

## **Aircraft Structures Definitions**

### **A**

#### Access panel

- removable panel for inspection or maintenance

#### Aft

- rear of in the direction of the rear of the aircraft

#### Aerodynamics

- the study of how the moving body (aircraft) interacts with air flowing around it, flies

#### Aerodynamic centre

- the point of application for additional aerodynamic loads

#### Aeroelasticity

- the study how to find measures against flutter (undamped vibration in the structure due to aerodynamic loads)

#### Airfoil

- wing-section

#### Afterburner

- extra injection of fuel in extra combustion chamber between the turbine and the nozzle of the engine; creates a higher thrust

#### Age hardening, ageing

- strengthening at room temperature of a quenched metal alloy by very small and uniformly dispersed particles that precipitate from supersaturated solution

#### Ageing

- decrease of mechanical properties of polymer matrix composites or adhesives by exposure to a wet environment

#### Aileron

- control surface for aircraft rolling

#### Airframe

- main components which carry all the loads

#### Aisle

- passage in passenger cabin between rows of chairs

#### Allowable stress

- maximum stress level allowed in a structure (so that it does not deform plastically or break)

#### Alloy

- the combination of several metal components

#### Angle of attack

- the angle between the chord line of a wing or other aerodynamic surface and the oncoming air

#### Anhedral (negative Dihedral)

- a wing in a reverse v-form

#### Aspect ratio

- the ratio of wing span to average chord, an indication of the slenderness of a wing

#### Assembly

- building parts and components together to an aircraft

#### Auxiliary power unit

- system to generate electric power when the engines are not running

#### Auxiliary spar

- an extra beam in the root in the wing for extra strength

### **B**

#### Beam

- a structural member loaded at an angle (often at a right angle) to its length

#### Bearing stress

- used for bolted or riveted joints – load/bolt diameter times material thickness

#### Bending moment

- the product of a force and its moment arm

#### Biplane

- aircraft with an upper and lower wing on top of each other

#### Bird strike

- an impact of a bird on the structure

#### Blade

- one half of a propeller

#### Bolt (nut)

- joining member consisting of head and stem using a nut to tighten it

#### Bonding or adhesive bonding

- method of joining using adhesive material (polymeric material with sufficient strength to transfer load)

#### Brace

- strengthening wire to support a structure, generally loaded in tension

### Bracket

- small fitting or support to attach system parts

### Brake

- system attached to the wheels to slow down or stop the airplane when on the ground

### Buckling

- out of plane bending, followed by crushing of material under compressive loads

### Bulkhead

- a panel separating areas in the structure

## **C**

### Cabin

- the space in the airplane where passengers (payload) stay during the flight

### Camber

- the curved line precisely between the upper and lower skin of an airfoil

### Canard

- an arrangement of foreplanes and wing, rather than the conventional wing and horizontal tailplane

### Cantilever

- a beam supported only at the end

### Centre of gravity

- point of balance of the mass of the aircraft (component)

### Centre of pressure

- the centroid of the pressure distribution

### Centre-line of aircraft

- line connecting geometric middle points of cross sections of the aircraft structure

### Centre wingbox

- central part of the wing which is located inside, right under or right above the fuselage

### Centrifugal force

- a resulting force by spinning a mass around

### Clips and Cleats

- small angles or simple sheet metal parts for (shear) connection of various parts

### Chord

- the distance between the leading and trailing edge of a wing section

### Chord line

- an imaginary line joining the leading and trailing edge of a wing section

### Cockpit

- place where pilots fly the airplane

### Composite

- containing more than one component (in particular materials containing a mixture of plastics and metal, or fibre reinforcements)

### Compression

- stress or force that tends to push material together

### Compressor

- part of the jet engine where the air coming from the inlet is brought to a higher pressure

### Controls

- instruments to control the aircraft: change the position of the control surfaces and the propulsion

### Corrosion

- attack of the material by an unwanted chemical reaction (oxidation)

### Cowling

- the covers around the engine

### Cruising flight, cruise

- the steady, stationary part of the flight when the airplane is not landing starting or performing a manoeuvre

### Cut out

- removing of material, opening in skin or structure

## **D**

### Deflection

- change of the position of the control surface

### Delta wing

- a wing in a triangular planform

### Dihedral

- wing in a v-shape

### Door

- a hatch for letting people or cargo in and out

### Double curvature

- structures that have different curvatures in two directions of various directions

**Doubler**  
- reinforcing sheet against the skin

**Downwash**  
- a small air velocity component in the downward direction aft of the wing

**Drag**  
- a resisting force as a result of the motion of body through a medium

**Drain holes**  
- holes in the structure to remove water accumulated during flight

## **E**

**Elastic limit**  
- point where elastic elongation changes in plastic elongation

**Elevator**  
- control surface for pitch

**Elevons**  
- control surface for pitch and roll

**Empennage**  
- the rear section of the body of the airplane with stabilisers

**Engines**  
- the power units for propulsion of the aircraft

**Extrusion**  
- a forming technique whereby a metal in plastic condition at elevated temperature is force, by pressure, through a orifice

## **F**

**Fail safe**  
- principle of maintaining adequate performance after some degree of damage or degradation has occurred

**Failure**  
- plastic deformation or breaking of a structure

**Fairing**  
- non-structural transition part between components to create an aerodynamic smooth shape and low drag

**Fan (ducted – unducted)**  
- propeller (shield – unshielded)

**FAR**  
- Federal Aviation Regulations, certification procedures and airworthiness standards of the US government (FAA)

**Fasteners**  
- means for mechanically joining parts (bolted and riveted joints)

**Fatigue**  
- failure, at relatively low stress levels, of structures that are subjected of fluctuating and cyclic stress

**Fence**  
- shield

**Fin**  
- vertical stabilizer, tailplane

**Finite element method**  
- numerical method of calculation by discretisation a continuum into a finite number of parts (elements)

**Fitting**  
- generally heavily loaded part or fixture to attach system or other part to a structure

**Flap**  
- the movable part at the trailing edge of the wing which, when extended and / or deflected, increase the lift

**Flaperon**  
- the surface which combines the control function of flaps and ailerons

**Flight deck**  
- place where the pilots fly the airplane

**Foreplane**  
- a horizontal stabilizing and control surface forward of the wing (see canard)

**Flutter**  
- an oscillation caused by interaction between structural and aerodynamic effects

**Floor**  
- lower surface of the cabin

**Frame**  
- a hoop-shaped fuselage member which gives it its cross-sectional shape

**Fuselage**  
- the mainbody of the aircraft, airframe without the wings and the tail

## **G**

Gust  
- turbulence

## **H**

Hardness  
- the measure of material's resistance to deformations by surface indentation or by abrasion

Hatch  
- door for inspection or maintenance

Heat treatment of metals  
- treatment to improve the material properties (mechanical properties, formability, corrosion resistance)

High lift device  
- device to create higher lift

Hinge  
- a movable joint with one (or more) degree(s) of freedom

Honeycomb  
- the core material, between face sheets of a sandwich structure, with the shape of the six sided wall shape made by the honeybee

Hooke's law  
- the strain is equal to the stress divided by the Young's modulus

Hoop stress  
- stress in a pipe wall acting circumferentially (in a plane perpendicular to the longitudinal axis of the pipe) and produced by the pressure of fluid or gas in the pipe

Horizontal stabilizer  
- horizontal tailplane

## **I**

ILS  
- instrument landing system

Impact  
- collision of object onto a structure

Inertia  
- a body's resistance to a change in its motion as a result of an applied acceleration

Intake  
- the inlet of the engine to decelerate the flow

Intercostal  
- part connecting two ribs for attachment of systems

## **J**

JAR  
- Joint Aviation Regulations, certification procedures and airworthiness standards of the European Joint Aviation Authorities (JAA)

Joggles  
- preformed flange of stringer to fit precisely and follow thickness steps in structure

Joint  
- the connection between two parts

## **L**

Landing gear  
- the system (wheels, brakes, shock absorbers, struts, etc) on which the airplane can land

Landing loads  
- the forces which are caused by landing in the landing gear and back-up structure

Leading edge  
- the front of the wing or tail plane

Lift  
- a force at right angles to a body's motion through the air, generated as a result of a pressure difference between opposite surfaces

Limit load  
- the high force which will be one time load the structure at which no plastic deformation should occur

Load  
- the forces and moments acting on a structure

Longeron  
- the main stringer in the fuselage or longitudinal beam

Lug  
- ear or connecting link

## **M**

### Mainframe

- frame at which wing spar is connected to the fuselage

### Maintenance

- to keep the plane in good condition for continued operation

### Manoeuvre

- movements of the aircraft deviating from the stationary flight (e.g. rolling, banking, turning)

### MIL handbook

- military handbook (USA)

### Modulus

- elastic modulus (or shear modulus): resistance against deformation of a material (see also Hooke's law), ratio of stress to strain, measure for the material stiffeners

### Moment arm

- the perpendicular distance from the line of action of a force to the point at which the moment acts

### Monocoque

- a structure with a closed cross-section which mainly consists of a thin skin

### Mould

- a form in which you can cast or form a part

### Mount

- to fix on a support

## **N**

### Nacelle

- outer casing and support structure of an aircraft engine

### Notch

- sharp groove or cut in material

### Nozzle

- the exhaust end of the engine where the air jet accelerates

## **P**

### Paint

- polymeric material used as coating for corrosion protection or for aesthetic reasons

### Panel

- structural subassembly of skin and stiffening elements

### Payload

- the cargo and people that have to be transported

### Pitch

- rotation around the y axis of the aircraft, distance between parts (e.g. rivet pitch)

### Plastic

- deformation which will not go back to the original state when the forces will be gone

### Plate

- flat piece of material with thickness over 6 mm (see also sheet)

### Poisson's ratio

- the negative ratio of lateral and axial strains that results from an applied axial stress in the elastic zone of a material

### Precipitation heat treatment

- hardening, by heating the quenched alloy at about 175C for a few hours, due to very small particles that precipitate from a supersaturated solid solution

### Prepreg

- continuous reinforcing fibres (UD or fabric) impregnated with uncured matrix resin to manufacture a composite part

### Pressure

- force by gas or liquid acting on a solid surface, depending on flow conditions

### Pressurization

- pump more air into the cabin than is allowed to escape

### Primary structure

- the parts of the plane in which failure will be causing fatal danger for the passengers

### Primer

- first coat of paint or diluted adhesive material

### Pylon

- slender compound of structure for attachment of engines

## **R**

### Redundancy

- the provision of alternative load paths or functional routes such that the failure of the element will not cause collapse of the entire structure or total system failure

### Residual strength

- a strength that remains in a material or part that contains a damage or crack

### Resultant of forces

- the sum of the forces acting on a structure

### Rib

- part of the wing structure which provides the wing-section's shape and supports the skin and stringers

### Rib cap

- part of the rib, flange, that connects to the skin

### Rivet

- fastener in sheet metal parts, consisting of head and stem, and after placing an upset head is formed by squeezing or hammering

### Rolling

- rotation around the x-axis of the aircraft, due to aileron deflection; deformation of sheet material with a rolling mill in a circular cross-section

### Root

- the end of the wing closest to the fuselage

### Rudder

- control surface that can turn the nose of the airplane to the left and the right

## **S**

### Sandwich

- a panel which has a great stiffness by spatial shape, build up of a core material with two face sheets

### Servo actuator

- independent power driven adjustment or shifting mechanism

### Shear / shearforce

- a form of loading which tends to cause the atoms or molecules of a material to slide over each other, similar to the action created by a pair of scissors

### Sheet

- flat piece of material with thickness under 6 mm (see also plate)

### Shell structure

- structure which is build up of load bearing, thin sheet material, with stiffening elements

### Shock wave

- an area of rapid change of air pressure created when air flows at a higher speed than the local speed of sound

### Skin

- the sheets on the outside of the structure

### Slat

- a control surface at the leading edge of the wing that increases wing surface area and lift when extended

### Slot

- opening or gap in the structure

### Smart structure

- structures that are able to sense changes in their environment and then respond to these changes in predetermined matter

### Span

- the distance from wing-tip to wing-tip

### Spar

- a spanwise beam in a wing which carries the majority of bending moment generated by lift, weight and inertia loads

### Spar cap

- upper and lower part of the spar separated by a web. The bending moment in the wing is transferred via shear in the web into tension and compression forces in the caps

### Speedbrake

- control surface to slow down the airplane

### Splice

- joint made in assembly of aircraft components (over a manufacturing division), in which all individual parts have to be connected

### Spoiler

- opening panels on upper surface of the wing to disturb the airflow over the wing (spoils lift), sometimes used to supply additional roll control

### Stabilizer

- to give the aircraft stability during flight, smaller wing (fixed horizontal and vertical) are located at the tail of the plane

### Stalling speed

- the lowest speed of the aircraft in flight at which the airflow over the wing separates and becomes turbulent, so the lift will be lost

### Station line

- measuring line or plane giving frame position

### Stiffness

- the measure of the resistance against deformation or displacement, material property (see modulus) but also structural characteristic

### Strain

- the elongation divided by the original length

### Strap

- strip of material used to join parts together

### Strength-to-weight ratio

- the ratio of the material's static strength to its weight, also called specific strength

### Stress

- the intensity of loading, given by the applied force divided by the area over which the force acts

### Stringer

- a stiffening member which supports a section of the load carrying skin, to prevent buckling under compression or shear loads

### Structure

- the way several parts are connected together to fulfill a load carrying function

### Strut

- a slender (bar or tubular) structural member which is loaded in compression

### Stub

- short stump, structure to attach engine to fuselage

### Sweep angle

- the angle between quarter chord line of the wing and centre line of fuselage, swept-back has a positive sweep angle

## **T**

### Tail unit

- aft section of the fuselage onto which the tailplanes are attached

### Taileron

- an aileron in the tail

### Tailplane

- the vertical or horizontal planes at the back of the fuselage

### Tension

- effect produced by two forces pulling against each other

### Thrust

- the force generated by the engine(s) making an aircraft to travel forwards, overcoming the drag force

### Thrust reverser

- system of flaps or doors on the jet engine that bends the jet forward, thus slowing down the aircraft after landing

### Tie

- a tension loaded part used to attach system parts

### Tip

- the outermost extremity of a wing

### Torsion

- moment in the cross-section

### Torsion box

- combined spars and skin that create a closed box in the wing to take torsion forces

### Trailing edge

- the back of the wing or tailplane structure

### Trim

- balanced condition, an airplane that is flying at an angle of attack such that its moment about the centre of gravity is zero

### Truss

- structure which it's made out of tubes, rods or thin elements, each element only loaded in tension or compression

### Tube

- a pipe which can take torsion, or used as strut

### Turbine

- a part of the engine which extracts kinetic energy from the expanding gases coming from the combustion chamber, using this to drive the compressor

### Turbulence

- gust of wind

## **U**

### Ultimate load

- the load which will cause failure of the structure

### Undercarriage

- the system on which the airplane can land or descent (also called landing gear)

## **W**

### Web

- a structural member mainly loaded in shear in the plane of the member (part of the spar, and sometimes in ribs and frames)

### Weight

- the mass multiplied by the gravitation

### Welding

- a way of jointing two parts together by local melting

### Window

- a cut-out in the structure, covered with a transparent material to look through

### Windscreen, windshield

- the front window

### Wing

- the plane to provide lift

### Wing box

- a box in the wing to take torsion forces

### Wing loading

- an aircraft's weight (or effective weight if it manoeuvring) divided by its gross wing area

### Wing span

- the distance from wing-tip to wing-tip

### Winglet

- the vertical aerodynamic plane at the end of the wings

### Wire-braced structure

- a structure that is held together by wires

### Work hardening

- the increase in hardness and strength of a ductile metal as it is plastically deformed below its recrystallization temperature

## **Y**

### Yield point

- stress level of a loaded material where next to deformation starts to become plastic