AN EXPERIMENTAL STUDY OF STAINLESS STEEL BEAM

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Abstract - Stainless steels have not traditionally been widely used as structural materials in building and civil engineering. Where the steels have been used for this purpose there has been some other imperative driving the design, usually corrosion resistance or architectural requirements rather than the inherent structural properties of the steel. The primary reason for this low use in structural applications is usually the perceived and actual cost of stainless steel as a material. Developments over the last 10 years, both in available materials and attitudes to durability, are now offering a new opportunity for stainless steels to be considered as primary structural materials. This paper introduces stainless steel alloys and briefly discusses the important properties and commercial aspects of these alloys relevant to structural designers. The paper also considers recent developments, particularly with respect to available alloys and considers obstacles to the wider use of stainless steels in structural engineering that are related to both supply chain costs and efficiency of design.

Key Words: Beam, Bending, Specimen, Grade, Yield

INTRODUCTION

Stainless steel represents one of the more recent groups of engineering materials. Although invented at the beginning of the 20th Century, it took several decades before their use became widespread. It was not until after the World War 2, that modern stainless steels were developed and commonly used. The single most important property of stainless steel is their corrosion resistance. Corrosion resistance, in combination with good mechanical properties and manufacturing characteristics, has helped establish stainless steel as an extremely versatile material which, in many cases, offers the only economically viable alternative for the designer. Stainless steel is an alloy of iron (Fe) and chromium (Cr), with a controlled amount of carbon (C). They are a family of steels containing a minimum of 11% chromium, whose primary property is that of corrosion resistance. If 11% of more chromium is added, a protective, passive film will form. The higher the chromium content, the stronger the passive film. Other elements such as molybdenum (Mo) and Nitrogen (N) further strengthen the passive film and improve corrosion resistance. If the passive film is removed or damaged, it will spontaneously re-form in the presence of air or water.
400 series. These steels have a moderate corrosion resistance, high strength and hardness developed by heat treatment. They have poor weldability and are magnetic.

**Ferritic:**

Are plain chromium alloys with low carbon levels and are also included in the AISI series. These steel have moderate to excellent corrosion resistance depending on chromium content. They cannot be strengthened or hardened and have poor weldability except in thin gauges. They are magnetic.

**Austenitic:**

These steels are included in both the AISI 300 and AISI 200 series and contain nickel with low to very low carbon contents. These materials have excellent corrosion and high temperature oxidation resistance. Strength and hardness can be increased by cold work. They have excellent cryogenic properties. They are non-magnetic. In steels in the 200 series, the nickel is partially replaced by manganese. These variants have properties similar to the 300 series, but have higher strength and lower corrosion resistance.

**Duplex:**

These steels contain less nickel than the austenitic alloys and have very low carbon contents. They have a duplex (mixed) crystal structure of ferrite and austenite. These steels have excellent corrosion resistance, particularly to pitting, crevice corrosion and stress corrosion cracking. They also have high strength, excellent weldability and are magnetic.

**Material Test specification:**

<table>
<thead>
<tr>
<th>Content</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Grade</td>
<td>SS202</td>
</tr>
<tr>
<td>Section</td>
<td>Angle</td>
</tr>
<tr>
<td>Dimension</td>
<td>45<em>45</em>6mm</td>
</tr>
<tr>
<td>Length</td>
<td>1000mm</td>
</tr>
</tbody>
</table>

**Tensile Test:**

The primary use of the testing machine is to create the stress-strain diagram. Tensile test determines the strength of the material subjected to a simple stretching operation. Typically, standard dimension test samples are pulled slowly (static loading) and at uniform rate in a testing machine while the strain (the elongation of the sample) is defined as: Engineering Strain = (change in length)/(original length) and the stress (the applied force divided by the original cross-sectional area) is defined as: Engineering Stress = (applied force)/(original area) =P/A0

The aim of the test is to assess some mechanical characteristics of testing material: its elasticity, ductility, resilience and toughness.

**Bending test:**

This test method evaluates the tensile behaviour of stainless steel beam in terms of areas under the load-deflection curve obtained by testing a simply supported notched beam under three-point loading.

This test method is used for the determination of

- The limit of proportionality (LOP), i.e. the stress which corresponds to the point on the load-deflection curve (=> F_u) defined in point 5 as limit of proportionality;
- Two equivalent flexural tensile strengths which identify the material behaviour up to the selected deflection. These equivalent flexural tensile strengths are determined according to point 5.
- Besides the necessary measurement of the mid-span deflection (δ), opening displacement of the mouth of the notch (CMOD) is optional. The purpose of both measurements is to formulate in a later phase: a relation between crack mouth opening displacement and mid-span deflection;

A relation between the stress-crack mouth opening displacement relationship, recorded during the bending test, on the one hand and the stress-crack width relationship, measured during a uniaxial tensile test, on the other.
BENDING STRENGTH = 167Mpa

3. CONCLUSIONS

From the past research work, suitability and material properties of stainless steel as a structural material is studied with reference to mechanical properties like tensile strength, bending strength and buckling strength. In this research, SS plates of grade SS202 will be used. and 6.0 mm thickness of SS202 shows the tensile strength of 502 MPa and bending strength of 167 MPa and Yeild strength of 247 MPa.

REFERENCES


