Structure and structural form

Structure

What structure is
Structure is the load-carrying part of all natural and man-made forms. It is the part which enables them to stand under their own weight and under the worst conditions of externally applied force.

The designer
In the context of structure, a designer is one who conceives a structural part or a structural system which functions satisfactorily, is integrated successfully within the overall design and is appropriate for its purpose in terms of material and form.
The design process
Without a brief it is not possible to design, since there are no rules and no constraints. Therefore, no matter how sketchy, it is the brief which sets the basic framework for the designer. It provides the lead-in for the first analysis of the problem which then develops into an iterative process, with ideas being tested, modified, rejected, until an appropriate solution to the problem is reached.

Optimum design
A designer should generally aim for the optimum solution in order to obtain the maximum benefit with the minimum use of material within the constraints of strength, stiffness and stability. The result will be EFFICIENCY combined ideally with ELEGANCE AND ECONOMY.

Influences on the designer
The major influences on creative structural design are:

- Precedent – what’s gone on
- Awareness – what’s going on
- Practicality – how to do it
Structural form

Structures take one of four basic forms which may exist singly or in combination.

Solid An homogeneous mass structure where the external surface is independent of the internal form – a three dimensional solid body.

Surface An homogeneous surface where the external and internal forms are similar – a two-dimensional panel.

Skeletal A framework where the assembly of members gives a clear indication of the form usually using one-dimensional elements.

Membrane A flexible sheet material sometimes reinforced with linear tension elements used either as single cables or as a cable net. A variation is the pneumatic where air under pressure is contained by a tension membrane skin.

Hybrid A combination of two of the above forms of near equal dominance.

For examples of all the above, see Chapter 7.

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Structure and structural form

Solid

Surface

Skeletal

Membrane
Structural form in nature

Here are some examples of objects in nature, all of which have a structure in one or more forms:

- Human and animal skeletons
- Birds’ wings
- Fish
- Flowers
- Honeycombs
- Leaves
- Plants
- Rock caves
- Shellfish
- Snails
- Snowflakes
- Spiders’ webs
- Trees
Structural form – man-made

Here are some examples of man-made objects, all of which have a structure in one or more forms:

Aeroplanes
Bicycles
Bridges
Buildings
Cars
Clothes
Cranes
Dams
Engines
Fabrics
Fastenings
Furniture
Musical instruments
Packaging
Pottery
Roads
Sculpture (3-D art)
Ships and yachts
Sports gear
Technical instruments
Tents
Tools
Toys
Tunnels
Wheels
Structure and structural form

PYRAMID

BICYCLE

IGLOO

WIGWAM

TWIG + BARK HUT

MICROELECTRONICS FACTORY

RIETVELD CHAIR
Palm House KEW

Car Body - Monocoque

Microlite Single Seat Aircraft

Forth Rail Bridge