# Team 10: High Strength Steel Characterization

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**Problem Statement:** The objective of this project was to characterize Advanced High Strength Steel (AHSS) for roll forming through a combination of research, simulation, prototyping and validation. This included a prototype methodology to form a U-channel, then correlate the results to simulation, and to validate tool designs prior to a production recommendation.

**Background:** Katayama did not have prototype methodologies, roll forming simulation software, or connections for AHSS material samples available to us. This forced the team to network with several different roll forming companies for recommendations since it is a niche industry. Our networking led to a relationship with Data M for their software, COPRA, that has roll forming simulation and FEA capabilities. We also formed a valuable relationship with Roll Form Solutions. Their team assisted with roller die designs and made an Ardcore roll form mill available to us free of charge for any prototype testing needs. For material samples, we worked with Cleveland Cliffs. They were able to provide numerous samples of AHSS free of charge.

**Business Case:** Katayama plans to use the results from the project to make a case if they should manufacture with AHSS on a full production scale.

**Key Specifications:**

**Material:** The material grades chosen must be AHSS, have a tensile strength of at least 780 MPa, and reach the minimum bend radii possible.

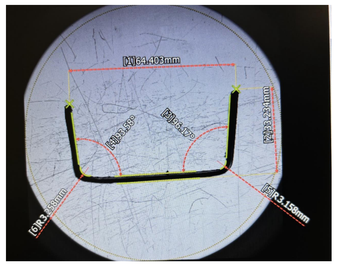
**Prototype:** Chosen AHSS must be formed into a U-channel with the provided dimensions, and accept the blank size required.

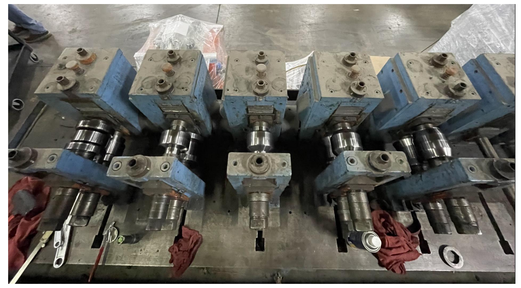
**Simulation:** The part must be overbent properly to meet given dimensions and follow a set bend progression of the specimen with a flower diagram.

**Research Results:** The three AHSS that were best suited for a U-channel based on its mechanical properties, required specifications, and sample availability were Martensite 1500 and CR980 (Cold Rolled 980).

**Prototype Results:** We ran several samples of Martensite 1500 and CR980 through a 5-pass prototype deign. The set up and results from the test are shown below and to the right.

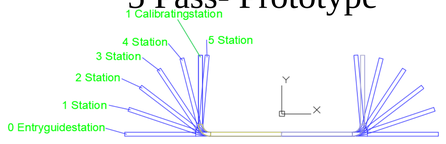
| Grade | Thickness (mm) |
|---|---|
| **M1500** | 1.60 |
| **CR980** | 1.50 |
| **CR980** | 1.20 |



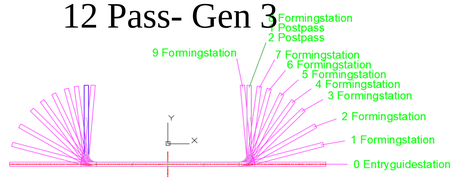



**Simulation Results:** Using COPRA FEA, and the results from our prototype, the team was able to create a simulated production model for the AHSS grades we studied. The gen 3 grades came out to be a 12-pass line, and the martensite a 16-pass set up. The flower diagram for each simulation completed are shown below.

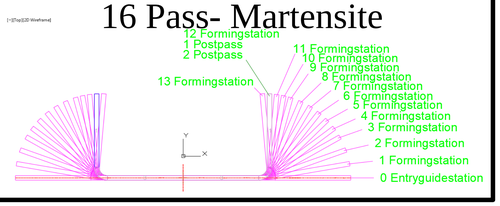
5 Pass- Prototype




12 Pass- Gen 3




16 Pass- Martensite




**Material Testing Results:** The Martensite 1500 and 3rd generation AHSS went through several rounds of testing. Pre-formed tests included: tensile, hardness, and spring back testing. After forming, tensile and hardness tests were repeated. To evaluate the physical structure of the material, dye penetrant was used to reveal any material cracking. The difference in the properties before and after forming for the gen 3 grades was negligible. Each of the materials were roll formed without the formation of micro-cracks.

Material Portfolio

| | CR980 1.2mm (Gen 3 AHSS) | CR980 1.5mm (Gen 3 AHSS) | MS1500 1.6mm (Gen 1 AHSS) |
|---|---|---|---|
| **Yield Strength, MPa (0.2% Offset)** | 716 | 749 | 1419 |
| **Tensile Strength, MPa** | 1080 | 1040 | 1597 |
| **% Elongation** | 23% | 14% | 11% |