Structural Mechanics

A brief history

Definitions

Design **- the creation of models of future entities**

Structural mechanics **- the mathematical logic and procedures used both for structural analysis and for technical design.**

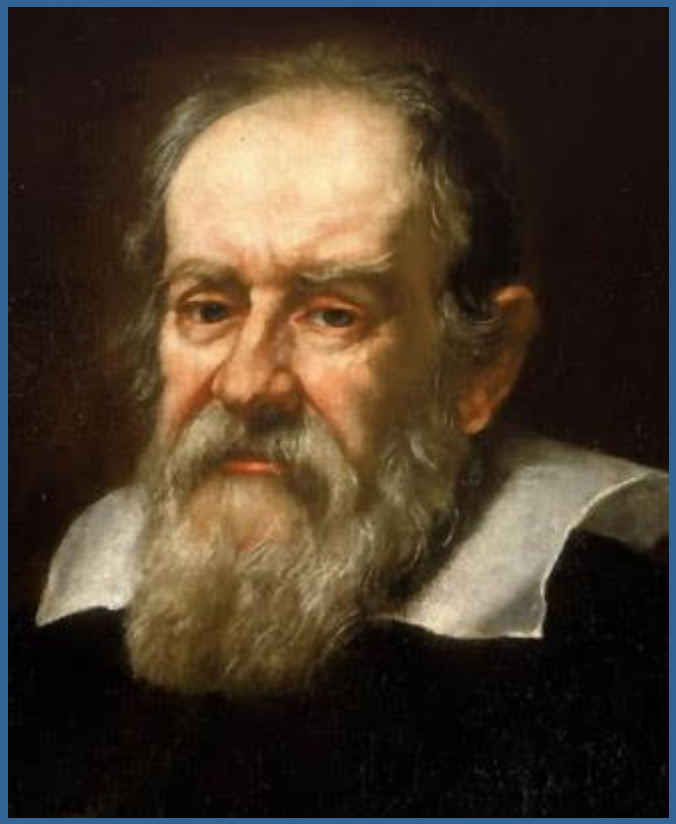
Structural analysis **- the use of structural mechanics to predict the behaviour of structures under load.**

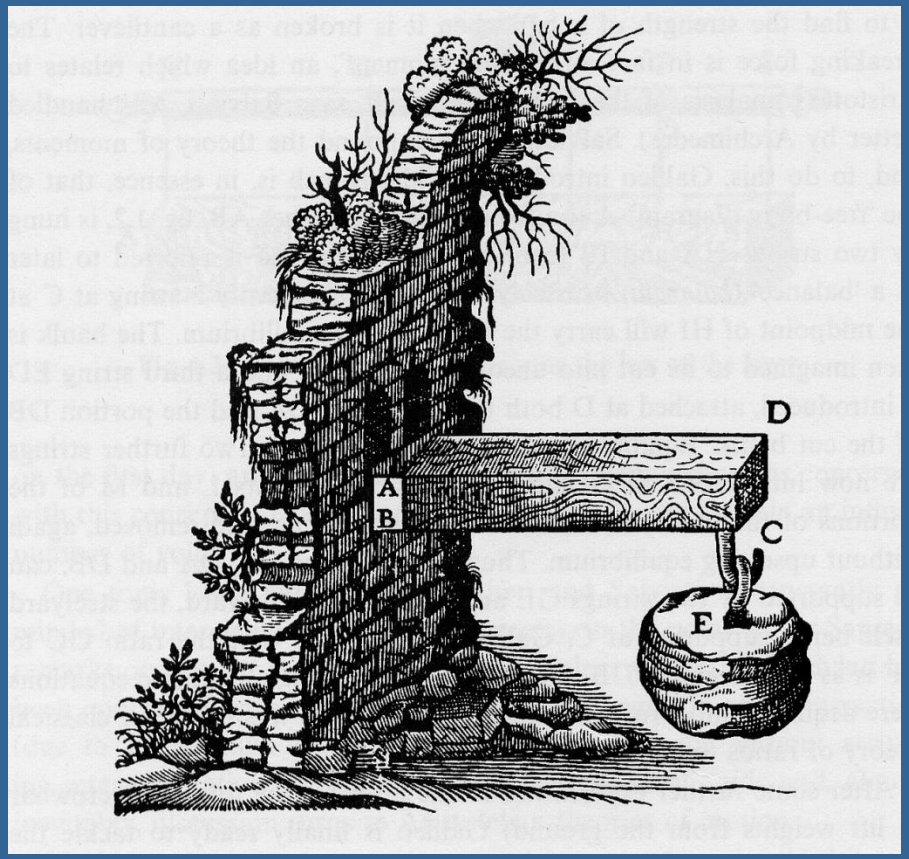
Technical design **- the use of design rules, which are mainly based on structural mechanics and set out in code of practice provisions, to assess the adequacy of structural members and components.**

Structural Mechanics

Early attempts at beam bending -

Galileo Galilei (1564-1642)





Structural Mechanics

Early attempts at beam bending

Leonhard Euler (1707-1783)

Euler is considered to be the pre-eminent mathematician of the 18th century and one of the greatest of all time.

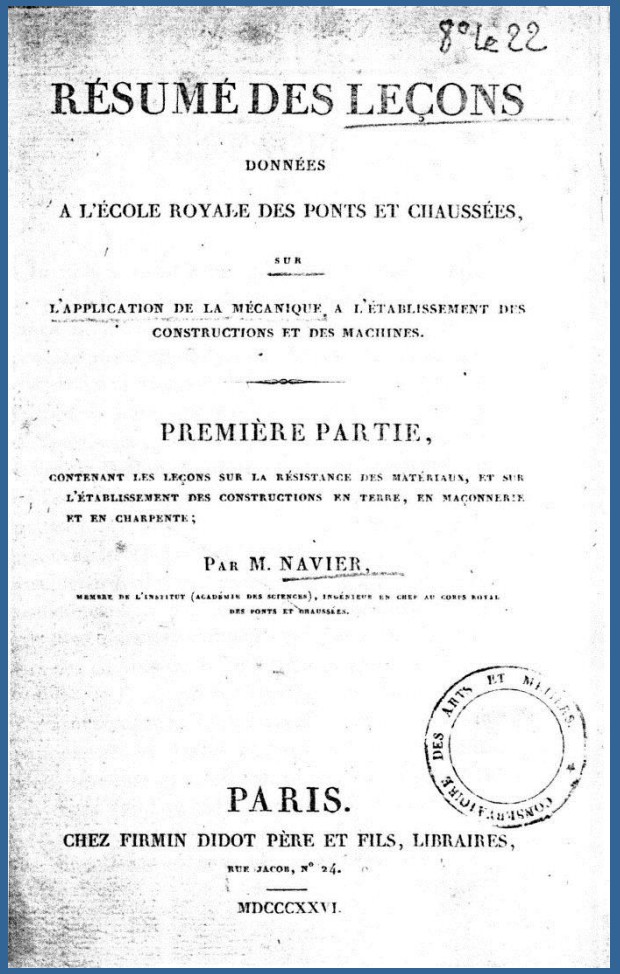
Structural Mechanics

Early attempts at beam bending

Daniel Bernoulli
(1700 – 1782)

The dawn of Structural Mechanics 1826

Louis Navier (1785-1836)



8°Le 22

RÉSUMÉ DES LEÇONS

DONNÉES

A L'ÉCOLE ROYALE DES PONTS ET CHAUSSÉES,

SUR

L'APPLICATION DE LA MÉCANIQUE A L'ÉTABLISSEMENT DES CONSTRUCTIONS ET DES MACHINES.

PREMIÈRE PARTIE,

CONTENANT LES LEÇONS SUR LA RÉSISTANCE DES MATÉRIAUX, ET SUR L'ÉTABLISSEMENT DES CONSTRUCTIONS EN TERRE, EN MAÇONNERIE ET EN CHARPENTE;

PAR M. NAVIER,

MEMBRE DE L'INSTITUT (ACADÉMIE DES SCIENCES), INGÉNIEUR EN CHEF AU CORPS ROYAL DES PONTS ET CHAUSSÉES.

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The dawn of Structural Mechanics 1826

In 1826, Louis Navier, a professor at the Ecole des Pont et Chaussés in Paris, published his *Leçons* on the use of mechanics in the design of buildings and machines. This made him the creator of that branch of mechanics which we call structural analysis. This was a major event in the industrial revolution. Prior to that time, the design of a beam would be based on heuristic rules e.g. limiting span to depth ratios. Using bending theory as presented in the *Leçons*, it became possible to design a beam with greatly reduced risk. Reliability increased, cost decreased, its use became widespread.

Structural Mechanics

Menai Bridge 1826

Thomas Telford

Airships

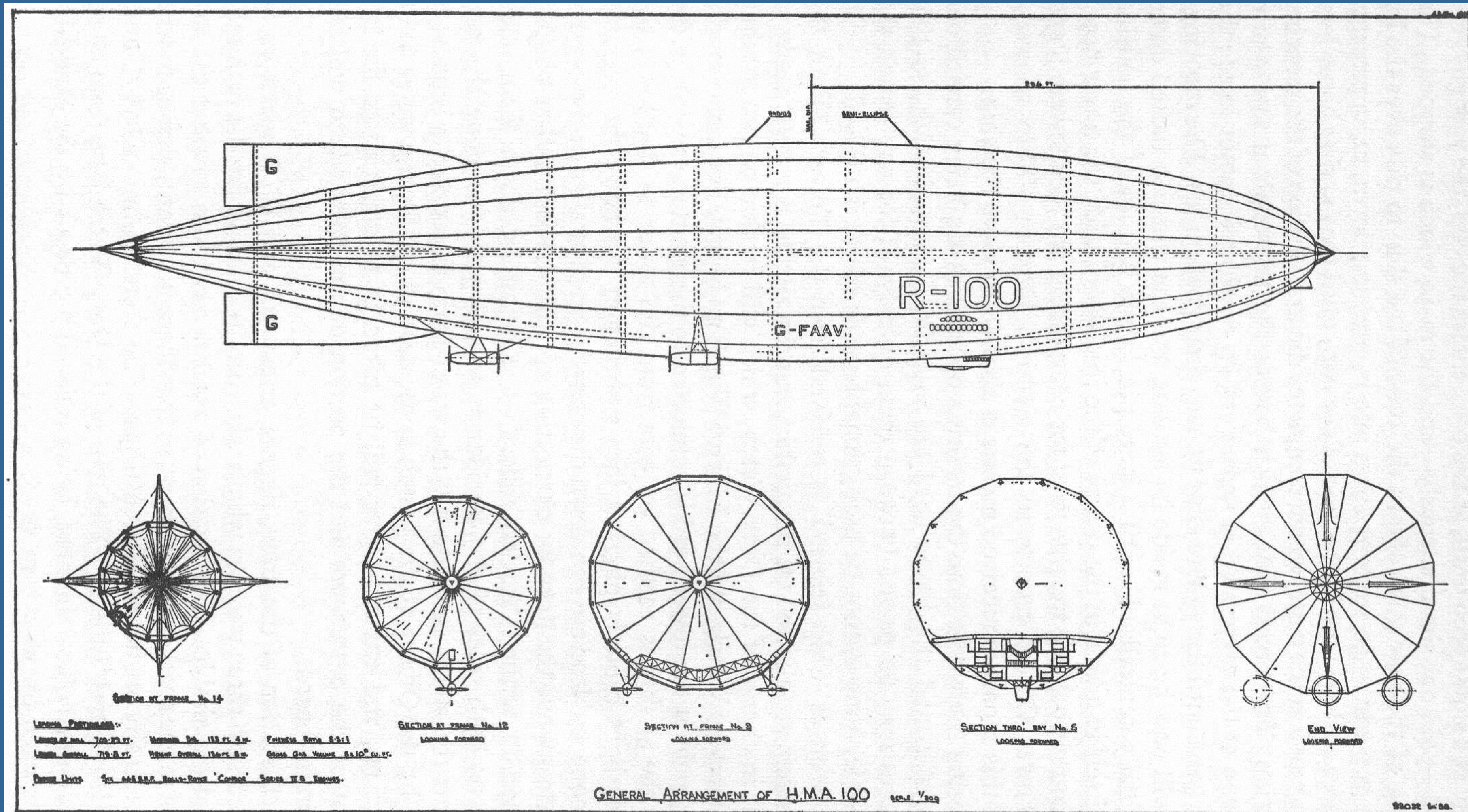
1930

Neville Shute

Airships

1930

Neville Shute was a well known author of novels in mid 20th century. In his early carreer he was a very successful aeronautical engineer. He was in charge of the calculations for the R100 Airship (first flew in 1029). A single calculation for a frame could take 4 weeks to complete


Semi-Ellipse
G
G
R-100
G-FAAV
Section at frame No. 12
Looking forward
Section at frame No. 9
Section thro' bay No. 5
Looking forward
End View
Looking forward
General Arrangement of H.M.A. 100

Structural Mechanics

1950s Introduction of computers

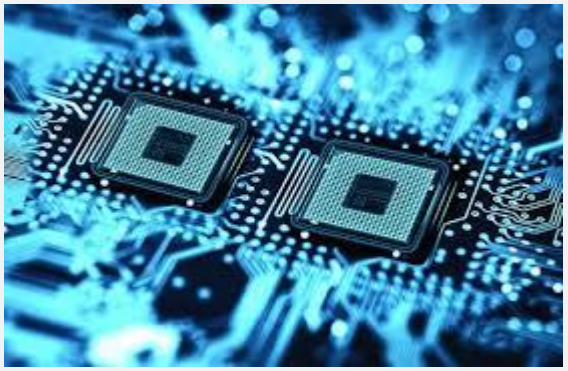
Solution times

1929
R100 7 unknowns - 4 weeks (R100)

1950
10 unknowns - 10 minutes (early computers)

2006
800,000 unknowns - 10 minutes

The computer era



This course is about how reduce the risk in the use of computers for analysis modelling

Use of the modelling process reduces risk of unsatisfactory outcomes and helps to develop understanding of structural behaviour.