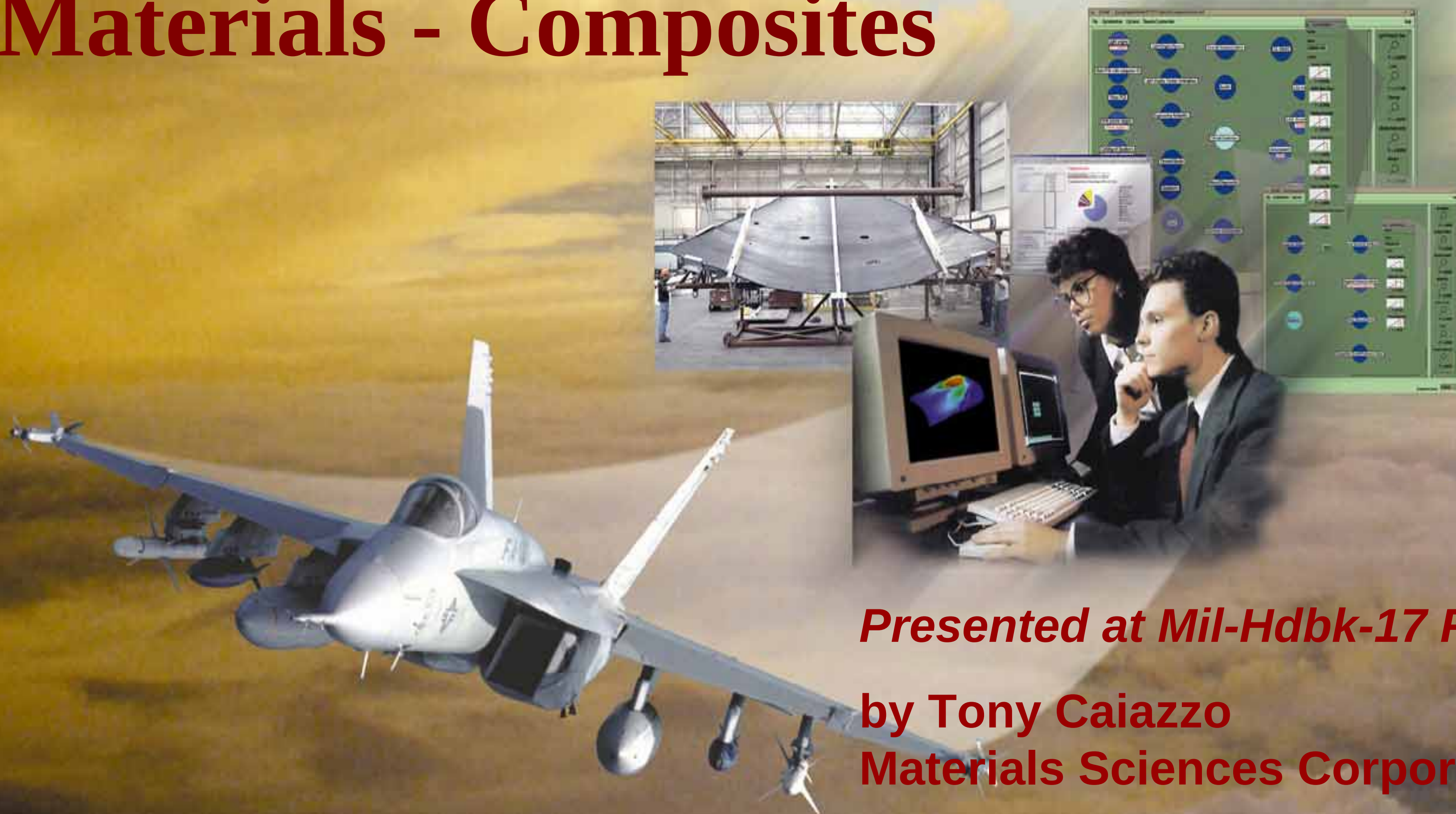
Accelerated Insertion of Materials - Composites



Presented at Mil-Hdbk-17 Forum

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AIM-C Team - Boeing (St. Louis, Seattle, Canoga Park, Philadelphia), Northrop Grumman, Materials Sciences Corporation, Convergent Manufacturing Technologies, Cytec Fiberite, Inc, Massachusetts Institute of Technology, Stanford & NASA (Langley)

AIM-C Alignment Tool

The objective of the AIM-C Program is to provide concepts, an approach, and tools that can accelerate the insertion of composite materials into DoD products

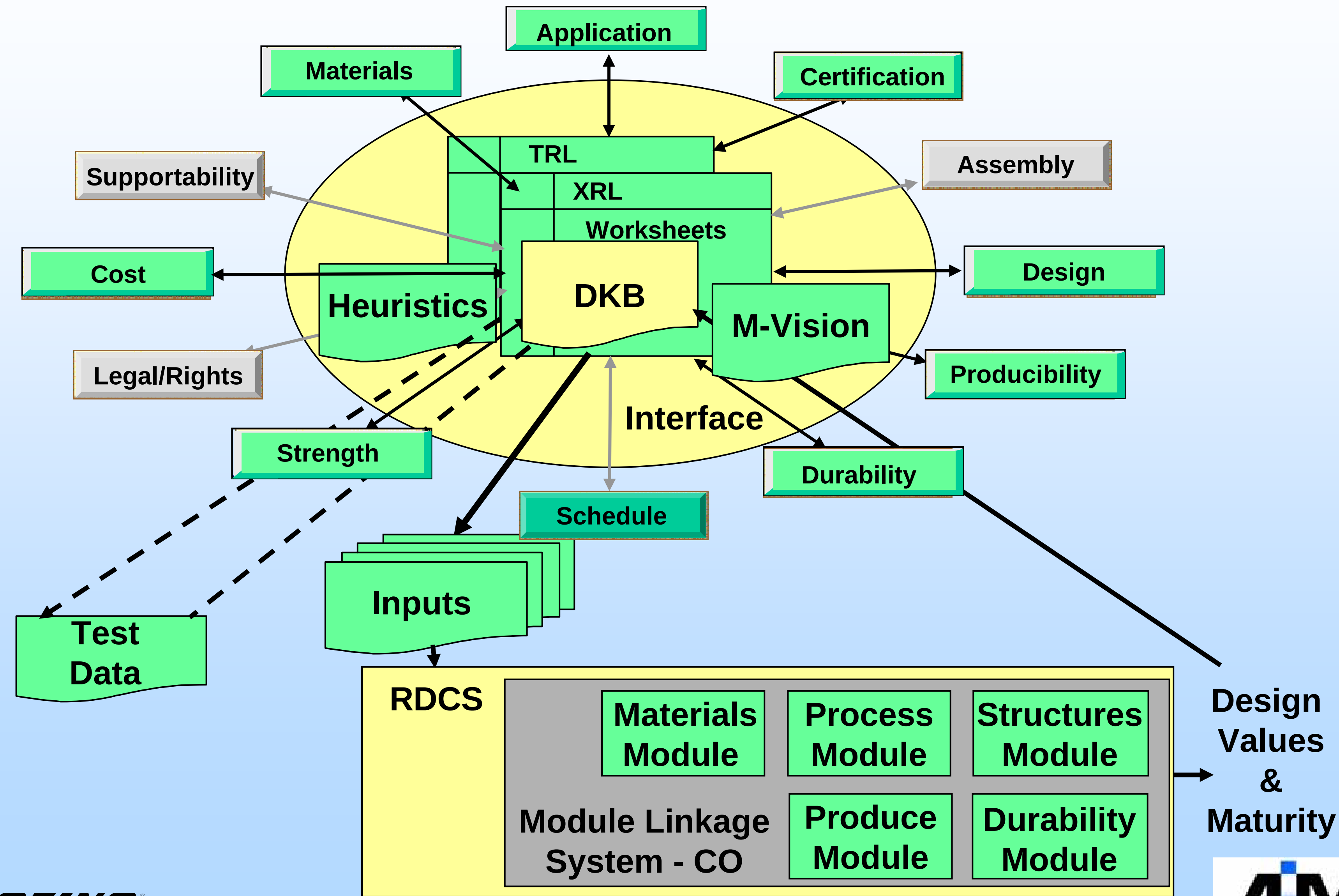
AIM-C Will Accomplish This Three Ways

Methodology - ***We will evaluate the historical roadblocks to effective implementation of composites and offer a process or protocol to eliminate these roadblocks and a strategy to expand the use of the systems and processes developed.***

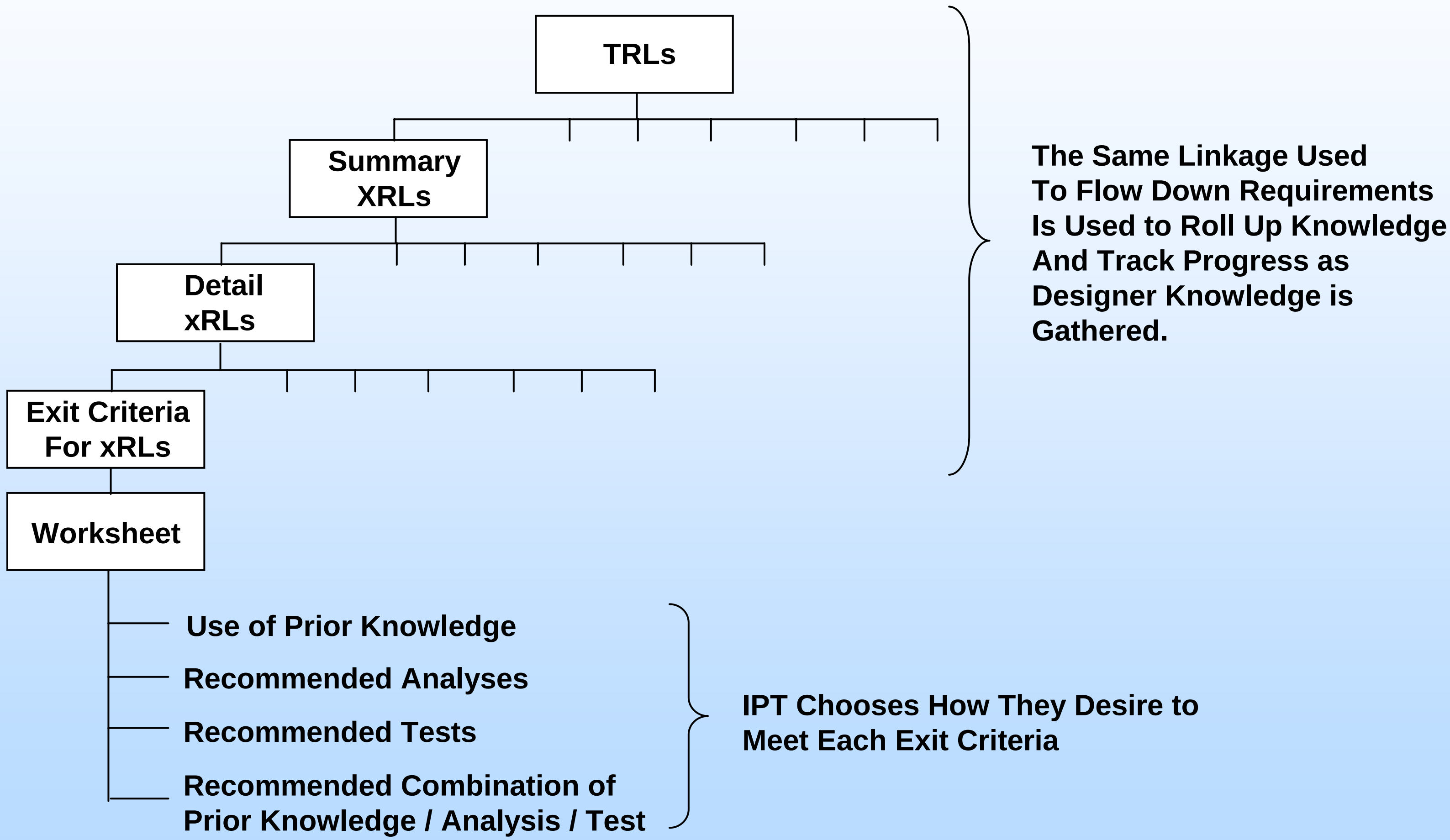
Product Development - ***We will develop a software tool, resident and accessible through the Internet that will allow rapid evaluation of composite materials for various applications.***

Demonstration/Validation - ***We will provide a mechanism for acceptance by primary users of the system and validation by those responsible for certification of the applications in which the new materials may be used.***

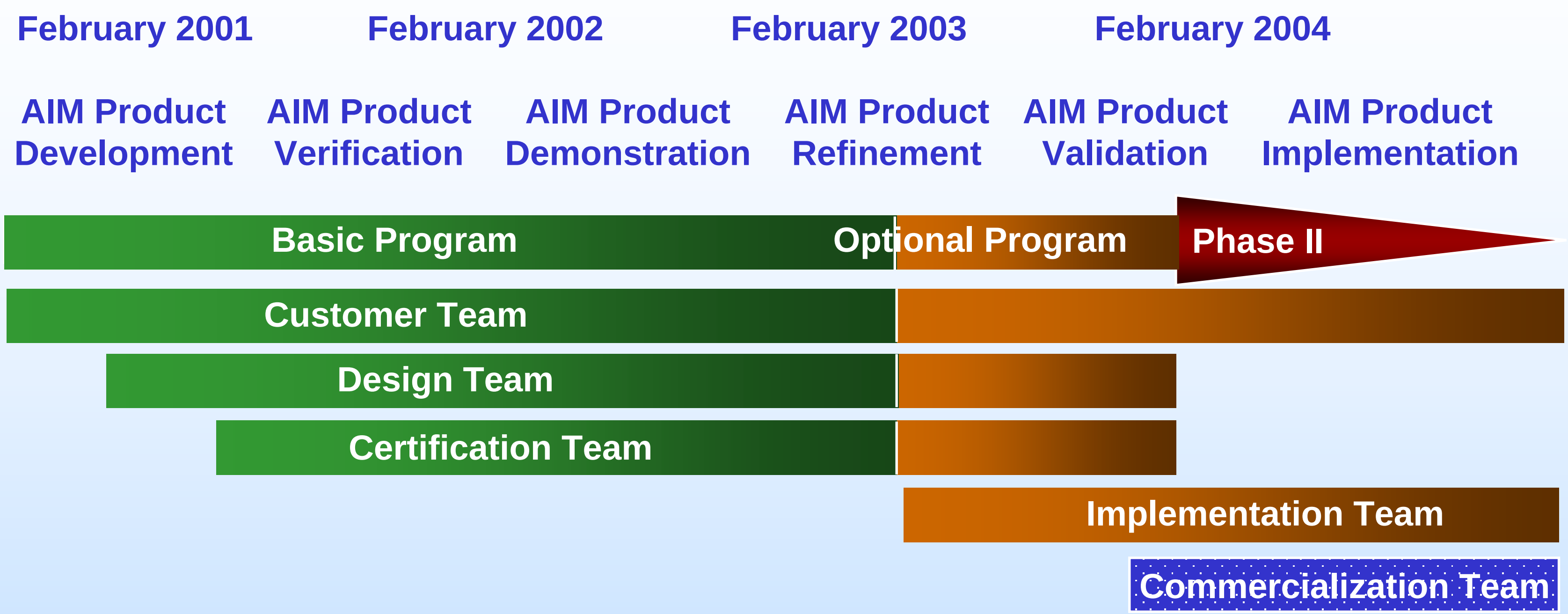
AIM-C System Vision



AIM Methodology Becomes a Requirements Flow Down and a Completion Roll Up



AIM-C Transition Plan



Customer Team – To ensure that the product meets the needs of the funding agents

Design Team – To ensure acceptance among users in industry

Certification Team – To ensure acceptance among the certification agents for structures

Implementation Team – To ensure acceptance among the user community

"Commercialization" Team – To ensure support of users

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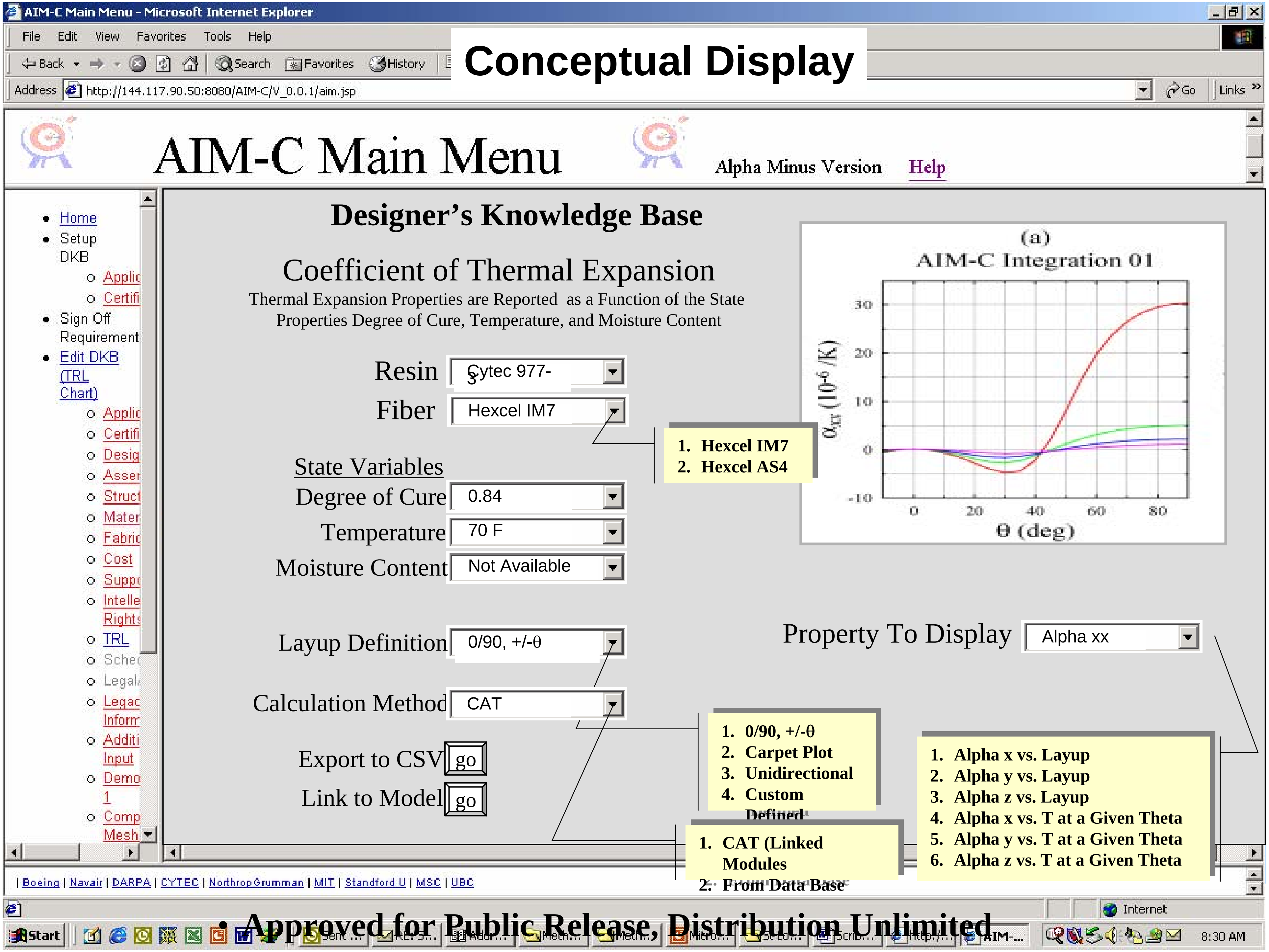
CC30033.01

AIM-C Certification Team

Agency	Integration	Structures	Materials	Producibility
Boeing	Charley Saff	Eric Cregger	Pete George	John Griffith
Navy	Don Polakovics	Dave Barrett	Kathy Nesmith	Steve Claus
Air Force	Tim Jennewine	Dick Holzwarth	Katie Thorp	Bob Reifenberg
FAA	Curt Davies	Larry Ilcewicz	David Swartz	Dave Ostrodka
Army	Mark Smith	Jon Schuck	Marc Portanova	Steve Smith
NASA	Mark Shuart	Jim Starnes	Tom Gates	Tom Freeman

To Insure That the Methodology, Verification, and System Validation We Do Satisfies Certifying Agencies

Conceptual Display



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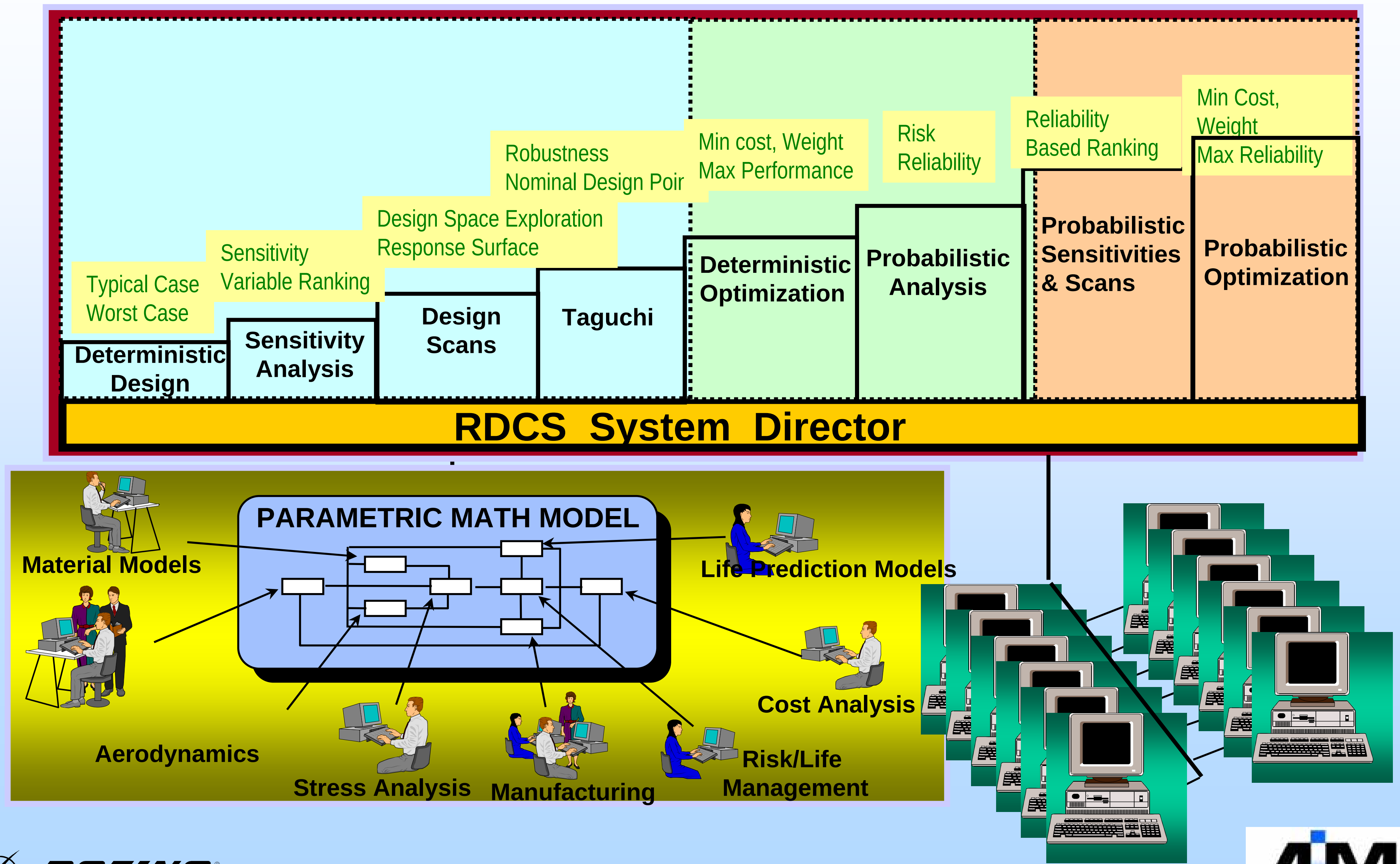
Robust Design Computational System



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RDCS Edge of Flange Disbond Study

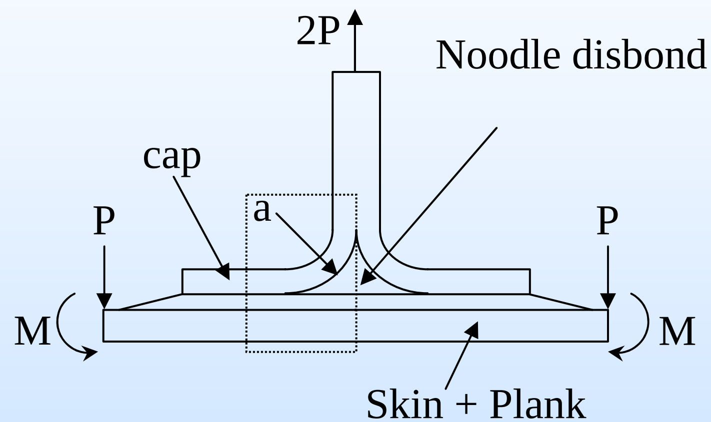
The Problem

Application Objective

- Investigate the effect of skin-stringer panel geometric parameters on maximum moment at the flange and margin of safety for stringer pull-off
- To aid in the selection of appropriate stiffener geometry and spacing

High Level Description

- **Design variables:** Skin Thickness, Flange Thickness, Stiffener Height, Total Flange Width
- **Response Variables**: Maximum Flange Moment, Pull-off Margin
- **Solvers/Methods:** RDCS, ANSYS/LEFM



Solution Scope

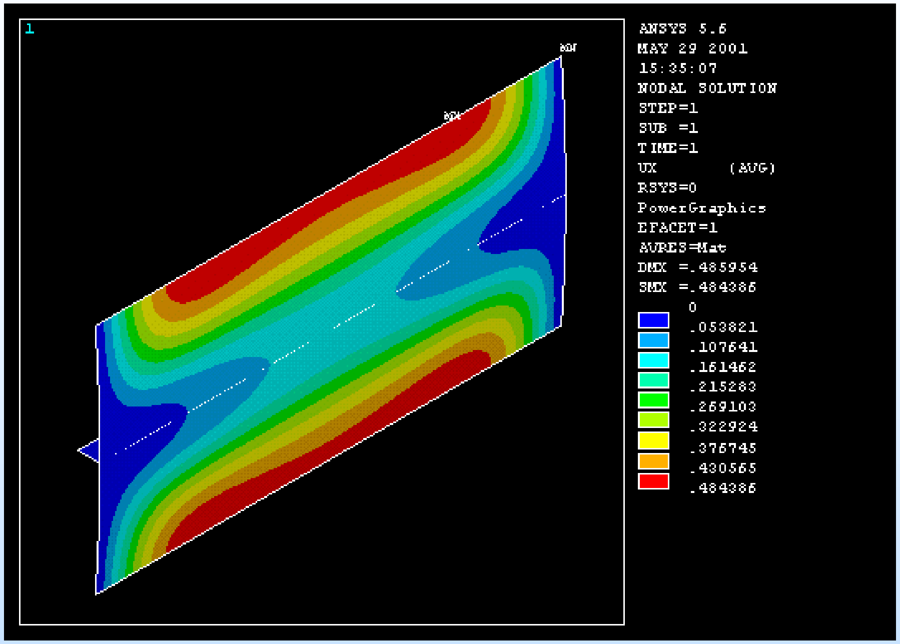
- **RDCS:** Sensitivity analysis, Factorial Design Space Explorations
- **ANSYS**: Static non-linear large deflection analysis
- **Solution Cases**: 81 Large Scale FEM Solutions

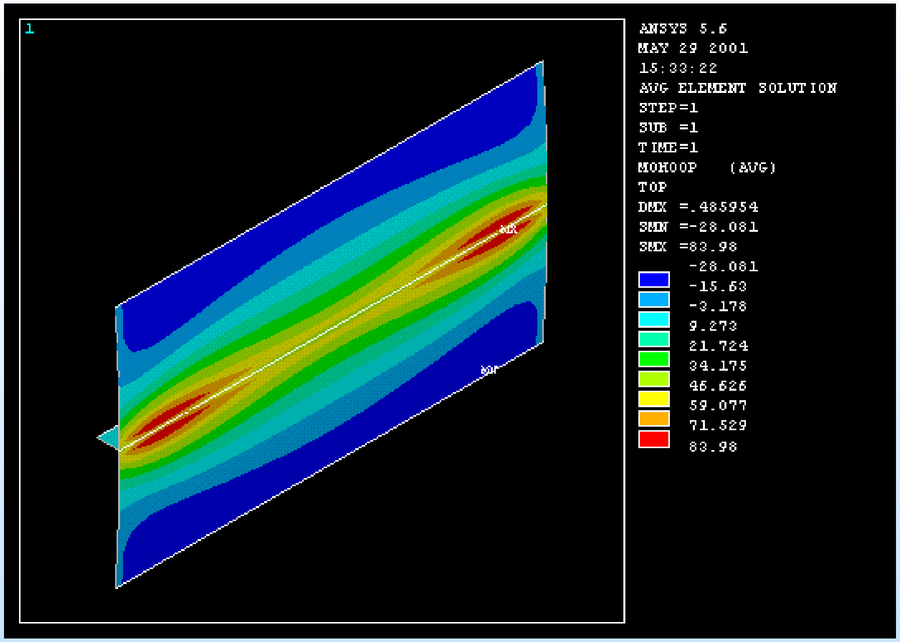
RDCS Application Benefits

- **Rapid factorial design calculations for external ANOVA study and response surface with significant cycle time reduction**
- **ANOVA helps identify critical factors and interactions**
- **Accurate surrogate response surface model helps simplify the design process**

RDCS Edge of Flange Disbond Study

The Problem



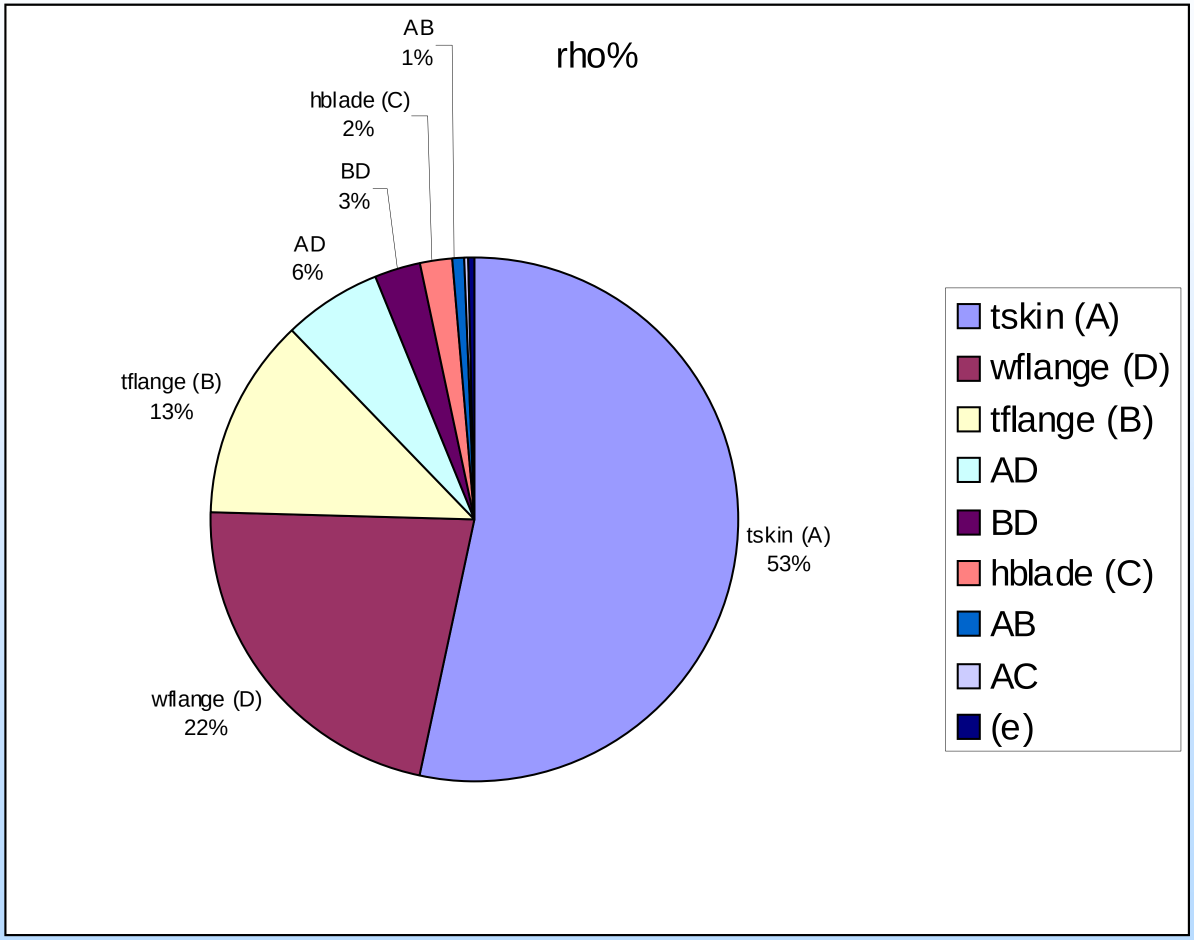


Internal Pressure (or postbuckling) create large pillowing deflections between stringers

These deflections create high moments at the skin-to-stringer bondline. The loads don't vary tremendously along the length – can be analyzed as a 2D problem using the maximum loads (conservative)

RDCS Edge of Flange Disbond Study

ANOVA Results



The major influences are skin thickness, flange width, flange thickness, and their interactions