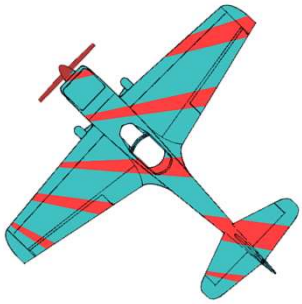
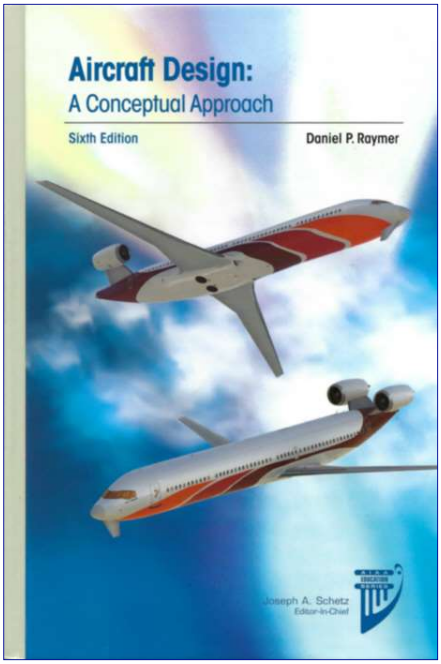
Raymer Tells All….



…about his textbook



Daniel P. Raymer, Ph.D.
Conceptual Research Corporation

Bio: Daniel P. Raymer

Aircraft Configuration Layout Designer & Project Engineer ~40 years

AIAA Fellow, 2010 winner of *AIAA Aircraft Design Award*

President & Founder, Conceptual Research Corporation

Director-Advanced Design at Lockheed, Director-Future Missions at Aerojet, Project Manager-Engineering at Rockwell North American Aviation, Aerospace Design Consultant for the RAND Corporation

Wrote *"Aircraft Design: A Conceptual Approach"* & *"Simplified Aircraft Design for Homebuilders"* plus numerous technical reports & papers

Developed CRC's RDS^{win} and Rockwell's CDS (aircraft design & CAD codes)

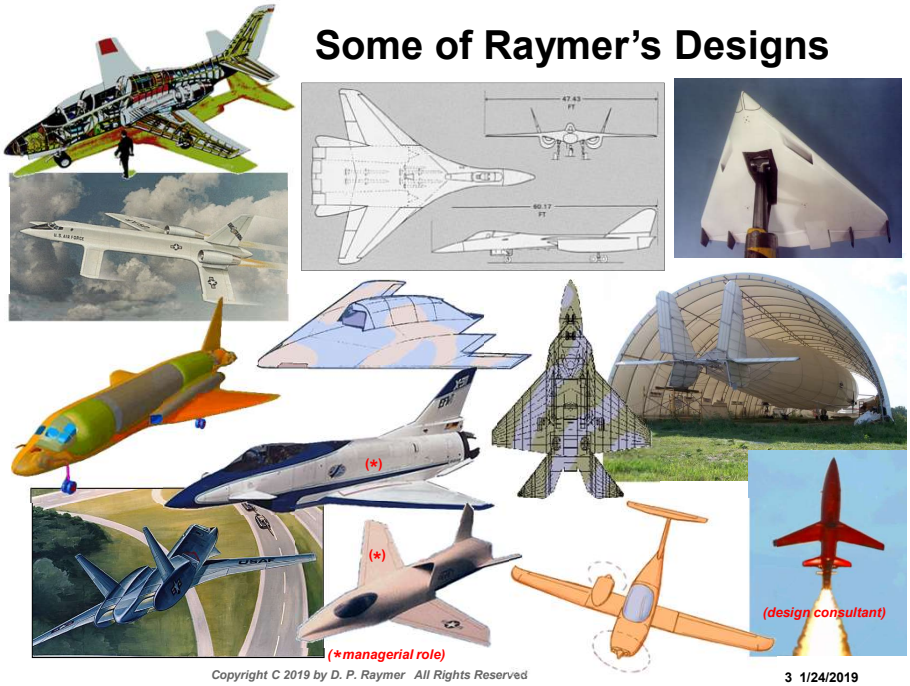
DPR Photo

Purdue University: B.S. and M.S. Engineering (Astronautics & Aeronautics)

University of Southern California: MBA

Swedish Royal Institute of Technology (KTH): Doctorate of Engineering (Ph.D. thesis *"Enhancing Aircraft Conceptual Design using Multidisciplinary Optimization"*)

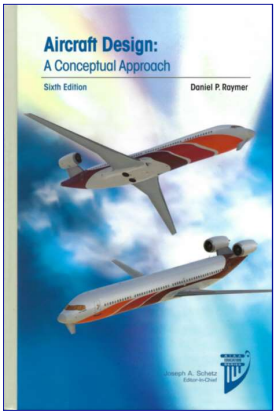
Some of Raymer's Designs

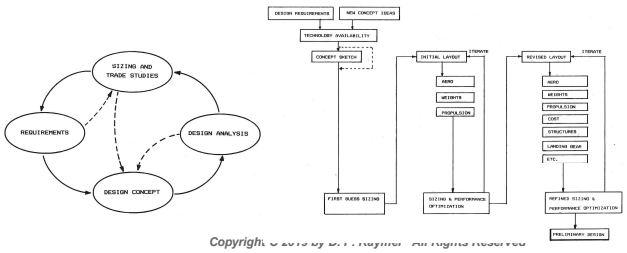


(*managerial role)

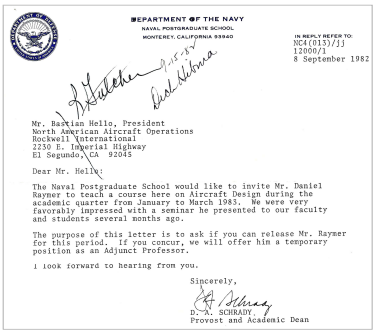
Hey Dan, how did you come to write your book?

- 1976: Raymer gets his dream job – a drafting table in the Advanced Design Department of North American Aviation (Rockwell then, Boeing now)
- *"but the industry methods I'm learning don't match those I learned in college!"*
- Key difference: in Industry, the whole process revolves around the design concept (actual layout)
- Raymer starts giving "correct way" talks at Northrop University, Naval Postgraduate School, and others





- **1983: Naval Postgraduate School invites Raymer to be a visiting Adjunct Professor for one semester, to teach an Aircraft Design Class**
- **Rockwell's Bastian Hello, later AIAA President, authorized it including paying all my expenses (thanks, Buzz!)**
- **Every night I made hand-drawn handouts for the next day's class, which the patient secretaries photocopied with minutes to spare**
- **Fellow professor Alan Fuhs, later AIAA VP-Publications, saw my notes and say "say Dan, why don't you turn those into an AIAA textbook?"**
- **Sounded easy….**



DEPARTMENT OF THE NAVY
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA 93940

IN REPLY REFER TO:
NC4(013)/jl
12000/1
8 September 1982

Mr. Bastian Hello, President
North American Aircraft Operations
Rockwell International
2230 E. Imperial Highway
El Segundo, CA 92045

Dear Mr. Hello:

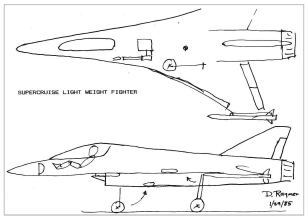
The Naval Postgraduate School would like to invite Mr. Daniel Raymer to teach a course here on Aircraft Design during the academic quarter from January to March 1983. We were very favorably impressed with a seminar he presented to our faculty and students several months ago.

The purpose of this letter is to ask if you can release Mr. Raymer for this period. If you concur, we will offer him a temporary position as an Adjunct Professor.

I look forward to hearing from you.

Sincerely,

D. A. SCHRADY
Provost and Academic Dean



- **Weird Fact: Dan Raymer was born in Monterey when his father Gordon Raymer was a student at the Naval Postgraduate School, and his class photo was still on the wall outside Dan's classroom**

RAYMER, Gordon E. LT — AERONAUTICAL ENGINEERING STUDENT - DATA CARD

RECEIVED FROM: VJ-61 | HOME ADDRESS: 919 Via Verde Monterey | PHONE: 26227

DATE REPORTED USNPS: 7/24/53 | NEXT OF KIN: Dorothy E. RAYMER Wife | RELATIONSHIP:

ORDERED TO UNIVERSITY: RPI 7/29 29848 | ADDRESS: 919 Via Verde

DATE DETACHED USNPS: 5 July 1955 | AIRCRAFT QUALIFICATION: VP (MATS) | TOTAL TIME: 1500

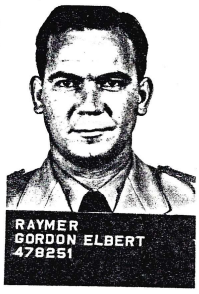
DATE REPORTED UNIVERSITY | INSTRUMENT QUALIFICATION: Standard | EXPIRATION DATE: 4/23/54

ORDERED TO | PRIOR EDUCATION: Mo. Sch. Mines & Metall. | DEGREE: B.S. M.A. | DATE: July '49

DATE DETACHED UNIVERSITY

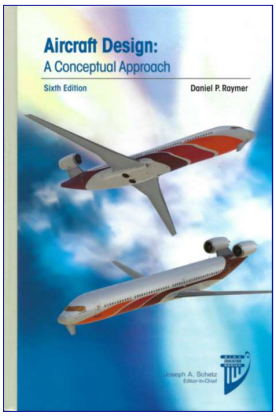
DEGREE RECEIVED	PLACE	DATE	THESIS	DATE OF BIRTH
				4-23-25
DEGREE RECEIVED	PLACE	DATE	THESIS	HEIGHT / WEIGHT
				5'8" 153

FITNESS REPORTS / PERIOD COVERED		DATE SUBMITTED	REPORTING SENIOR
3 July 1953	TO 3/28/54	3/1/54	Arnold
3-1-54	TO 6-3-54	6-3-54	R.W.A
6-4-54	TO 6-2-55	7-22-55	R.W.A
	TO		



- 1st Edition 1989 (729 pages)
- 6th edition 2018 (1062 pages)
- 60,000+ sold
- AIAA Summerfield Book Award
- Aviation/Space Writers' Association Award of Excellence
- Used around the world – Dan's favorite fan letter said:

...thank you for your aircraft design book. Being an aerospace engineering student it helps me a lot in my studies. Although our instructor insists on another book, which is really boring, almost 95 percent of our design class use your book.



BOOK & SHORT COURSE OBJECTIVES

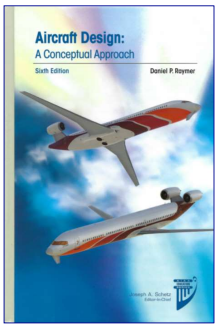
Practical Working Knowledge of Aircraft Design
....As It Is Actually Performed

No Cartoons: designer must include a good initial estimate of all major subsystems, structural layout, engines, landing gear, etc., and do preliminary TOGW sizing to estimate the sizes of wings, tails, engine, wheels, & fuel tanks

Book and short course ~follow the chronological sequence of industry design practice

Analysis, optimization, and trades studies are treated as mandatory tools to make the design concept better (not ends in themselves)

My target audience: A professor teaching in the middle of nowhere, who never worked in industry



TOC Scheme

Intro to Book & Design Process
- Chapter 1 Design—A Separate Discipline
- Chapter 2 Overview of the Design Process

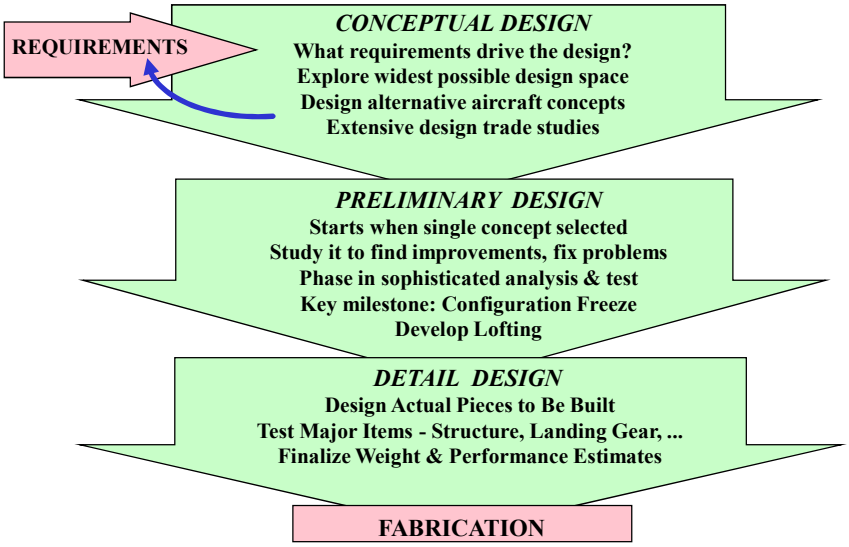
Doing that first "Dash-One"
- Chapter 3 Sizing from a Conceptual Sketch
- Chapter 4 Airfoil and Wing/Tail Geometry Selection
- Chapter 5 Thrust-to-Weight Ratio and Wing Loading
- Chapter 6 Initial Sizing
- Chapter 7 Configuration Layout and Loft
- Chapter 8 Special Considerations in Configuration Layout
- Chapter 9 Crew Station, Passengers, and Payload
- Chapter 10 Propulsion and Fuel System Integration
- Chapter 11 Landing Gear and Subsystems

Rest & Review
- Intermission Step-by-Step Development of a New Design

Analyze & Optimize the Dash-One, get ready to do the Dash-Two
- Chapter 12 Aerodynamics
- Chapter 13 Propulsion
- Chapter 14 Structures and Loads
- Chapter 15 Weights
- Chapter 16 Stability, Control, and Handling Qualities
- Chapter 17 Performance and Flight Mechanics
- Chapter 18 Cost Analysis
- Chapter 19 Sizing and Trade Studies

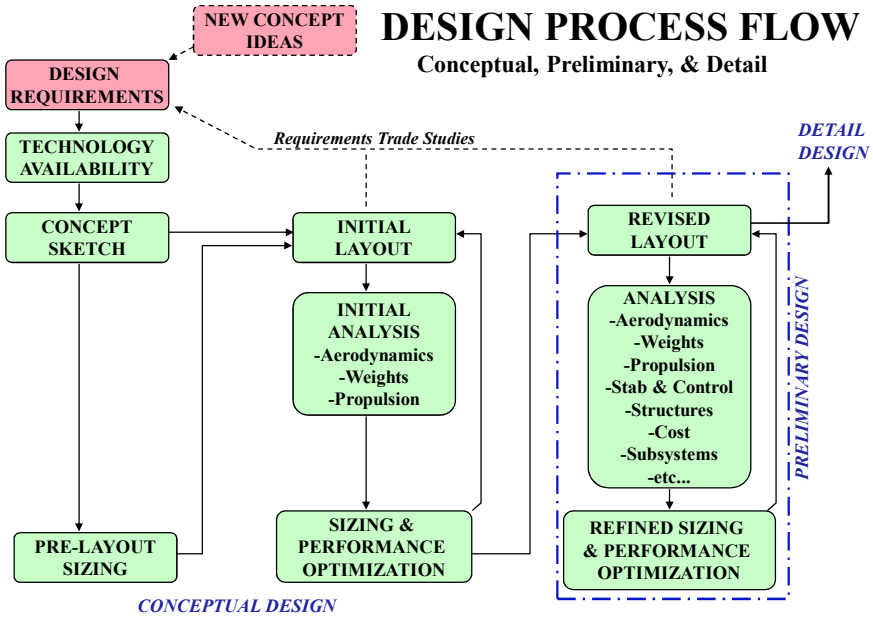
Weirder Airplanes and finally, some examples
- Chapter 20 Electric Aircraft
- Chapter 21 Vertical Flight—Jet and Prop
- Chapter 22 Extremes of Flight
- Chapter 23 Design of Unique Aircraft Concepts
- Chapter 24 Conceptual Design Examples

PHASES OF AIRCRAFT DESIGN

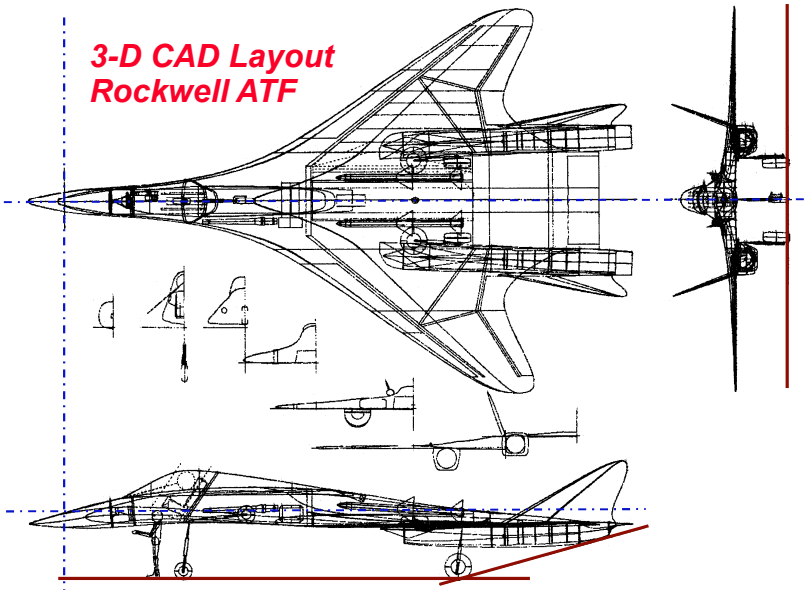


DESIGN PROCESS FLOW

Conceptual, Preliminary, & Detail



TYPICAL INITIAL CONCEPTUAL DESIGN



INITIAL SIZING EQUATION

Fuel is estimated from W_0 based on empty weight estimates, not from how big a fuel tank you can find !

$$W_0 = W_{crew} + W_{payload} + W_{fuel} + W_{empty}$$

$$W_0 = W_{crew} + W_{payload} + \left(\frac{W_f}{W_0}\right) W_0 + \left(\frac{W_e}{W_0}\right) W_0$$

This can be solved for W_0 as follows:

$$W_0 - \left(\frac{W_f}{W_0}\right) W_0 - \left(\frac{W_e}{W_0}\right) W_0 = W_{crew} + W_{payload}$$

$$W_0 = \frac{W_{crew} + W_{payload}}{1 - (W_f / W_0) - (W_e / W_0)}$$

Beware of the "leverage effect!"

No weight drops permitted, and assumes "rubber engine"

Chromosome Gene String Definition

(as used in this research)

T/W	W/S	A	taper	sweep	t/c	fuselage l/d	C_L-design
000000	000000	000000	000000	000000	000000	000000	000000

- Spectrum from lowest to highest permitted value
- Example: wing loading ranges from 40 to 100 (user input)

000000	⟹	40
111111	⟹	100
001010	⟹	40+(100-40)(10/63)=49.52

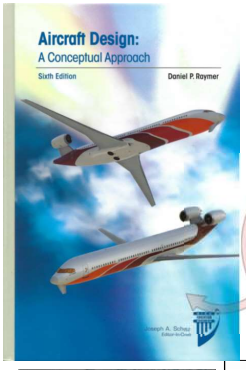
$$resolution = \frac{x_{\max} - x_{\min}}{2^l - 1}$$

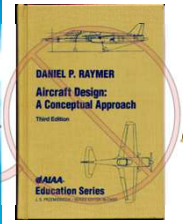
Where l is the number of bits per variable
Resolution of W/S = 0.95 = (100-40)/63

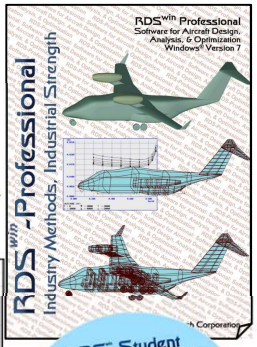
Raymer Thoughts on Teaching Design

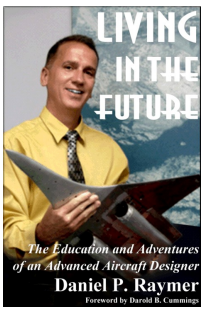
1. For 1st semester exposure, every student does everything themselves - sketch, initial sizing, layout, analysis, trade studies, & optimization - NO TEAMS !
2. Use a designer-oriented textbook *(need a hint?)*
3. Teach/provide/allow rapid analysis methods so that students don't spend most of their time in calculations
4. Result of 1st project is NOT a final, good design, and student reports should reflect that. "My design DOESN'T work yet, here is what is wrong, and here is how the next iteration will get closer to convergence!" Trade study results are critical.
5. In follow-on class, work in teams to further develop a selected design from the initial class
6. DBF is excellent but beware of too much student time doing fabrication grunt work. Use ARF & existing components, allow Q&D fab methods (balsa, blue foam sheet), and select simple project

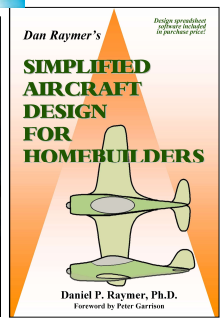
Raymer Books & RDSwin Software

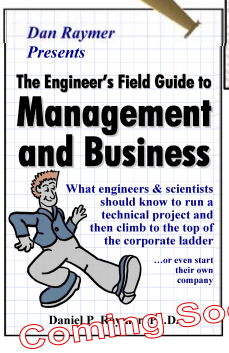












Coming Soon

Dan Raymer's Aircraft Design & RDS Website

www.aircraftdesign.com

RDS win Windows® software for Aircraft Design & Analysis

Conceptual Research Corp.

Learn Aircraft Design from Dan Raymer

The famous 5-day *Aircraft Conceptual Design Short Course* and the 1-day *Advanced Layout Class*

April 1-5 & April 6, 2019 in Los Angeles near LAX

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and just who is Dan Raymer?

...Aircraft Design