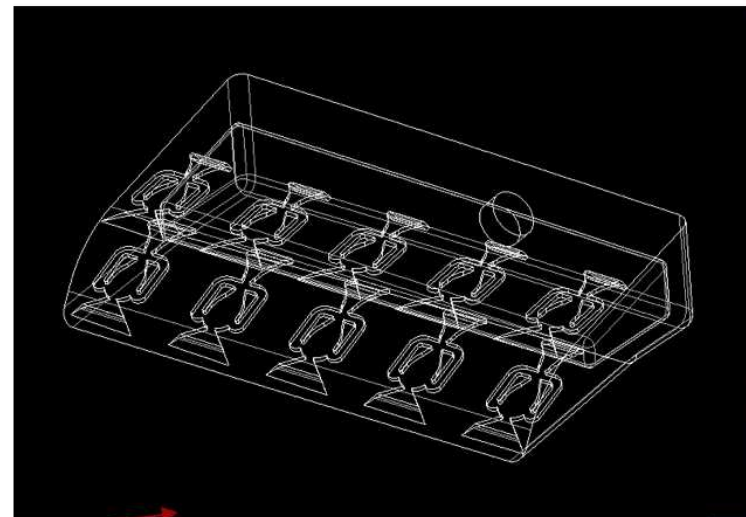
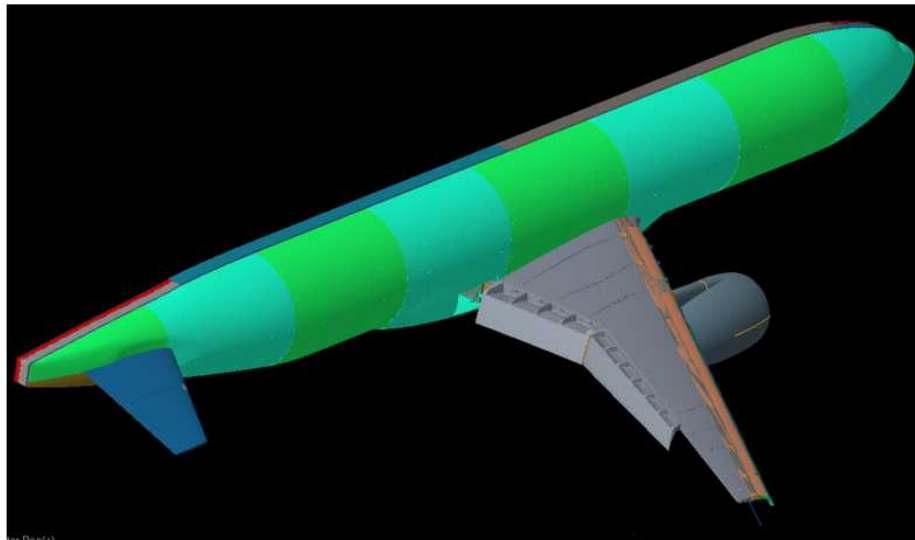
-Several of Space X's Falcon 9 configurations were designed and built at LaRC to observe Ground Wind Load (GWL) affects on the pad. The test is currently being conducted in the Transonic Dynamic Tunnel (TDT)

-Turbulence Generators were also designed and built to simulate turbulent conditions that the rocket would observe while on the launch pad.



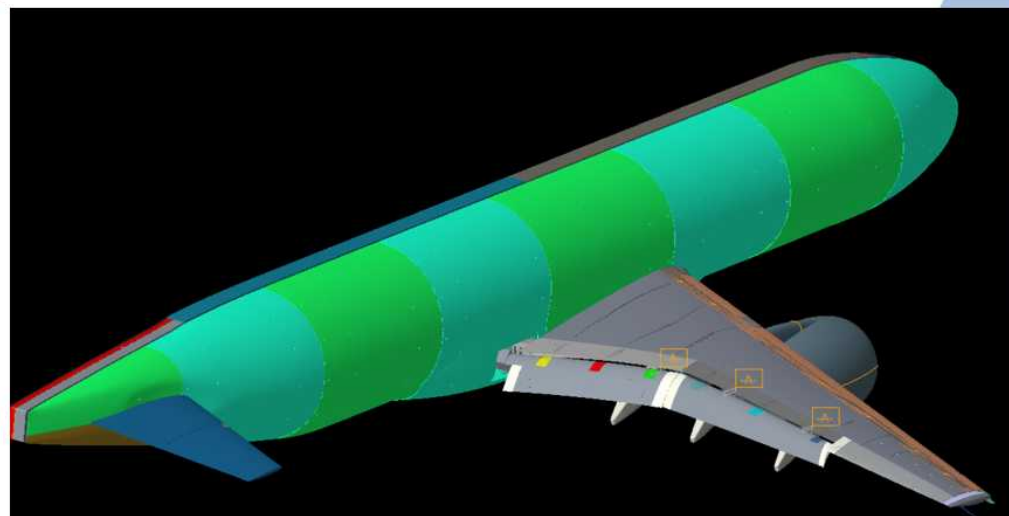
Designed by:
Chris Laws D201
Mark Cagle D201
Terry Clark D202
Jamie Shiflett D202





SHL Flap and Cartridge

ASEB Team members:
Dave Castle (Initial TPE)
Jared Fell TPE
Chris Laws
Sandy Webb
David Lewis
Miranda Snyder
Reggie Kidd
Nigel Schneider (D202)



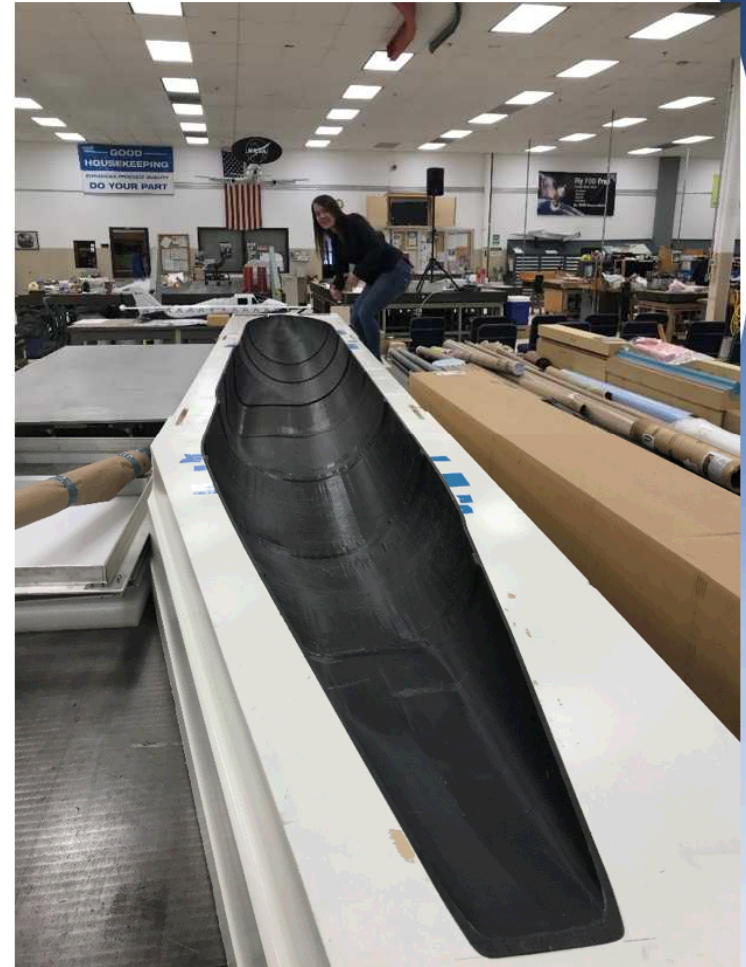
Conventional Flap configuration



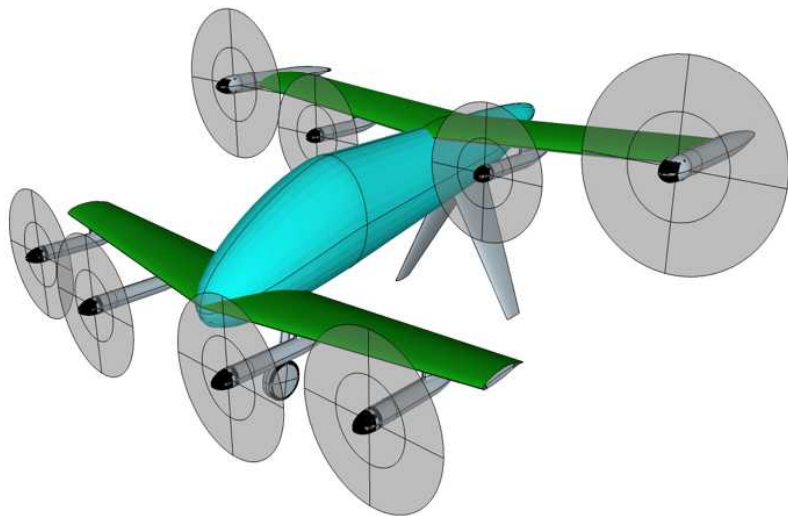
10% CRM-HL



- The model's purpose is to advance the high lift technology in the areas of active flow control, airframe noise reduction and computational fluid dynamics code validation. It is representative of a modern transport aircraft.
- Funded by Nasa Advanced Air Transport Technology Project
- Will be tested in 14x22 and Europe
- Approx. 21.5' long with 10' wingspan with 6 conventional flap deflections from 0-43 degrees plus SHL (simplified high lift) at 50 degrees
- Components fabricated from: fuselage is carbon fiber and aluminum, wing is steel and flaps are aluminum
- SHL flap will have removable cartridges, 4 inboard and 6 outboard, made from SLA, incorporating 2 rows of active flow control actuators



➤ **Description:** Rapid Design, build and fly a generic sub-scale Urban Air Mobility concept experimental UAS and wind tunnel model. Conduct research flights and provide performance and aerodynamic data of the ODM concept .





Model System Reports



Dr. Jones Blade Loss Impact Analysis Study



NASA Langley Research Center

William M. Langford
Aeronautics Systems Engineering Branch
8 November 2017

Reviewed by Doug Weber 9 November 2017

Revised 20180209

Reviewed by Lonnie Brown 12 February 2018

Dr. Jones Impact Blade Study

- 1 -

5.2% Scale Semi-span 777 CRM MSR Number D301-17-0002

NASA Langley Research Center



Prepared by:
Kairlyn M. Masiak
William M. Langford
Aeronautics Systems Engineering Branch

7th July 2017
13 December 2017
23 January 2018 (rev 15)

Reviewed by Mr. Lonnie Brown, 24 January 2018

MSR# D301-17-0002

Page 1

Model System Report Rudy King Sting 2017 Model Number D201-18-0001



NASA Langley Research Center

Prepared by:
William M. Langford
Aeronautics Systems Engineering Branch

7 December 2017

*Reviewed by Mr. Lonnie A. Brown
LaRC-D3, Jacobs Technology Company
21 December 2017*

Model # D210-18-0001

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3-DOF Mounting Bracket Analysis Report



NASA Langley Research Center

William M. Langford
Aeronautics Systems Engineering Branch
14 November 2017

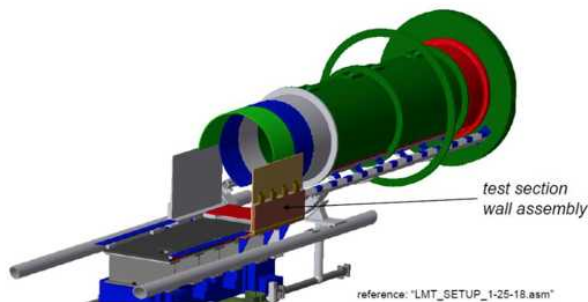
Rev. 1. 20180102
Rev. 1A 20180208

Reviewed by Mr. X on day month year

3-DOF Mounting Bracket MSR

- 1 -

8ft HTT test section walls 20180130

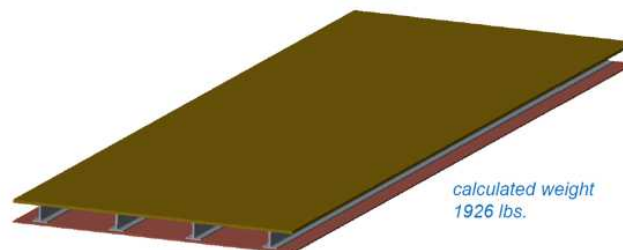


reviewed by Mr. Doug Weber 20180208

W. M. Langford
30 January 2018
NASA LaRC ED ASEB

rev1 20180202
rev. 2 20180207
rev. 3 20180209

8ft HTT deck board & beams



reviewed by Mr. Doug Weber 20180201

W. M. Langford
31 January 2018
NASA LaRC ED ASEB

rev. 1 20180202