

UNIT I INTRODUCTION AND ALLOWABLE STRESS DESIGN

Structural steel types – Mechanical Properties of structural steel- Indian structural steel Products-Steps involved in the Design Process -Steel Structural systems and their Elements- -Type of Loads on Structures and Load combinations- Code of practices, Loading standards and Specifications - Concept of Allowable Stress Method, and Limit State Design Methods for Steel Structures-Relative advantages and Limitations-Strengths and Serviceability Limit states.

Allowable stresses as per IS 800 section 11 -Concepts of Allowable stress design for bending and Shear –Check for Elastic Deflection-Calculation of moment carrying capacity –Design of Laterally supported Solid Hot Rolled section beams-Allowable stress design of Angle Tension and Compression Members and estimation of axial load carrying capacity.

INTRODUCTION

Steel is by far the most useful material for building structures with strength of approximately ten times that of concrete, steel is the ideal material for modern construction.

- Due to its large strength to weight ratio, steel structures tend to be more economical than concrete structures for tall buildings and large span buildings and bridges
- Steel structures can be constructed very fast and this enables the structure to be used early thereby leading to overall economy.
- Steel structures are ductile and strong and can withstand severe loadings such as earthquakes. • Steel structures can be easily repaired and retrofitted to carry higher loads.
- Steel is also a very eco-friendly material and steel structures can be easily dismantled and sold as scrap.
- Thus the lifecycle cost of steel structures, which includes the cost of construction, maintenance, repair and dismantling, can be less than that for concrete structures

1.1 Structural steel types

Steel is an alloy of primarily iron, carbon (1 to 2%) and small amount of other components (manganese, nickel). Carbon contributes to strength but reduces ductility.



Structural steel is a material used for steel construction, which is formed with a specific shape following certain standards of chemical composition and strength. They can also be defined as hot rolled products, with a cross section of special form like angles, channels and beams/joints. There has been an increasing demand for structural steel for construction purposes in the United States and India.

Types of structural steel:

Various types of structural steel sections and their technical specifications are as follows:

- Beams
- Channels
- Angles
- Flats

Steel Beams

Steel Beams is considered to be a structural element which mainly carries load in flexure meaning bending. Usually beams carry vertical gravitational force but are also capable of carrying horizontal loads generally in the case of an earthquake. The mechanism of carrying load in a beam is very unique, like; the load carried by a beam is transferred to walls, columns or girders which in turn transfer the force to the adjacent structural compression members. The joists rest on the beam in light frame constructions.

The beams are known by their profile meaning:

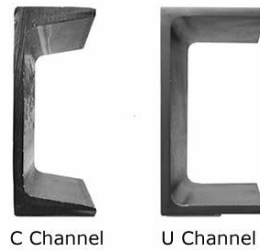
- The length of the beam
- The shape of the cross section
- The material used

The most commonly found steel beam is the I beam or the wide flanged beam also known by the name of universal beam or stouter sections as the universal column. Such beams are commonly used in the construction of bridges and steel frame buildings. The most commonly found types of steel beams are varied and they are mentioned below:

- I beams
- Wide flange beams
- HP shape beams

Steel Channels:

Steel channels are used ideally as supports and guide rails. These are roll-formed products. The main metal used for making channels is steel along with aluminum.



There are certain variations that are available in the channels category, the categorization is mainly on the shape of the channel. A major variant of the channel is the mild steel channel. Such channels are generally used in heavy industries. They are used in the heavy machinery industry and automotive industry too.

Steel Angle:

A steel angle is long steel with mutually vertical sides. The steel angles are the most basic type of roll-formed steel. The most commonly found steel angles are formed at a 90° angle and has two legs of equal length. The sides are either equal or of different sizes. There are certain variations in the steel angles depending on its basic construction. The variations are like; if one leg is longer than the other then it is known as L angle. If the steel angle is something different from 90° then it is known as V angle. In some steel angles, double thickness is achieved by folding the legs inward. If the steel angle has same sides, then it means that it has identical width. The steel angles are made according to the strength that is required for the different structures for construction purposes.

Steel Flats:

Flats are actually thin strips of mild steel having the thickness of the strip commonly varying from 12mm to 10mm but thicker flats than this are also available. Steel flats are produced by the utilization of relatively smooth, cylindrical rolls on rolling mills. Generally, the width to thickness ratio of flat rolled products is fairly large. The steel flat bars are manufactured using advanced thickness control technology for controlled thicknesses. The hi-tech machineries enable the production of top grade steel flat bars with superlative flatness and controlled thickness. This product is highly customized and the specific sizes according to the client's requirement are produced. After production the flat steels are subjected to a variety of finishes like, painting and galvanizing. The flat carbon steel is a hot or cold rolled strip product also known as a plate product. These plate products have a size variation between 10mm to 200mm and the thin flat rolled flat rolled product's size varies from 1 mm to 10 mm.

- **Carbon steel:** Carbon steel is a special type of steel that, as the name suggests, has a higher concentration of carbon than other types of steel. Most types of steel have a relatively low carbon content of about 0.05% to 0.3%. In comparison, carbon steel has a carbon content of up to 2.5%
- **Fire resistant steel:** A steel is generally considered fire-resistant if its strength when heated to such temperatures for short periods of time remains equal to 0.6–0.7 of its strength at room temperature. The greatest resistance to fire — up to 800°C — is obtained in steels that contain boron.
- **High strength carbon steel:** High-carbon steel has a carbon content of 0.60– 1.25 wt.% and a manganese content of 0.30 – 0.90 wt.%. It has the highest hardness and toughness of the carbon
- **High strength tempered steel:** tempering are processes that strengthen and harden materials like steel and other iron-based alloys. The process of quenching or quench hardening involves heating the material and then rapidly cooling it to set the components into place as quickly as possible. The process is tightly controlled, with the heating temperature, cooling method, cooling substance and cooling speed all dependent upon the type of material being quenched and the desired hardness. A typical heating range is between 815 and 900 degrees celcius, with extra care being taken to keeping the temperature as stable as possible.
- **Medium and High strength micro alloyed steel:** Microalloyed steel is a type of alloy steel that contains small amount of alloying elements (0.05 to 0.15%), including niobium, vanadium, titanium, molybdenum, zirconium, boron, and rare-earth metals. They are used to refine the grain microstructure or facilitate precipitation hardening
- **Stainless Steel:**Stainless steel is a group of iron-based alloys that contain a minimum of approximately 11% chromium a composition that prevents the iron from rusting and also provides heat-resistant properties. Different types of stainless steel include the elements carbon (from 0.03% to greater than 1.00%), nitrogen, aluminium, silicon, sulfur, titanium, nickel, copper, selenium, niobium, and molybdenum. Specific types of stainless steel are often designated by a three-digit number.
- **Weathering steel:** Weathering steel, often referred to by the genericized trademark COR-TEN steel and sometimes written without the hyphen as corten steel, is a group of steel alloys which were developed to eliminate the need for painting, and form a stable rust-like appearance after several years' exposure to weather.