

# Mechanical Properties of Cold - Formed Steel Under Tensile Testing

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## Mechanical Properties of Cold -Formed Steel Under Tensile Testing

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**Abstract.** Material properties play an important role in the performance of structural members. Cold-formed steel has been used in bridge construction, drainage facilities, a metal building of industries, residential construction, automotive and its applications. Cold-form steel structure joints generally use the self-drilling screw to easy installing and providing a rapid joint. Nowadays, a premature collapse of cold- formed steel structures could be occurred, though during the installation process. This paper shows the mechanical properties results by tensile testing of cold-formed steel, based on ASTM E8 Code. The results testing shows the yield strengths of the cold-formed steels range from 566 to 575 MPa. The ductility ratio of cold-formed steel is from 1.1 to 5.2. The effects of cold work on formed steel members depend largely upon the spread between the tensile and the yield strength of the virgin material. The strength of cold-formed steel structural members depends on the yield point or yield strength, except in connections and in those cases where elastic local buckling or overall buckling is critical.

**Keywords:** cold-formed steel, yield strength, ductility, mechanical properties

### 3 1. Introduction

3 In steel construction, there are two main families of structural members. One is the familiar group of hot-rolled shapes and members built up of plates. The other, less familiar but of growing importance, is composed of sections cold-formed from steel sheet, strip, plates, or flat bars in roll-forming machines or by press brake or bending brake operations [1].

Cold-formed steel has been used in bridge construction, drainage facilities, a metal building of industries, residential construction, automotive and its applications. Material properties play an important role in the performance of structural members. Based on that fact, we need to measure the

mechanical properties of cold-formed steel in the laboratory [2].

2. Method

Specimen Testing

The Cold-formed steel plate of 0.75 mm was used as the dogbone specimens. Static testing was carried out on the dogbone specimens based on ASTM-E8. The ultimate strength and strain due to tension loading of the specimens were measured.

Table 1 Tension Testing of Metallic Materials

Nominal Width	Dimensions, mm						
	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5	Specimen 6	Specimen 7
	12.5	40	40	20	20	25	25
G - Gage length	50.0 ± 0.1	50.0 ± 0.1	200.0 ± 0.2	50.0 ± 0.1	100.0 ± 0.1	50.0 ± 0.1	100.0 ± 0.1
W - Width	12.5 ± 0.2	40.0 ± 2.0	40.0 ± 2.0	20.0 ± 0.7	20.0 ± 0.7	25.0 ± 1.5	25.0 ± 1.5
T - Thickness	Measured thickness	Measured thickness	Measured thickness	Measured thickness	Measured thickness	Measured thickness	Measured thickness
R - Radius of fillet	12.5	25	25	25	25	2.5	25
A - Length of reduced section	60	60	230	60	120	60	120
B - Length of grip section	75	75	75	75	75	75	75
R - Width of grip section	20	50	50	25	25	40	40

3. Results

Tension strength of cold-formed steel refers to ASTM-E8 standards, and are as shown in Table 2.



Fig. 1 Tensile testing of cold-formed steel

Table 2 Tensile strength of cold-formed steel

No	Width (mm)	Thickness (mm)	Area (mm <sup>2</sup> )	Ultimate Load (N)	Tensile Strength (N/ mm <sup>2</sup> )
1	29.85	0.75	22.39	11,025	492.5
2	29.85	0.75	22.39	11,250	502.5
3	29.95	0.75	22.46	11,150	496.4

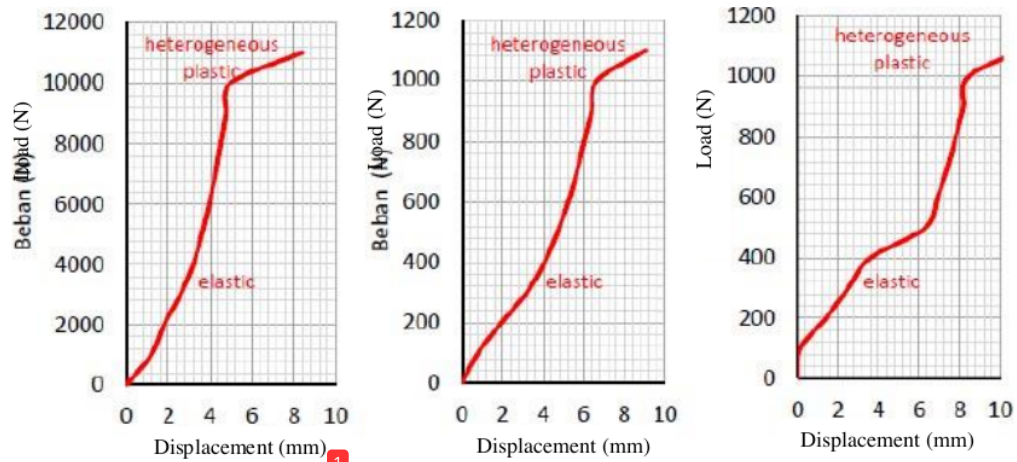


Fig. 2 Load-displacement curves of cold-formed steel

**a. Tensile Strength**

The strength of cold-formed steel structural members depends on the yield point or yield strength, except in connections and in those cases where elastic local buckling or overall buckling is critical. The results testing shows the tensile strengths of the cold-formed steels range from 566 to 575 MPa, it is still in the required range of 185-

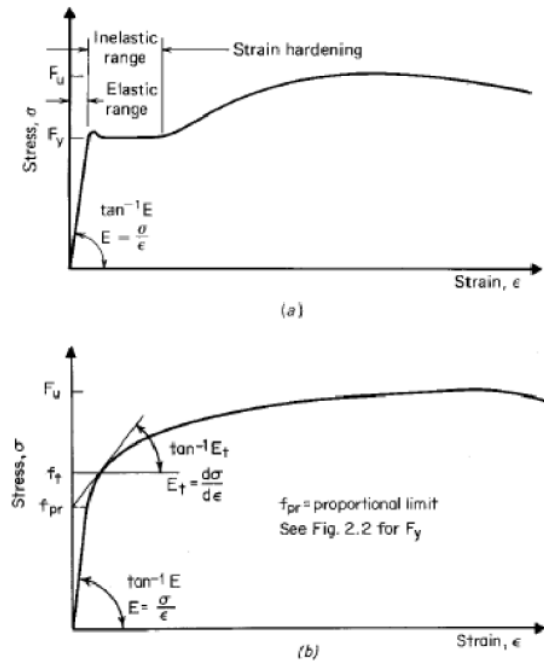


Figure 3 The stress-strain curves of steel sheet or strip (a) Sharp-yielding. (b) Gradual-yielding.

**b. Ductility**

According to the AISI Specification, the ratio of  $F_u/F_y$  for the steels used for structural framing members should not be less than 1.08, and the total elongation should not be less than 10% for a 2-in. (50.8 mm) gage length. The ductility ratio of cold-formed steel is from 1.1 to 1.2.

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