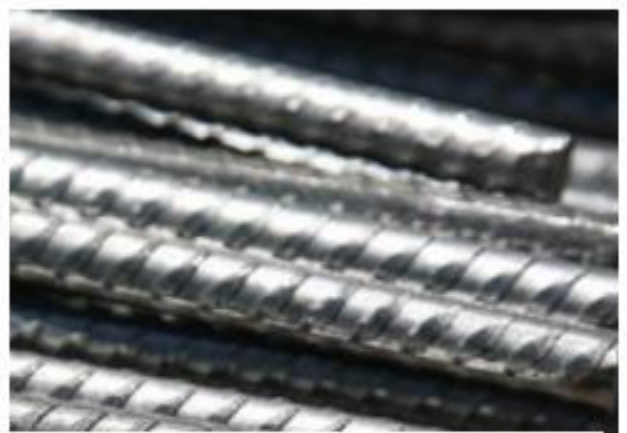


Difference Between Carbon Steel (Mild Steel) And Stainless Steel

Understanding the main difference between the carbon steel and stainless steel is very essential when it comes to making a decision on which steel for a specified construction project. Choice in the grade of steel will come only after the choice between the carbon and stainless steel. In order to facilitate this choice, we will discuss the key difference between carbon steel and stainless based on different properties.



CARBON STEEL BARS



STAINLESS STEEL BARS

Certain properties are mentioned based on which the differentiation is carried out.

Difference Between Carbon Steel And Stainless Steel

Appearance

When the metal has to be used as an exterior structural element, the need for aesthetics becomes the most preferred criteria.

Both the elements can be sanded and polished to have a shiny look and brightness. But the carbon steel requires a painting procedure quickly after this polishing to avoid tarnishing and followed by rusting. When cosmetic appearance is a factor, the stainless steel with particular finishes is employed.

A scratch in stainless steel; retains the luster in the scratched area. But the situation in carbon steel will ask for repainting, otherwise, it will result in the corrosion.

Corrosion Resistance

Another main difference between the carbon and stainless steel is their respective ability to resist corrosion. Stainless steels are the most resistant to corrosion when compared to carbon steels. Both the elements consist of iron that will oxidize when exposed to the environment. This will create rust.

The stainless steel consists of chromium which makes it corrosion resistant compared with carbon steels. The chromium will attach more to oxygen readily when compared with iron. A chromium oxide layer is formed due to this reaction, which will result in the prevention of corrosion and degradation.

The carbon steel does not consist of sufficient amount of chromium to form this layer. This is hence exposed to corrosion and rust formation. Hence if the project is more concerned about corrosion, the stainless steel is the best option.

Stress- Strain Behaviour

When considering the stress-strain behavior of both stainless steel and carbon steel; both differ in different aspects. Figure-2 shows the typical stress-strain behavior of the stainless steel and carbon steel. The stainless steel mentioned are the **duplex** and the **austenitic**.

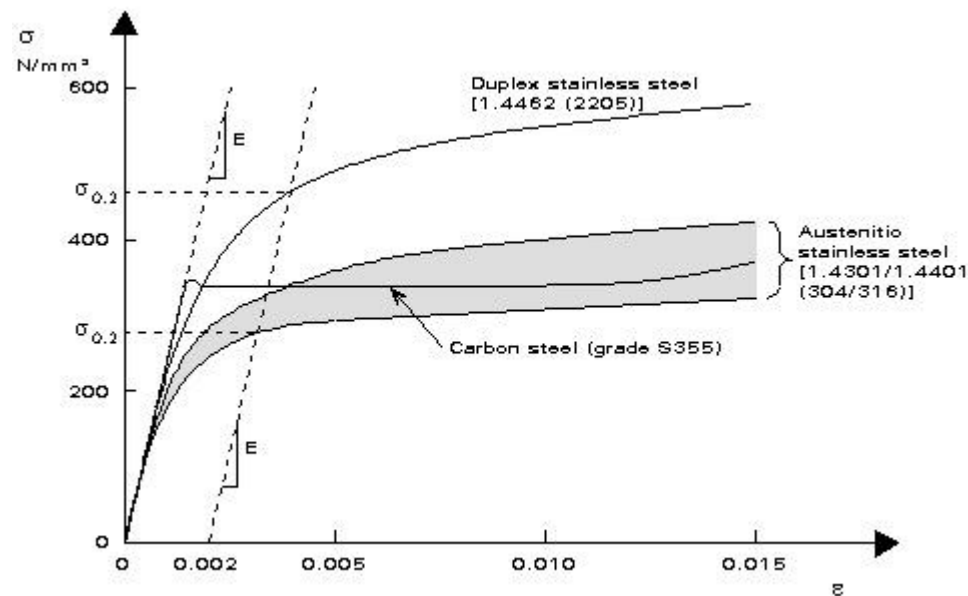


Fig.2: The

Stress-Strain Curve For Stainless Steel and Carbon Steel

From the above figure, the **0.2** is the 0.2% proof strength and **E** are the moduli of elasticity. The yield strength of stainless steel is mainly represented by means of the proof strength of 0.2%. That means the proof strength at an offset permanent strength of 0.2%.

The following comparison can be made between the stainless steel and the carbon steel:

1. There is a departure from linearity by the stress-strain curve of the stainless steel. This is happening at a lower stress value when compared to the carbon steel.
2. The work hardening property of the stainless-steel shows that **the stainless steel has greater ductility compared to carbon steel.**
3. The modulus of the material of the stainless steel reduces with an increasing stress value. This is unlike the case of carbon steel.
4. The fabrication of stainless steel will result in the formation of residual stresses that are higher in value compared to the carbon steel.

The above-mentioned reasons are the main reason behind the difference in the structural behavior of stainless steel and carbon steel.

Deflection

The stiffness of the stainless-steel decrease with the increase in the stress value. This will create greater deflection in stainless steel than compared to the carbon steel members. This will make it necessary for using a **reduced modulus** in order to predict the member behavior for which higher stress will occur.

Mechanical Properties

As there are different grade and hence difference varieties of stainless steel and carbon steel, a clear differentiation based on the mechanical properties is difficult.

Grade	Design strength (N/mm ²)	Ultimate tensile strength (N/mm ²)	Young's Modulus (N/mm ²)	Elongation (%)
Stainless steel				
304 (1.4301)	210	520	200 000	45
316 (1.4401)	220	520	200 000	40
Carbon steel				
S275	275	410	205 000	22
S355	355	490	205 000	22

Table-1: Comparison of Mechanical Properties of Stainless Steel and Carbon Steel

But the stainless-steel ought to have a greater ductility because of their higher content of nickel. But there are also stainless-steel grades that are **brittle in nature** which is called as **martensitic grades**.

The carbon steel that possesses lower amounts of carbon won't match with the tensile strength of the stainless steels due to the alloying elements present in the stainless steel. This alloy content in stainless steel is the main reason behind higher strength gain.

Cost

Even though a large variety of both the elements are present in the market, the stainless steel is more expensive compared with carbon steel. The main reason behind the high cost is due to the addition of alloys like:

- Nickel
- Manganese
- Chromium and Others

The carbon steel is mainly affordable as it contains iron and carbon element. These are not expensive. Working with a tight budget will ask you to choose carbon steel.

How to Choose between stainless steel and Carbon steel?

All the criteria's mentioned above are compared to carry out a decision between the stainless steel and carbon steel. Wherever the steel used will be finally hidden, there is no sense of using a stainless steel. But If the steel is hidden from view but will be exposed to a highly corrosive environment, then stainless steel is the best option.

Hence the final choice will also depend on the need and requirements of the job or the project.