



AEROELASTIC CONCEPT ENGINEERING

INPUTS TO

PRELIMINARY TECHNOLOGY CONFIGURATION

October 14, 1997

HSR II - TECHNOLOGY INTEGRATION

NAS1-20220. Task 20. WBS 2.1.3

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2.1.3



Presentation Overview

Overview of ACE

DOSS - Design Optimization Synthesis System (Dave)

Weight Sensitivity Study

PAC Studies

Recommendations for the PTC



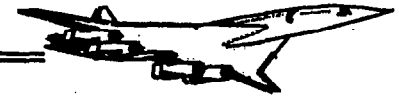
ACE OBJECTIVES & KEY ELEMENTS

ACE Objectives

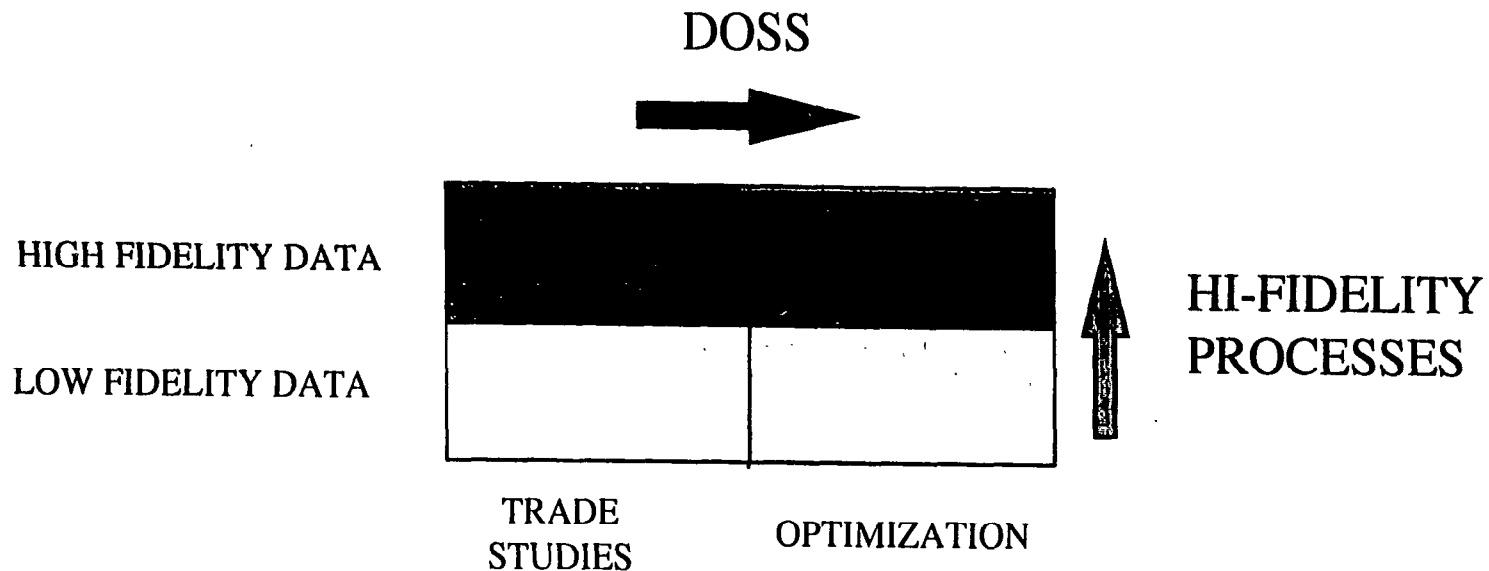
- Develop process, methods and tools to integrate Aero, Structures, Propulsion and Controls
- Use Optimization methods to help design sized HSCT vehicle
- Validate & demonstrate the new process to generate the Optimized Aeroelastic Concept (6/98)

Key Elements

- Generate sized airplanes with realistic constraints
- Determine airplane config. based on simultaneous optimization of several key design variables
- Reduce uncertainty by generating input data using high fidelity analysis methods

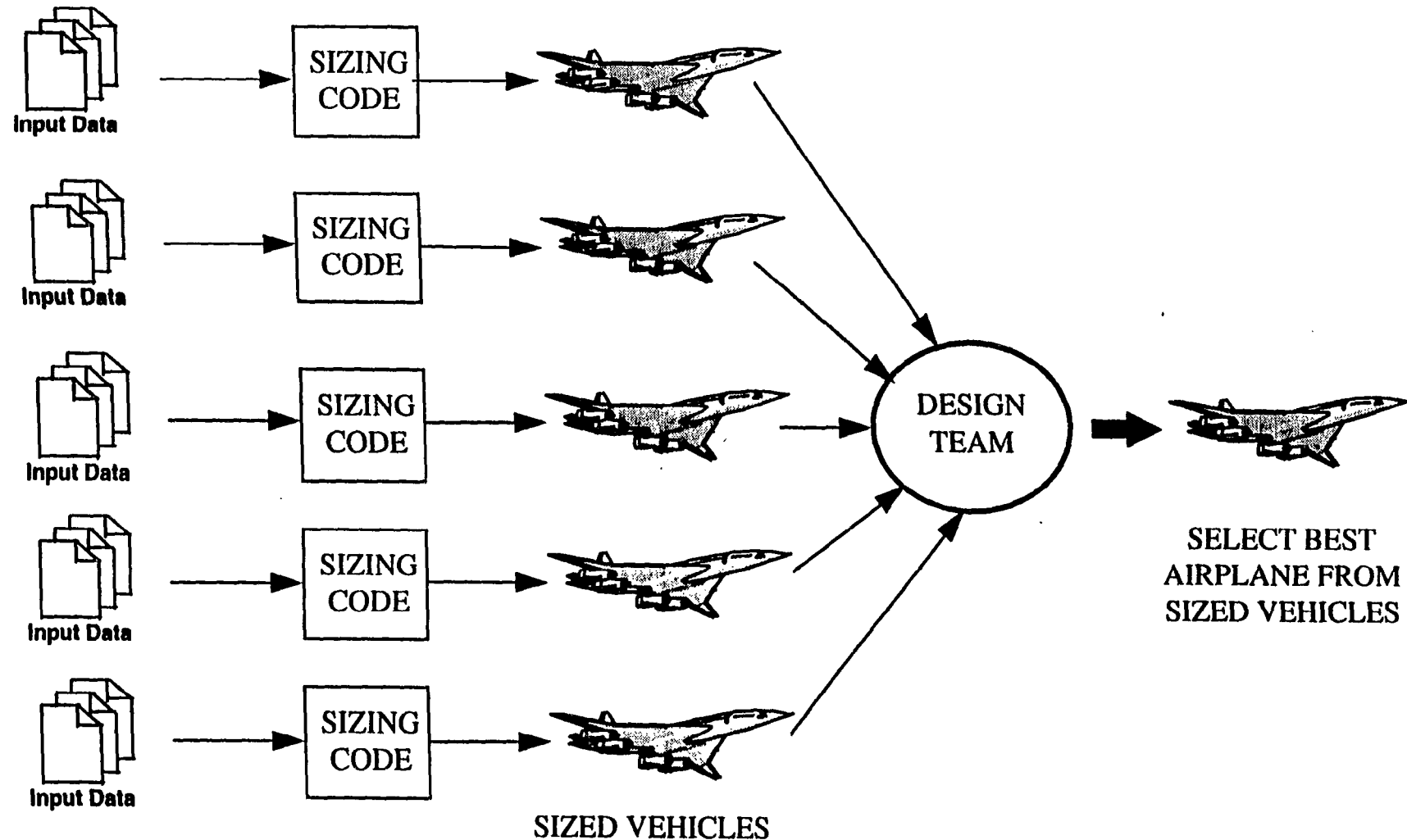


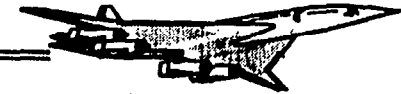
APPROACHES TO IMPROVE AIRPLANE SIZING



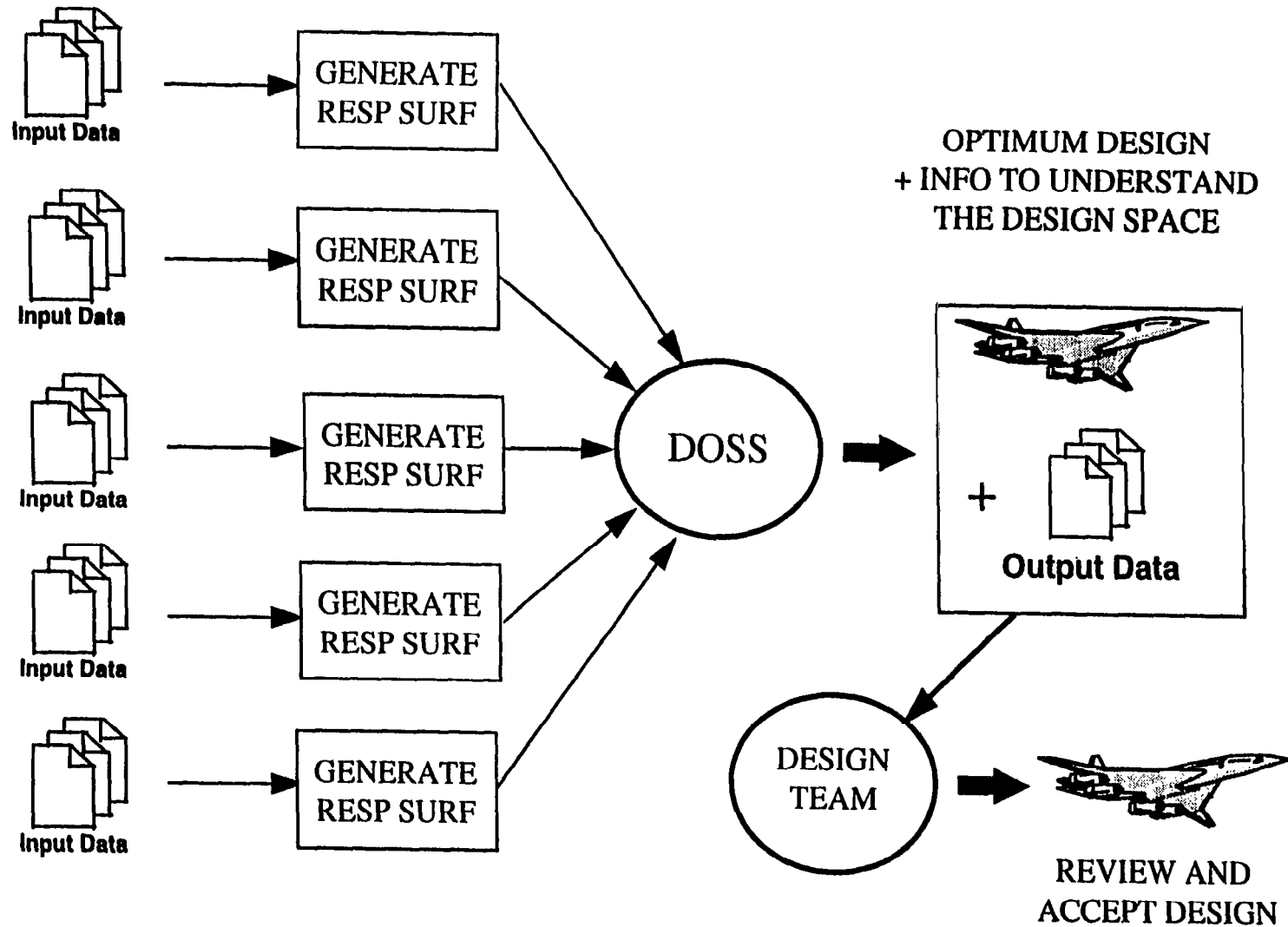


TRADITIONAL DESIGN APPROACH





ACE DESIGN APPROACH





DOSS STATUS

DOSS CODE

- DOSS 1.0 released in April 97
- Code installed at Long Beach, Seattle, Langley, GE and training provided
- Code evaluated by potential users
- Many improvements made, and DOSS 2.0 released at end of Sep. 1997

APPLICATIONS

- Comparisons of DOSS sizing with other sizing codes
- Optimization of Aspect-Ratio and Sweep for the "WEDGE" with a fixed engine
- Optimization of Aspect-Ratio and Sweep for the "WEDGE" with a free engine
- Effect of uncertainty in OEW due to planform change
- Preliminary Aeroelastic Concept demonstration (thickness distribution)



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Assess Impact of Wing Weight Variations on the Optimum Planform

Issue: Know that changes to wing wt. affects MTOW directly

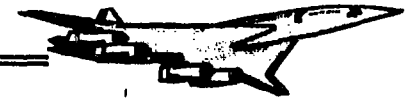
$$\Delta \text{MTOW} \sim 5 \times \Delta \text{OEWS}$$

Also know that we are unsure about changes in wing wt. due to planform changes, i.e., sensitivity of wing wt. to planform is not very good.

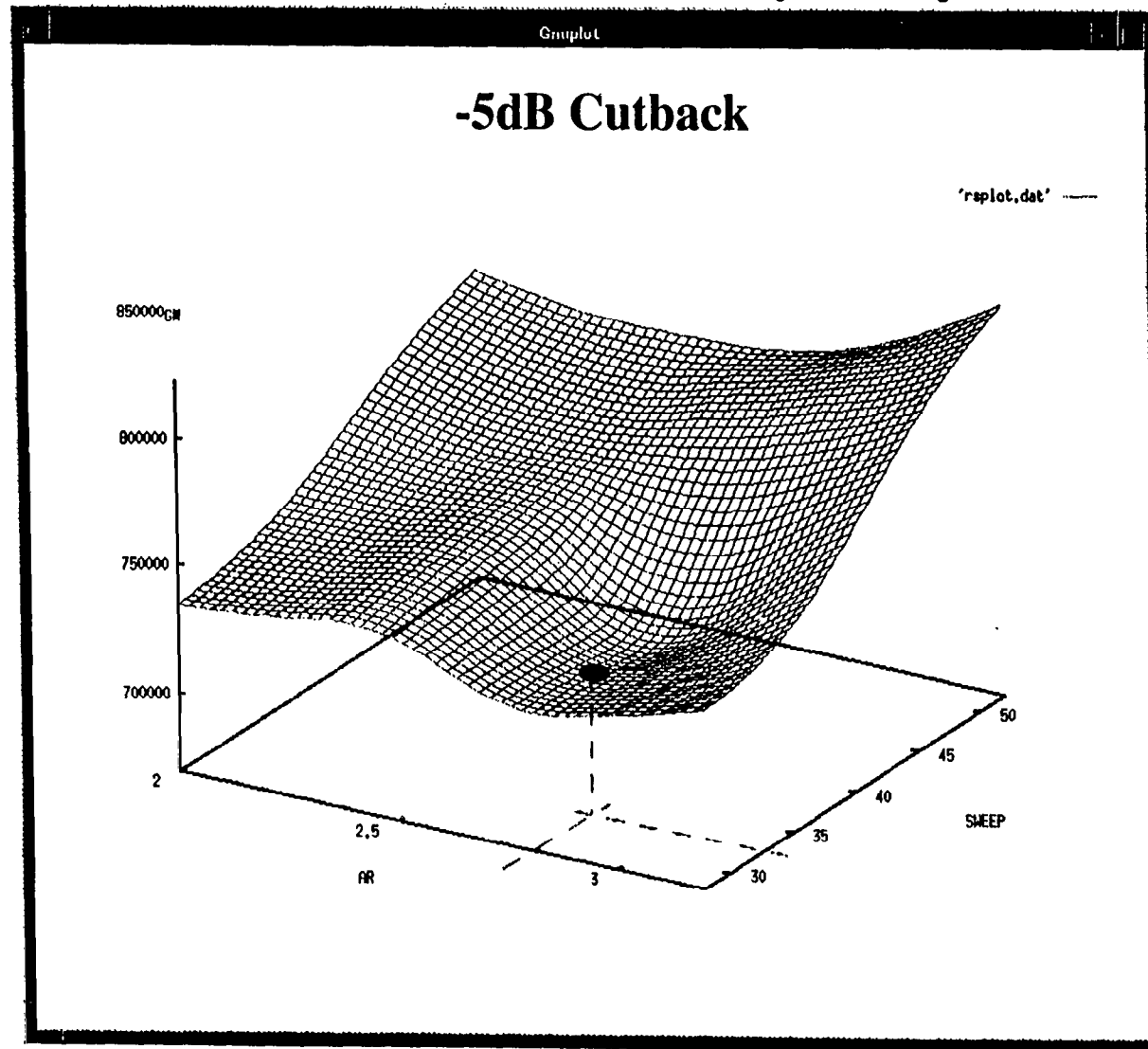
Question: How will our choice of best planform change if wing weight uncertainty changes significantly ?

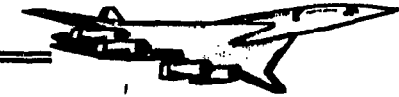
Assessment:

- Modify changes in wing weight predicted by Parametric Wts. Equation by an assumed factor
- Perform sizing and optimization with modified weights

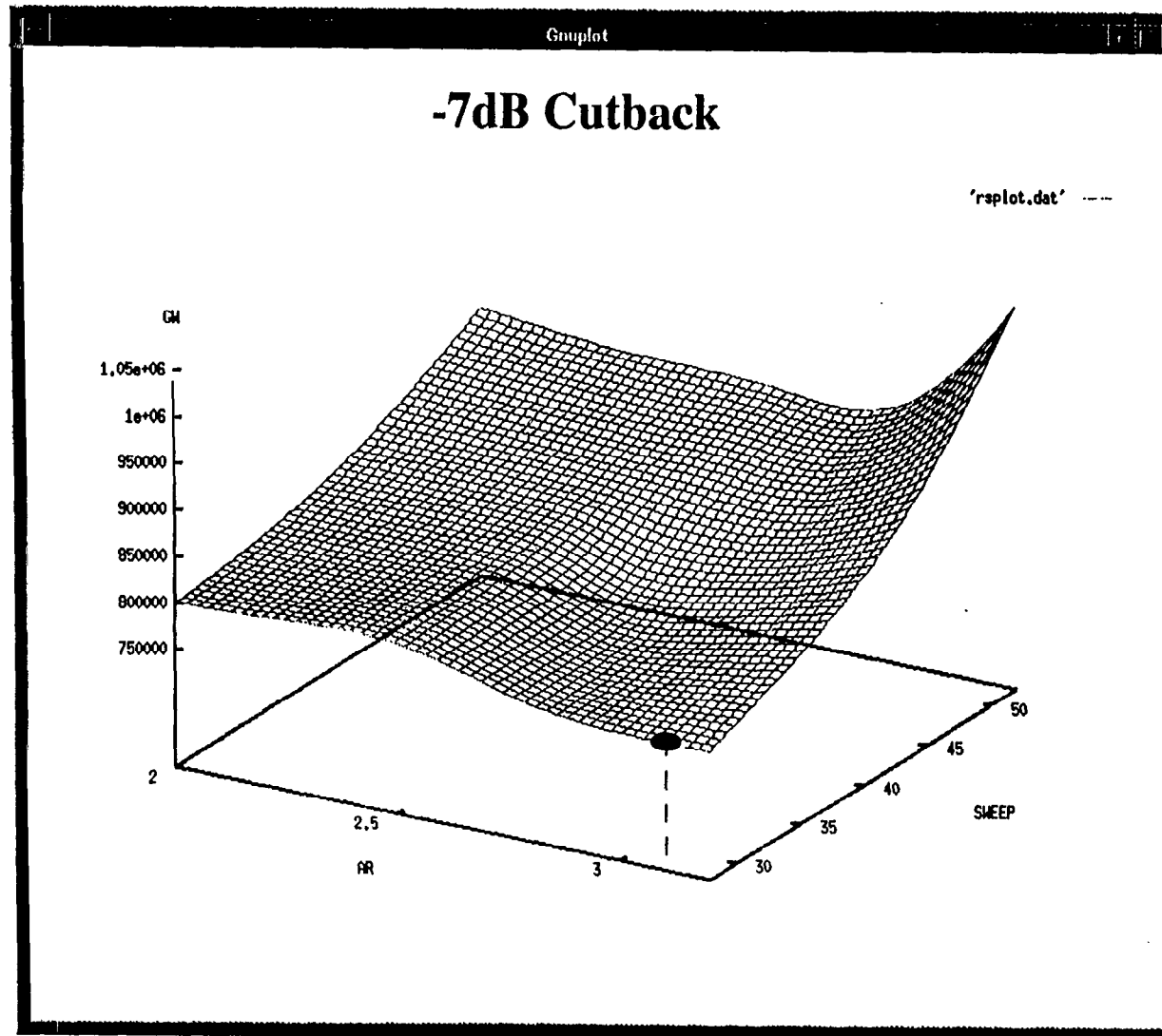


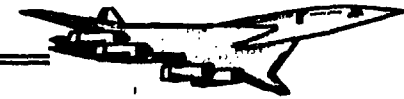
DOSS Weights Sensitivity Study





DOSS Weights Sensitivity Study

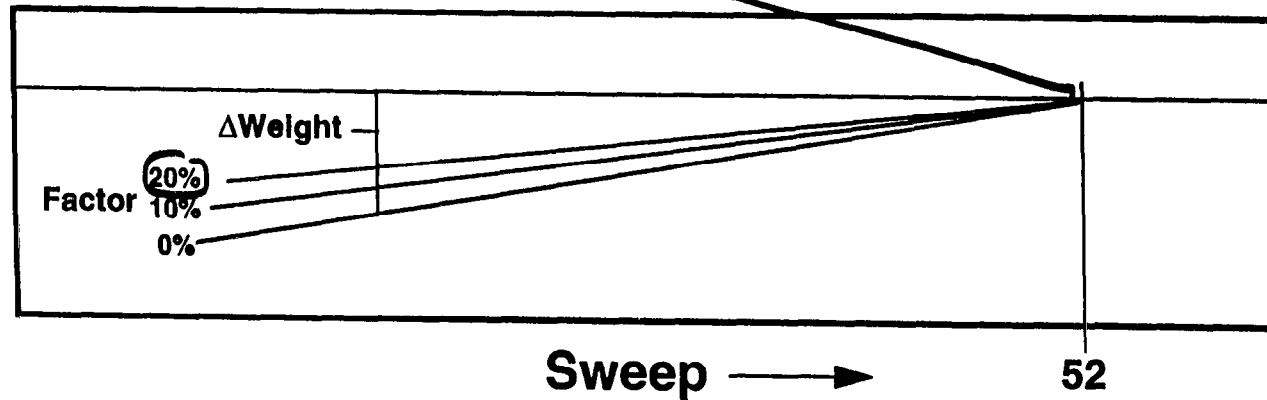




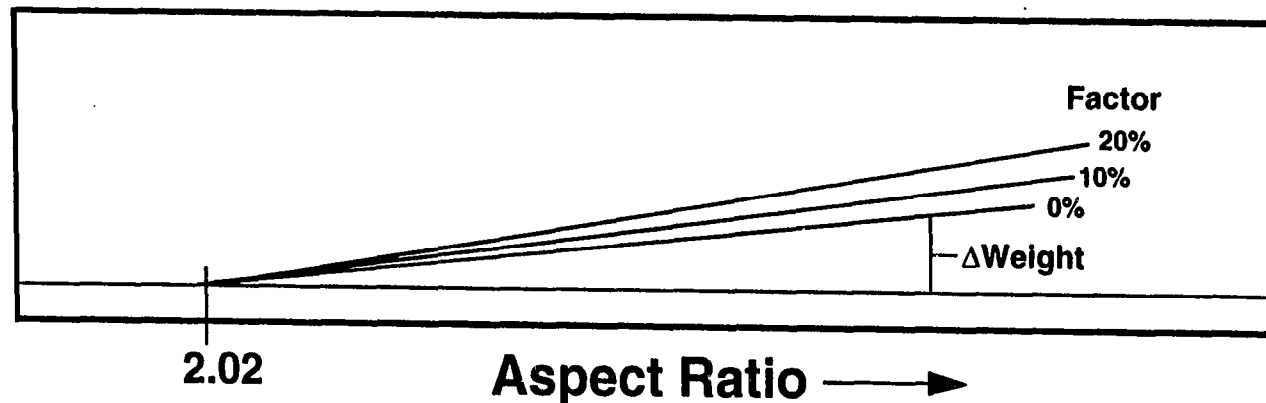
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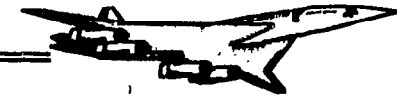
200% Δ OEW Estimation Process

Wing
Weight

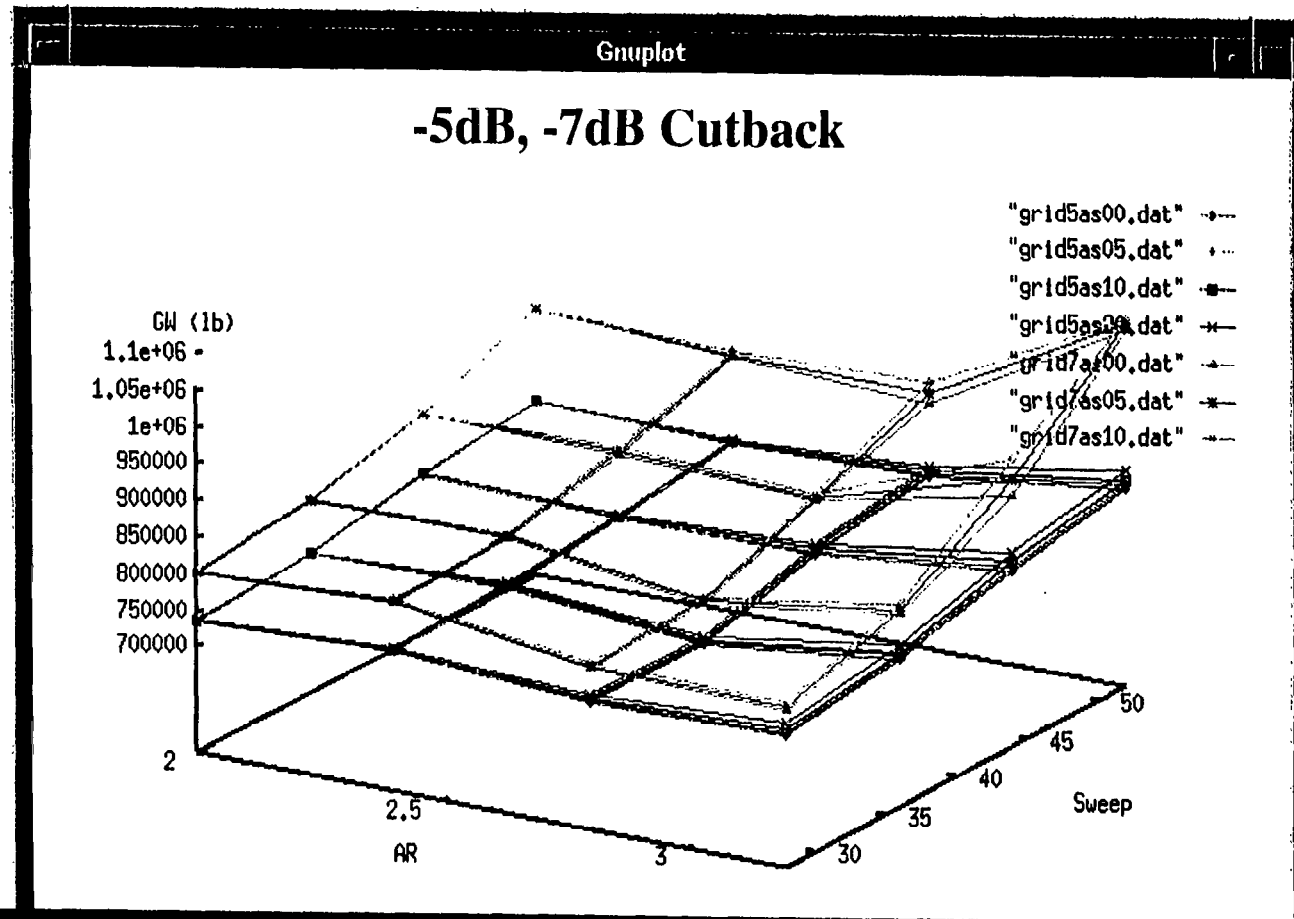


Wing
Weight

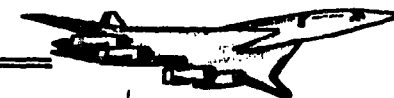




DOSS Weights Sensitivity Study



**Wing Weight Factors Show Very Little Impact on
Configuration Sizing Surface**



DOSS Weights Sensitivity Study

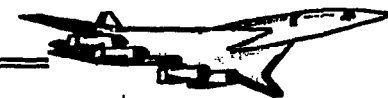
Optimum Sized Points

-5dB Cutback

Factor	Base	10	15	20
MTOW	717,108	723,019	726,058	729,012
OEW	311,933	315,233	316,894	318,548
Wing Area	8,621	8,654	8,669	8,682
Thrust	49,788	50,289	50,578	50,864
Aspect Ratio	2.805	2.799	2.791	2.782
Sweep	33.162	32.912	32.888	33.007

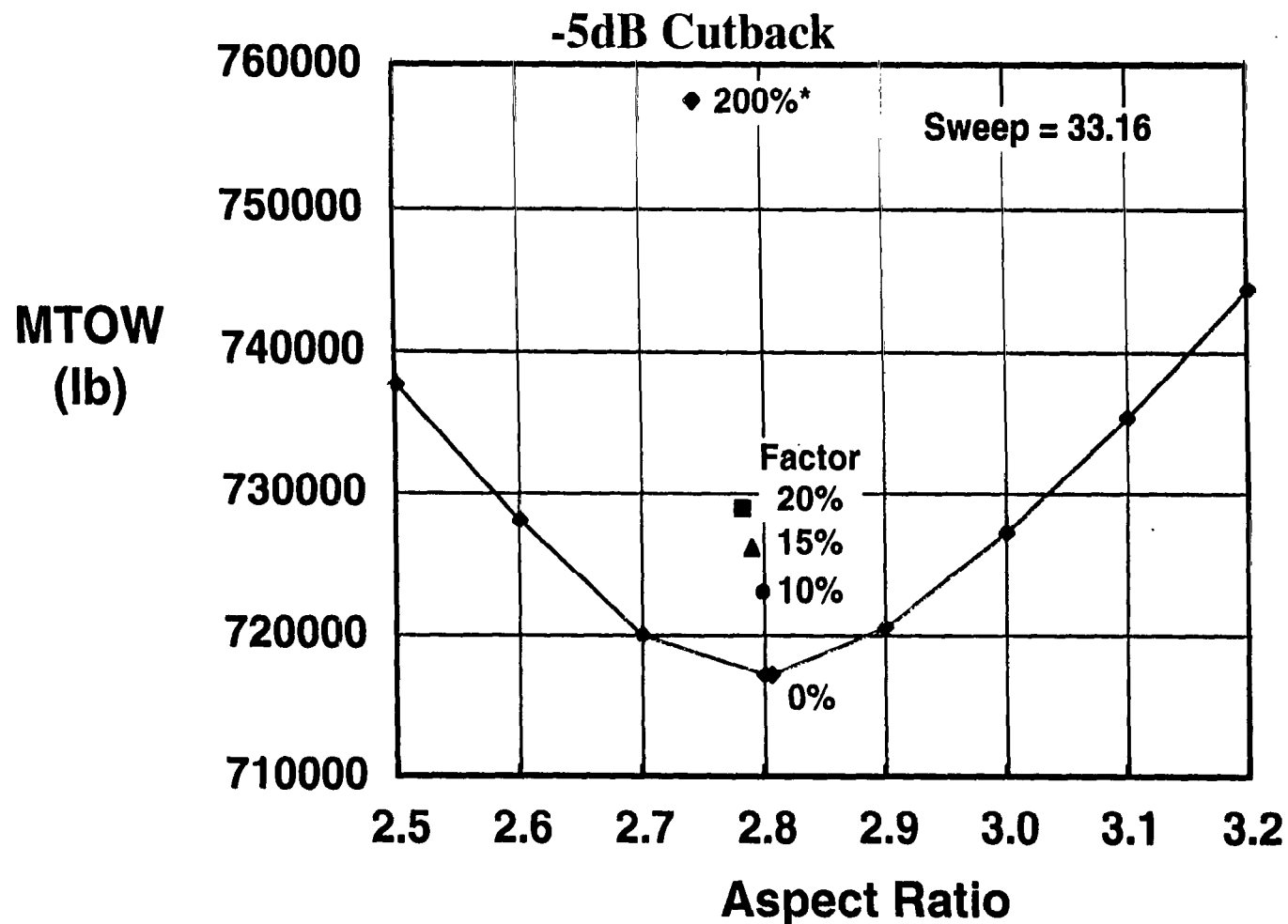
-7dB Cutback

Factor	Base	10
MTOW	763,493	773,522
OEW	338,196	343,638
Wing Area	9,144	9,188
Thrust	55,402	56,397
Aspect Ratio	3.136	3.104
Sweep	28.0	28.0

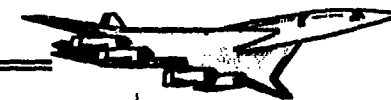


DOSS Weights Sensitivity Study

MTOW Variation with Aspect Ratio



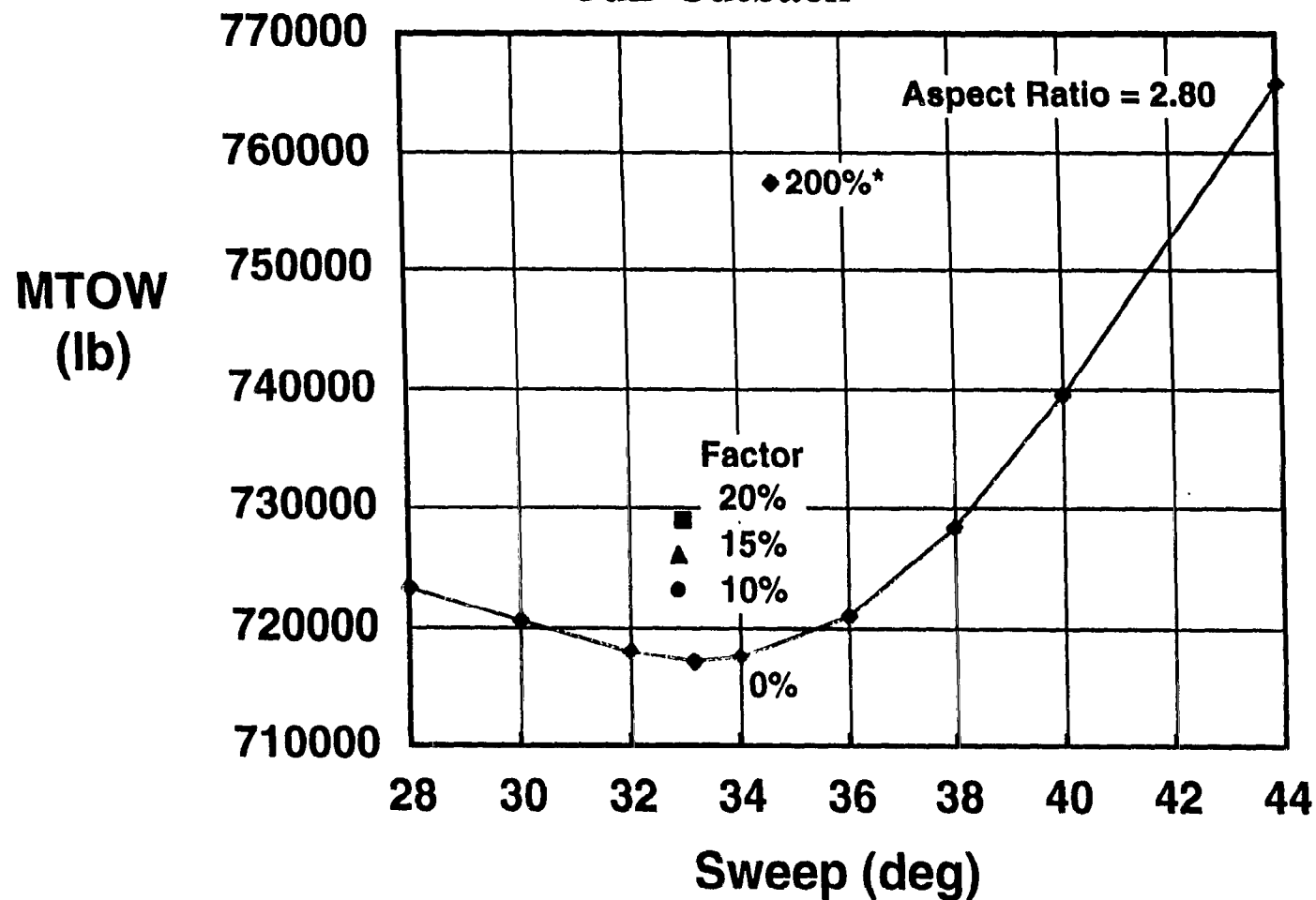
*Applied to Sweep Only



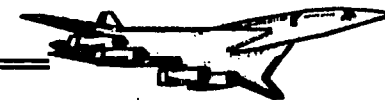
DOSS Weights Sensitivity Study

MTOW Variation with Sweep

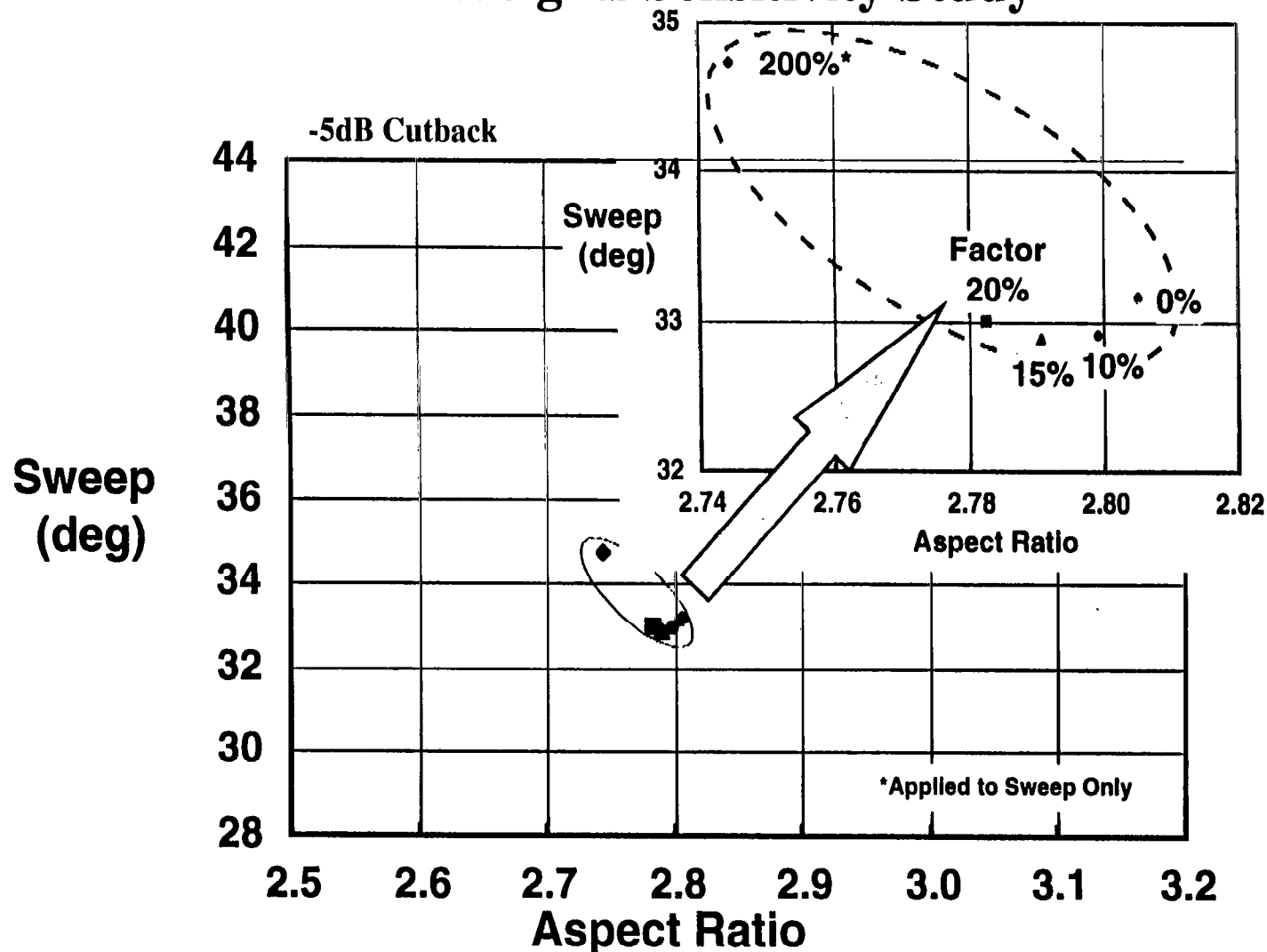
-5dB Cutback



*Applied to Sweep Only



DOSS Weights Sensitivity Study



Large Variation in Δ OEWS Shows Some Impact on Optimum Configuration

included in the optimization using appropriate sensitivity information. These studies are scheduled to culminate in the Optimized Aeroelastic Concept (June 1998).

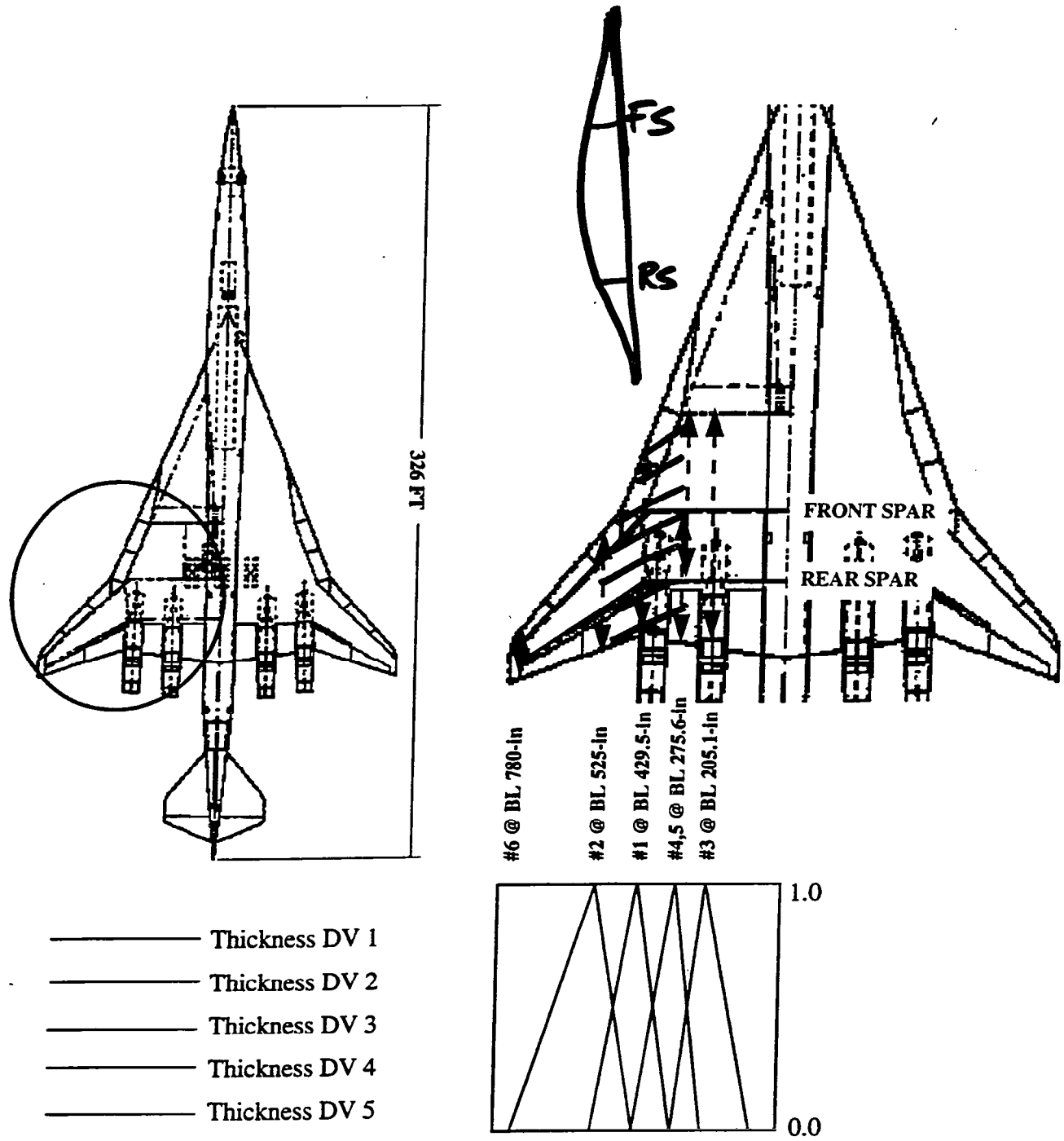
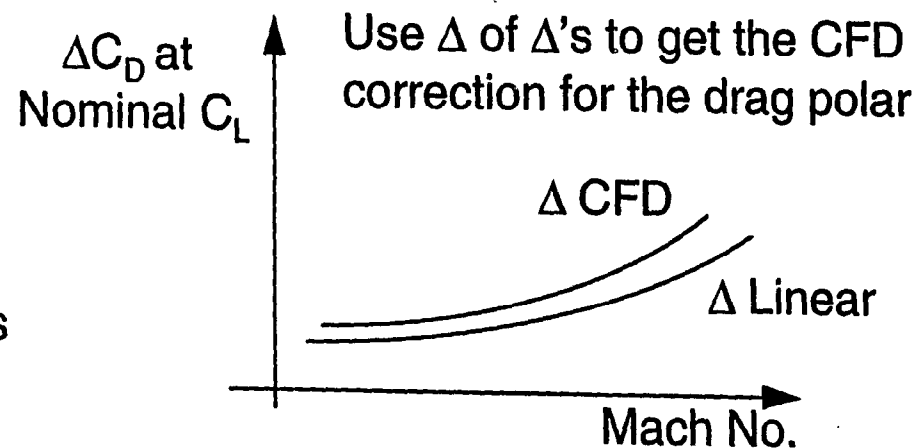
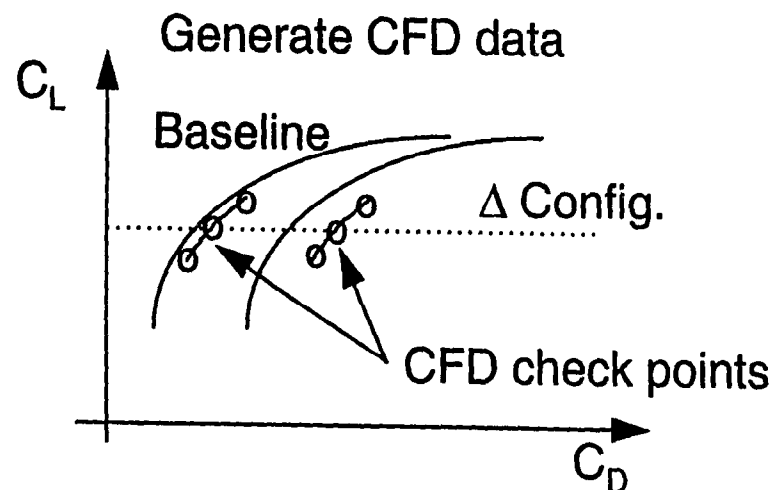
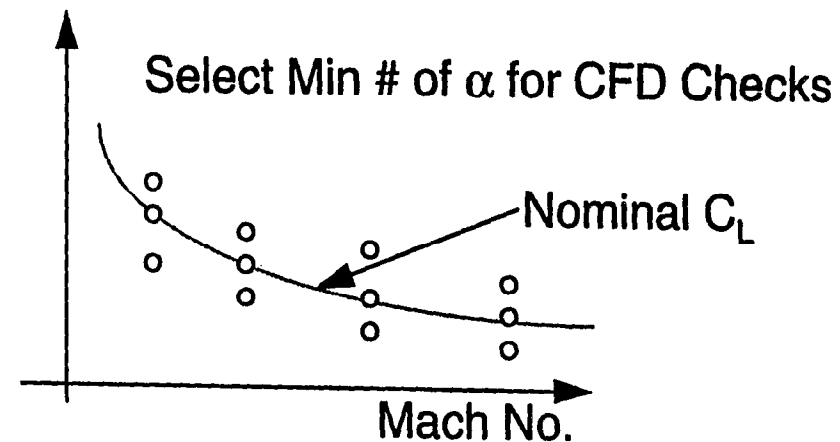
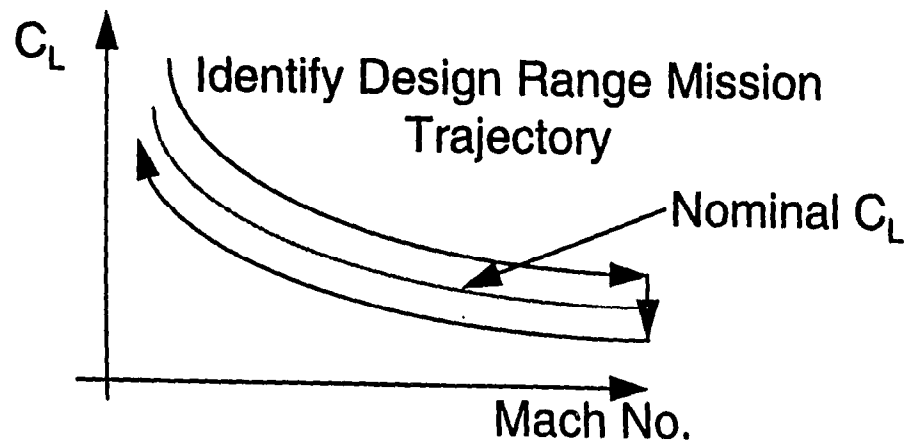


Figure 1. Thickness perturbation design variables for the Preliminary Aeroelastic Concept



CFD Correction Process to Linear Aerodynamic Database

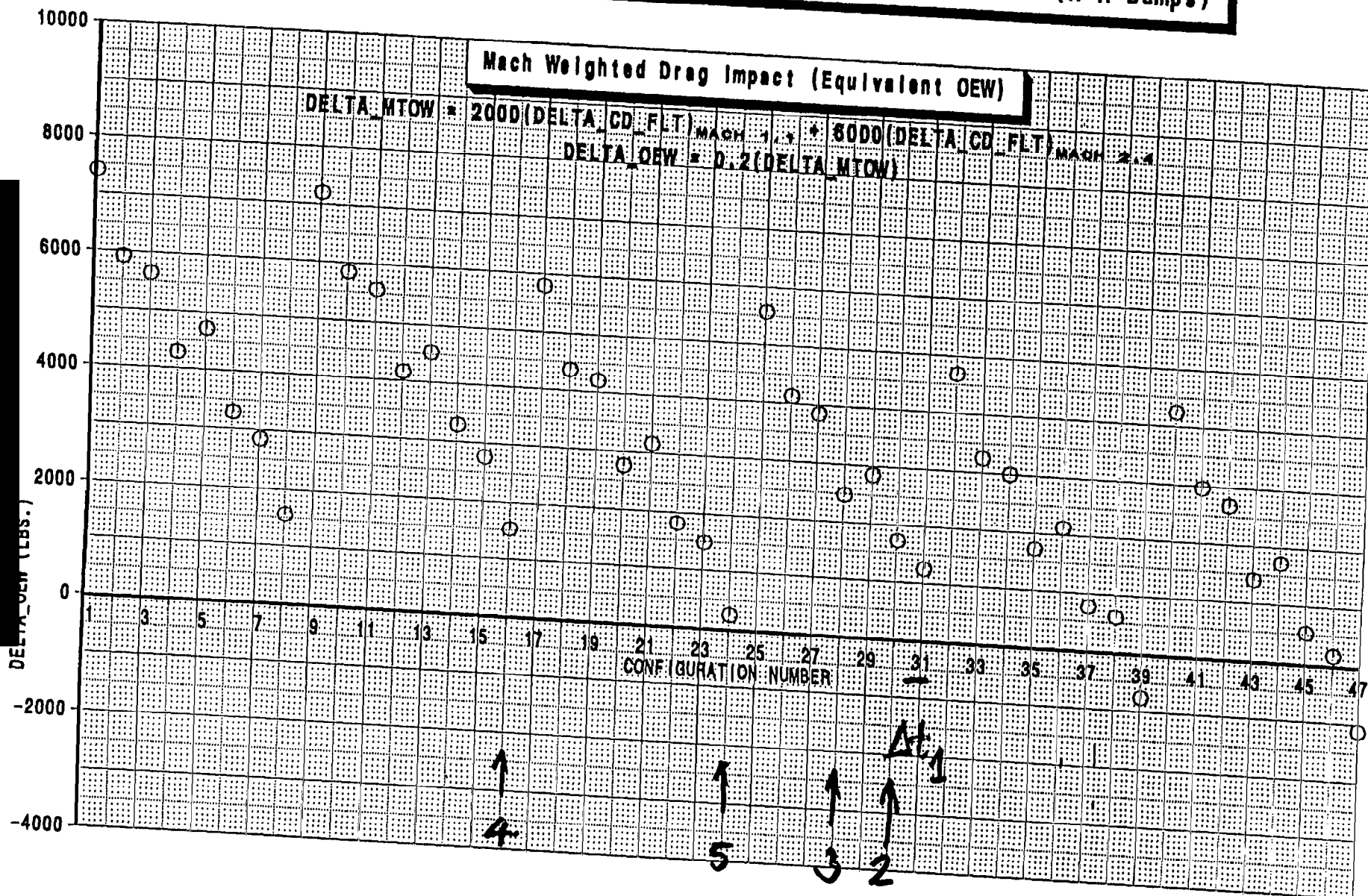


Linear Potential Analysis of Thickness Perturbations (H-H Bumps)

Mach Weighted Drag Impact (Equivalent OEW)

$$\Delta_{MTOW} = 2000(\Delta_{CD_{FLT}})_{MACH=1.4} + 8000(\Delta_{CD_{FLT}})_{MACH=2.4}$$

$$\Delta_{OEW} = 0.2(\Delta_{MTOW})$$



BDEIND

High Speed Civil Transport -- Weights Group

ACE THICKNESS STUDY

WEIGHT RESULTS

MODE	LOFT	Thickness Increase	FS Affected?	RS Affected?	WBL	Weight (lb/apl)
1	W10000	30%	Yes	Yes	429	-1,350
2	W01000	30%	Yes	Yes	525	-750
3	W00100	30%	Yes	Yes	205	-1,160
4	W00010	20%	No	Yes	275	-400
5	W00001	20%	Yes	No	275	-200

750
1700
2500
1500
300

ASSUMPTIONS

- Weight changes based on methodology found in:
"Aircraft Design Processes Common Weight Methodology"
- No Loads or Stress analysis was done
- Geometry changes (ie: Lofts) provided by Aero
- Only wing box and engine strut changes considered
- Based on TCA strength sized model, affects of flutter ignored



Recommendations for the PTC

- Planform 2.8-28 seems OK. Moving to 2.8-34 could save approximately 10,000 lb. in MTOW
- Based on very limited data, it seems reasonable to increase thickness at wing break by as much as 30%. Unable to make recommendation at other stations.
- Results of Wing Weight Sensitivity Study are intriguing. Need a closer look. Preliminary indications are that it would be better to go to a lower Aspect Ratio.