

Phase-1

Test Report on Mechanical Properties of STARK Steel

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Disclaimer

This report summarizes the test results of mechanical properties of STARK STEEL High strength rebars such as Young's Modulus, Yield Strength, Ultimate Strength and Percentage Elongation. Results pertain to only one diameter supplied and cannot be extrapolated to other diameters.



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1. INTRODUCTION

This report presents the mechanical properties of Stark Steel rebars provided by Somani wires under tensile loading. Elastic modulus, yield strength, ultimate strength, percentage elongation after fracture, nominal stress-strain diagrams were found by testing of rebars under tensile loading. This report summarizes the test results of tensile properties of high Strength steel rebar samples made by high tensile steel rods are twisted with each other forming single rebar, i.e., STARK STEEL rebar, supplied by Somani wires. Test samples were prepared and tested as per the provisions of IS:1608-2005. They were anchored using a hardened steel grip at both ends. Figure-1 shows the sample placed on the MTS-250 kN machine. The extensometer of gauge length of 50mm and a strain gauge length of 2mm was mounted on the tested sample to measure the deformations and strains during testing.



Grip pressure = **8MPa**
Grip Length = **60mm**
Rate of loading = **2mm/min**

Figure-1: Setting up of test sample.

2. EXPERIMENTAL SETUP AND DETAILS

The high strength steel rebar test sample is mounted in the grips of a servo-controlled MTS-250 kN testing machine, as shown in Figure-2 and monotonically loaded in tension until failure. Details of the test specimens are presented in Table 1 and Figure-3. A TML strain gauge of 2mm gauge length was used to measure strain. Three rebars were tested under displacement control mode using a servo-controlled fatigue testing machine. The specimens were loaded at a rate of 2 mm/min. The loading rate was chosen to ensure that the ultimate failure should occur between 1 to 10 min. During the testing of specimens, strain gauge reading was recorded using an external data acquisition system (DAQ).



Figure-2: MTS-250 kN machine

Table-1: Details of the test specimen.

S. No	Specimen	Nominal Diameter (mm)	Area (mm ²)	Length (mm)
1	HSS-1	5.2	21.23	860
2	HSS-2	5.2	21.23	860
3	HSS-3	5.2	21.23	860



Figure-3: Specimen Details

Extensometer:

The extensometer supplied by Epsilon Tech is a general-purpose one used for axial tensile, and compression strain measurements. It offers a gauge length of 50mm. Most often, they are connected to a test machine controller. Epsilon extensometer comes with a compatible connector wired to plug directly into the controller to collect the displacement data. Three wire-120-ohm strain gauges of gauge length 2 mm were used to measure the strain in the specimen during the testing. Figure 4 shows the extensometer and strain gauge used while testing of the sample.

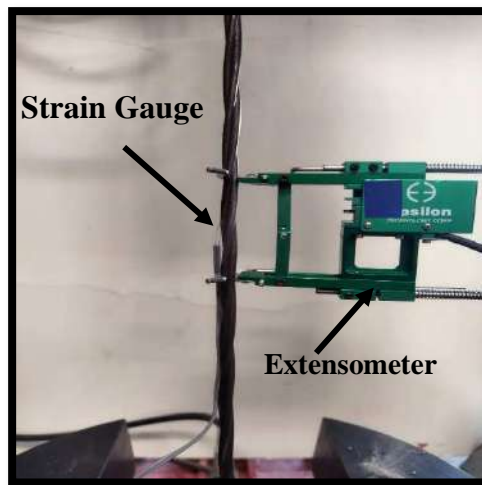


Figure-4: Extensometer (Epsilon) & Strain Gauge.

3. RESULTS AND DISCUSSIONS

The stress-strain behavior of the tested specimens is shown in Figure-5. The yield and peak loads presented in table 2 correspond to data obtained from the load cell connected to the testing machine. The elastic modulus, yield strength, ultimate strength and percentage elongation of the specimens are presented in Table -2.

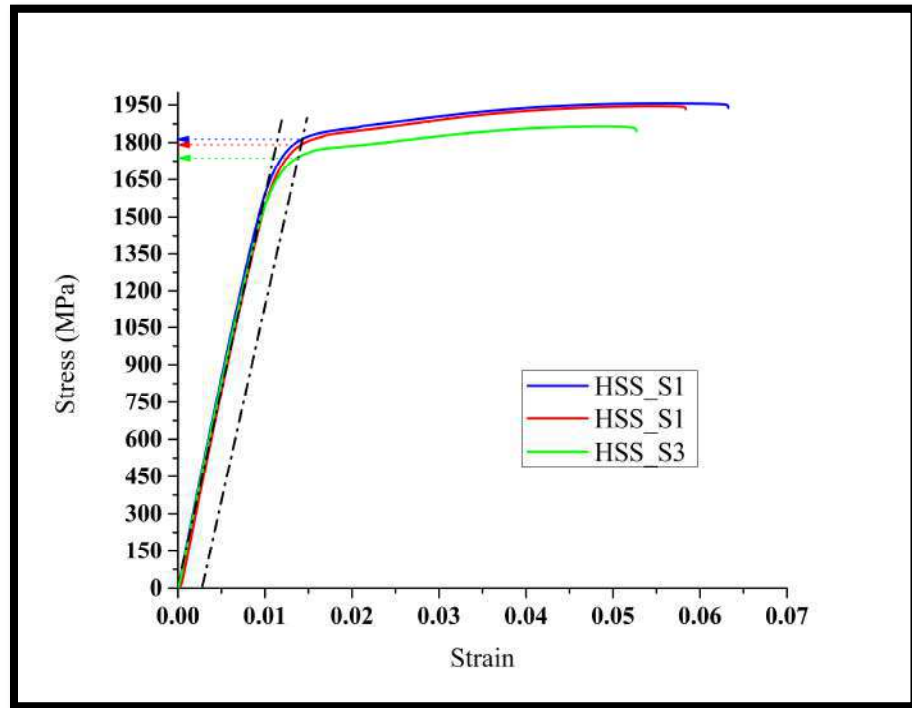


Figure-5: Stress-Strain behaviour of STARK Steel



Figure-6: Failure modes of STARK Steel

Table-2: Summary of results.

S.No	Sample_Id	Diameter (mm)	Gauge length (mm)	Elastic Modulus (GPa)	Yield strength (MPa)	Ultimate strength (MPa)	Percentage elongation (%)
1	HSS_S1	5.2	690	192	1740	1956	5.20
2	HSS_S2	5.2	684	189	1785	1945	5.50
3	HSS_S3	5.2	682	190	1805	1864	5.42

Note: HSS means High Strength Steel.

S1, S2, and S3 means Sample 1, 2 and 3, respectively.

***Note:**

- The elastic modulus was measured by drawing a tangent at 0.2% strain parallel to the linear elastic region.

4. SUMMARY

The following test results can be summarized based on testing of STARK STEEL rebars:

- The average yield strength is **1776 MPa**.
- The average yield load is **37.7 kN**.
- The average ultimate tensile strength is **1921 MPa**.
- The average ultimate load is **40.8 kN**.
- The average Elastic modulus is **190 GPa**.
- The average observed failure strain of **5.37%**.



5. REFERENCES

1. IS 1608:2005, ISO 6892:1998, “METALLIC METRIALS -TENSILE TESTING AT AMBIENT TEMPERATURE” (Third Revision).