

Grant Recipient Report

Steel Curriculum Development Grant

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Virginia Tech currently provides students with a basic understanding of steel and steelmaking and is currently expanding its curriculum to include an Introduction to the Steel Industry lecture class for freshman and sophomore undergraduate students and an Advanced Steel Making and Heat Treatment lecture plus laboratory class for junior and senior undergraduate students.

The Materials Science and Engineering (MSE) Department at Virginia Tech (VT) has a strong commitment to the metalcasting industry, has developed a significant steel industry focus and wants to grow its relationship with the steel industry. As pointed out by the AIST International Steel Academy, “Today’s steel industry is teeming with innovation and advanced technology. Many of the breakthroughs are the result of experienced personnel who have merged hard work with efficiency and opportunity. Young professionals, devoid of the industry experience beneficial to developing new technologies, must rely on the steelmaking curriculum from academic institutions, which in recent years has waned.” This goal of this proposal is to help address the lack of academic institution training.

Over the past 10 years, the MSE Department at Virginia Tech has had over 30 undergraduate students participate in summer internships or co-ops at steel mills and many of these students accepted full-time employment at steel mills and primary metal producers. In general, VT students have been well received by the steel industry. Many VT students have received AIST Steel Intern scholarships and AIST Southeast Member Chapter scholarships. VT undergraduate students were awarded 1st place in the AISTech undergraduate student project presentation competition in 2022 and 2023.

Virginia Tech would like to significantly increase the number of students considering careers in the steel industry by offering an Introduction to the Steel Industry lecture class for engineering and nonengineering freshman and sophomore undergraduate students. This class will target students that do not have a metallurgy background. This class will provide a somewhat nontechnical introduction to the steel industry with the hopes of generating student interest in pursuing careers in the steel industry. A visit to a steel mill will be included in this class; Nucor Steel–Hertford County, Gerdau Long Steel North America Petersburg Mill and Steel Dynamics Inc. – Roanoke Bar Division have all agreed to host student tours.

The Kroehling Advanced Materials Foundry at Virginia Tech is one of the few university foundries that is capable of producing steel alloys. The foundry at Virginia Tech has induction melting capability, vacuum/inert atmosphere, arc button melting capability and an iron-melting cupola. Molding capability includes green sand, chemically bonded sand and investment. The foundry also has a propane forge, a spectrometer calibrated for steel and steel alloys, three heat treatment furnaces (including a 1,700°C, controlled-atmosphere furnace recently donated by Nucor Steel–Hertford County, grit blast equipment, metallography equipment, metallurgical microscopes, Brinell hardness equipment, and a state-of-the-art dust and fume collection system. The Virginia Tech foundry routinely produces plain carbon steels, alloy steels, tool steels and stainless steels. The proposed Advanced Steel Making and Heat Treatment lecture plus laboratory class for junior and senior undergraduate students will provide students the opportunity to make steel alloys and evaluate the material produced. Student-produced steel alloys and commercially purchased steel will be heat treated (spheroidized, annealed, normalized, quenched and tempered, etc.) and the structure and properties of the heat-treated steels will be evaluated. This will provide the students with (1) a basic understanding of steel melting, molten steel handling and steel casting and (2) an understanding of steel heat treatment, the effect of heat treatment on microstructure, and the relationship between microstructure and mechanical properties. A visit to a steel mill and/or heat treat shop will also be included in this class. Virginia Tech encourages interdisciplinary teaching and collaboration.

The existing MSE Metals and Alloys elective class, which devotes 6 weeks to steelmaking and steel heat treating, is often taken by mechanical engineering, industrial and systems engineering, and civil and environmental engineering students. Virginia Tech takes a hands-on, engaging approach to education and the on-campus foundry allows the students to perform melting and casting. ♦