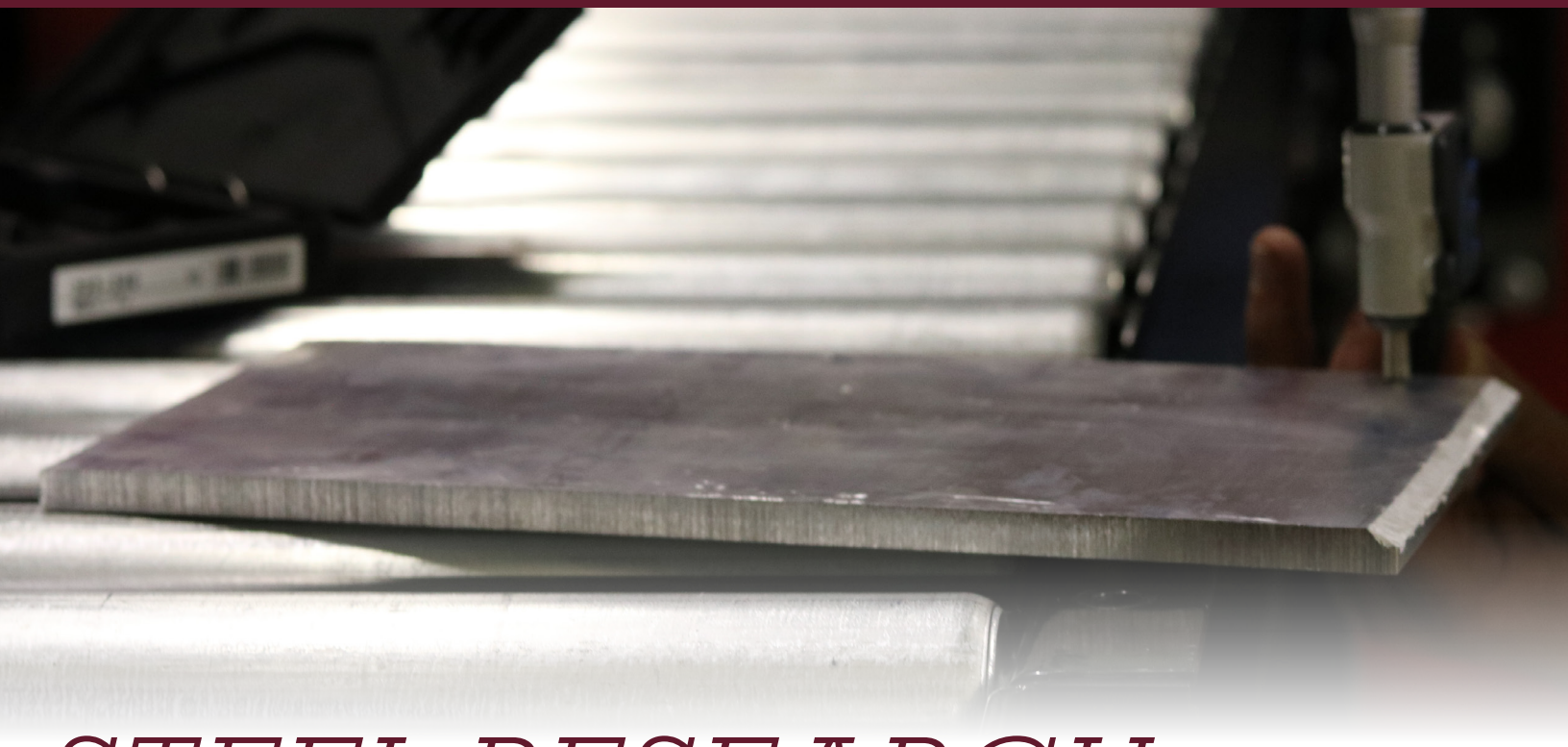
MISSISSIPPI STATE UNIVERSITY™
CENTER FOR ADVANCED
VEHICULAR SYSTEMS



STEEL RESEARCH

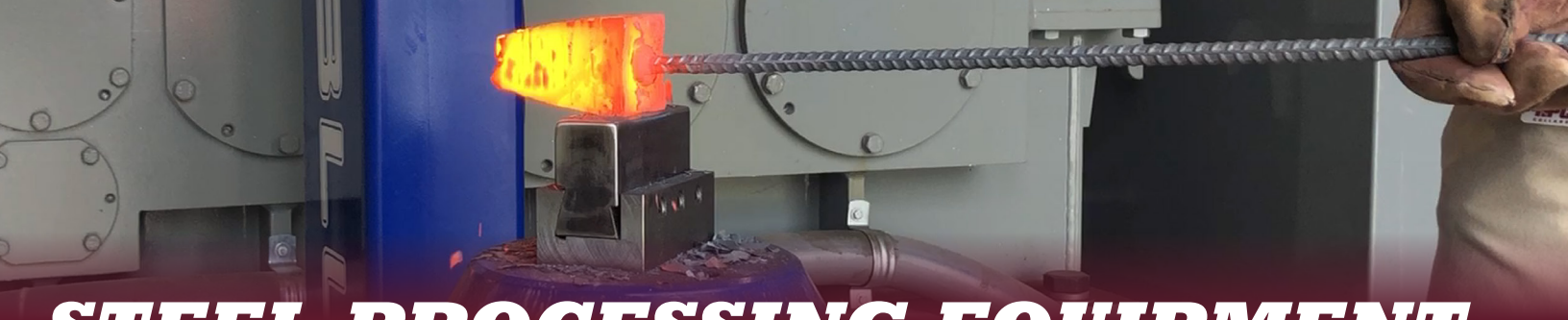
ABOUT STEEL RESEARCH AT CAVS

CAVS research includes the development of various steel grades, including structural steels and automotive advanced high-strength steels, as well as models to understand and predict properties and performance. A well-equipped steel manufacturing facility, located in the Edwards Building on the MSU campus, allows for casting, rolling, and forging of custom alloys to mimic commercial production on a small scale.

EDWARDS BUILDING

CAVS and MSU's Michael W. Hall School of Mechanical Engineering recently renovated the Edwards Building on the MSU campus, which houses a small-scale steel manufacturing facility. Originally built in the 1960s for nuclear engineering research, the space is now equipped for the design and prototyping of steel alloys and processing techniques, bridging the gap between research labs producing a few ounces of steel and industrial steel production facilities.

From melting and casting to rolling and forging downstream processes, the Edwards facilities enable MSU researchers to advance steel development in areas relevant to both industrial and government sectors. Precise impurity control through vacuum induction melting provides an ideal environment for alloy design. Subsequent thermomechanical processing can be carried out through controlled hot and cold rolling or by forging schedules, making CAVS capabilities relevant to a variety of industries.



STEEL PROCESSING EQUIPMENT

MELTING AND CASTING

Our 50-lb vacuum induction melt furnace enables production of highly precise alloys. For a typical melt, raw materials are loaded into a crucible and melted at ~1600°C, with pouring temperatures dependent on the specific alloy being cast. Once melted and mixed, various molds (rectangular book molds as well as custom designs) are used to cast ingots for further processing.

HEAT TREATMENT

CAVS facilities can conduct laboratory-scale heat treatment of metal alloys, which is a crucial part of material development. Equipment includes reheat and muffle furnaces with a temperature range of up to 1500°C and volume up to 15×15×20 inches.

HOT- AND COLD-WORKING

A reversible rolling mill enables CAVS researchers to hot and cold roll various metal alloys using up to 850,000 pounds of roll separation force. Combining 2-high and 4-high setups, the mill allows for hot rolling of ingots from 3-inch thickness down to 0.15 inches and cold rolling of plates down to 0.055 inches. A pneumatic power hammer and a 50-ton hydraulic press are also available for forging of various-sized workpieces.

GLEEBLE

CAVS' Gleeble thermomechanical simulator provides an additional route for steel processing design and application. Capable of closed-loop physical simulation and testing, the Gleeble enables precise thermal and deformation schedules to be applied to various sample geometries with complete independent control of temperature, deformation, and deformation rate under vacuum or controlled atmospheres.

DEVELOPING THE NEXT GENERATION OF HIGH STRENGTH STEELS

The steel research team at CAVS leverages multi-scale modeling, testing, and characterization capabilities to develop 3rd-generation advanced high-strength steels. These steels show a combination of strength and ductility higher than those of the 1st-generation steels, but without the prohibitive cost associated with manufacturing 2nd-generation steels, such as TWIP and fully austenitic stainless steels.

CAVS steel research teams work closely with steelmaking partners by using integrated computational materials engineering (ICME) methods to explore novel metallurgical effects at lower length scales. Findings can be explored in the laboratory and then upscaled to obtain innovative steel manufacturing methods that are cost-effective, reliable, and can be integrated in current steel plant infrastructures.

WWW.CAVS.MSSTATE.EDU

FOR MORE INFORMATION ON STEEL RESEARCH AT CAVS, CONTACT DR. HONGJOO RHEE, ASSOCIATE DIRECTOR FOR ENGINEERING MECHANICS AND MATERIALS SCIENCE.

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