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AN EXPERIMENTAL STUDY OF STAINLESS STEEL BEAM

Dr.A.Anbuchezian [1], S.Sathish Kumar [2]

[1] Principal, Annapoorana Engineering College, Salem – 636308, Tamilnadu, India
[2] Assistant Professor, Department of Civil Engineering, Annapoorana Engineering College, Salem – 636308, Tamilnadu, India

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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, Yeild

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.

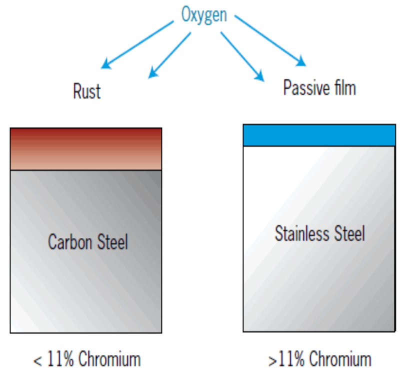

Fig 1

MATERIAL PROPERTIES,CLASSIFICATION AND TESTS:

Material Properties:

- Higher corrosion resistance
- Higher cryogenic toughness
- Higher work hardening rate
- Higher hot strength
- Higher ductility
- Higher strength and hardness
- Higher stress resistance
- A more attractive appearance
- Lower maintenance

Material Classification And Grades:

Since their invention and initial development, the number of stainless steel grades has increased rapidly, with hundreds of different chemical compositions standardised around the world .Since the micro structure of the steel determines its properties, stainless steel have traditionally been divided into categories based on their structures. This gives a rough classification in terms of both composition and properties. The relationship between the various stainless steel classifications is summarised below and is schematically illustraded in figure .

Martenstic :

Are plain chromium alloys with relatively high carbon levels. Are included in the American Iron and Steel Institute (AISI)

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:

Content	Properties
Material	Stainless Steel
Grade	SS202
Section	Angle
Dimension	45*45*6mm
Length	1000mm

Tesile 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.

Fig 1

Fig 2

TENSILE STRENGTH =502Mpa
YIELD STRENGTH =247Mpa

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 deter-mined 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 dis-placement 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.

Fig 3

BENDING STRENGTH= 167Mpa

3. CONCLUSIONS

From the past research work, suitability andmaterial 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

[1] Ben Young, "Experimental and numerical investigation of high strength stainless steel structures", Journal of Constructional Steel Research 64 (2008) 1225-1230.

[2] E.L. Salih, L. Gardner, D.A. Nethercot, " Numerical study of stainless steel gusset plate connections", Engineering Structures 49 (2013) 448–464.

[3] Eunsoo Choi, Young-Soo Chung, Kyoungsoo Park, Jong-Su Jeon, "Effect of steel wrapping jackets on the bond strength of concrete and the lateral performance of circular RC columns", Engineering Structures 48 (2013) 43–54.

[4] Graham Gedge, "Structural uses of stainless steel - buildings and civil engineering", Journal of Constructional Steel Research 64 (2008) 1194-1198.

[5] L. Di Sarno, A.S. Elnashai, D.A. Nethercot, "Seismic retrofitting of framed structures with stainless steel", Journal of Constructional Steel Research 62 (2006) 93–104.

[6] L. Gardner, A. Insausti, K.T.Ng, M.Ashraf, "Elevated temperature material properties of stainless steel alloys", Journal of Constructional Steel Research 66 (2010) 634-647.

[7] L. Gardner, M. Theofanous, "Discrete and continuous treatment of local buckling in stainless steel elements", Journal of Constructional Steel Research 64 (2008) 1207-1216.

[8] Mahmud Ashraf, Leroy Gardner, David Nethercot, "Finite element modelling of structural stainless steel cross-sections", Thin-walled Structures 44(2006)1048-1062.

[9] S.M. Zahurul Islama, Ben Young, "Strengthening of ferritic stainless steel tubular structural members using FRP subjected to Two-Flange-Loading", Thin-Walled Structures 62 (2013) 179–190.

[10] Standard Test Methods for Tension Testing of Metallic Materials Designation: E 8/E 8M– 08 by ASTM.