VT FIRE – Reigniting the Casting Industry

by LeeAnn Ellis

The Department of Materials Science and Engineering teamed up with other departments and with members of the metal casting industry in an exciting endeavor to establish a world-class research and teaching foundry at Virginia Tech. The Virginia Tech Foundry Institute for Research and Education (VT FIRE) supports a growing interest in foundry science and the metal casting industry. Locating the foundry on the Virginia Tech campus offers an excellent teaching facility for our students and for the American Foundry Society's (AFS) Piedmont region.[1] VT FIRE was designed with an emphasis on green engineering and industry best practices. This institute serves as a greenhouse for new technologies, for the transfer of technology from research to production, and for developing methodologies for converting non-cast components to casting processes.

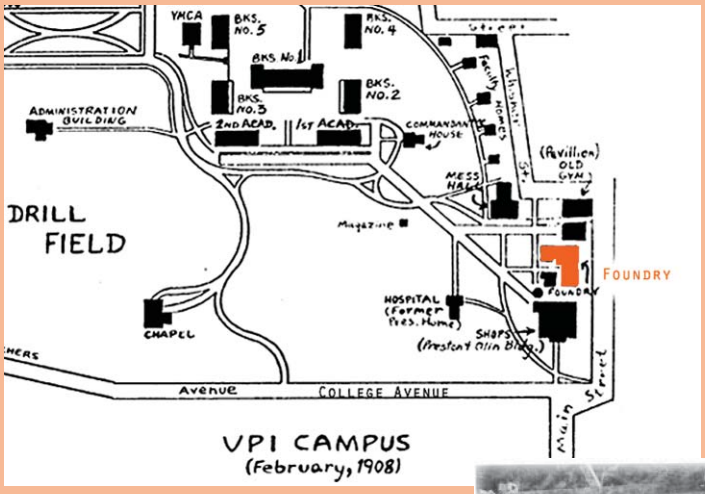
Metal casting in America dates back to 1642, making it among the earliest industries in this country, according to historical information on the AFS website.

The process of metal casting involves melting metal and pouring it into a mold to create a component or a usable good. Over 90% of manufactured goods and capital equipment require castings as components or for use in the manufacturing process. Quoting from the AFS website, "… in 2008, more than 12 million tons of castings in the U.S. were valued at more than $31.5 billion. The U.S. is the world's second largest producer of castings (China is first)…." Furthermore, metal castings feature heavily in products for automotive applications and construction, for internal combustion engines, pumps, and compressors just to name a few, and they are essential to all sectors of the U.S. military.[2] Castings are also found in advanced technology products such as jet engine turbine blades. Locally, on our own college campus, MSE Professor Bill Reynolds stated, "A foundry is something that would have broad use." He pointed out that the MSE department often receives requests from Virginia Tech student design teams who need various parts and components cast. Students in the College of Architecture and Urban Studies, the School of Visual Arts, and in the Industrial Design Program will also be able to make use of the foundry.

The Piedmont Chapter of the AFS has been instrumental in this initiative to establish a teaching foundry on the Virginia Tech campus. "The only way our industry is going to survive is to attract young engineers who will come up with innovative manufacturing techniques to

Did you know...

Once upon a time there was a foundry at Virginia Tech. Early in this university's history, when agriculture and mechanical arts were the focus, a foundry/forge was built in 1882, located just behind the main building on the campus of what was then the Virginia Agricultural and Mechanical College (VAMC). It is interesting to note where these first buildings were located. Back in the late 1800s, if you stood at the intersection of College Avenue and Main Street, you would be standing at the entrance to VAMC, and Preston and Olin Hall would be in front of you. If you walked around the building, you would find the foundry and other shop buildings.[1]



[1]*Tech Triumph: A Pictorial History of Virginia Tech*, Thomas C. Tillar, Jr., ed., Blacksburg, Va., Virginia Tech Alumni Association, 1984. Many thanks to Bruce Ferguson for sharing valuable insight on this historical foundry, and for sharing his copy of *Tech Triumph*. Mr. Ferguson is the Associate Director for Planning, University Planning, Design, and Construction Services at Virginia Tech.

compete with overseas sources," states MSE alum and AFS member, Paul Huffman, who played a major role in raising awareness and igniting enthusiasm for this initiative.

Whittemore Hall houses a small casting facility, where hundreds of engineering students participate in required manufacturing lab courses involving welding and casting, among other manufacturing processes. This facility is limited to pouring small quantities of aluminum in a strictly educational environment. "The difference between a real foundry," states Bill Reynolds, "and what we have had so far is that a real foundry has furnaces designed and optimized to melt a wide variety of metals, has a place to make molds, and has a way to break out molds at the end. A foundry incorporates all of the steps in the casting process under one roof. We have never had this capability."

Soon after returning to the MSE department in 2008, Professor Robert Hendricks joined the VT FIRE effort. He brainstormed new ways to raise funds, discovered partners to donate equipment, and created a senior design team who devoted an entire year to exploring equipment needs, researching engineering requirements, and designing a floor plan. They worked with Paul Huffman to determine necessary equipment, and they worked with architect, Derek Cundiff, who incorporated their floor plan into the final 4500 sq. ft. building design.[3] "They did a very good job," Professor Hendricks said. "They laid out the foundry; that was their task."

In support of VT FIRE, three engineering departments developed a minor in foundry engineering, and to that end, Professor Reynolds (MSE) reintroduced a metal casting course in 2009, something that had not been taught for about five years. Professor Reynolds taught this as a metallurgy of casting course, addressing the theory behind casting, and he described it as a problem-based learning course where the students worked as a group to solve a series of problems. "All of the learning is from the bottom up," Reynolds explained. "They are seeking information rather than having it provided." Students worked collaboratively in teams, without competition, and they worked well together. Some of the problems the class tackled involved reducing coring and macro segregation in a specialty nickel alloy and designing a gating system for a submarine propeller.

The second course for the new minor was introduced in 2010 and focused on solidification modeling under the direction of Professor Hendricks (MSE). Students in this course receive hands-on experience with ProCAST, a professional industrial modeling environment for casting. A third course in rapid prototyping is taught by Professor Chris Williams in the Department of Mechanical Engineering. In addition, Professor Bob Sturges in the Department of Industrial and Systems Engineering developed a course in manufacturing operations for the metal casting industry.

There has been a lot of interest and support for VT FIRE not only from the university but also from industry. Precision Castparts Corp. (PCC) donated time and financial support for the development of the foundry. "We are excited about the foundry," said Jack Hyzak, the director of Corporate Technical Development for PCC. One of PCC's primary competencies is casting, and they hope to foster interest among students in metals research. "Hands-on experiences are the best education," Hyzak stated. "This lab will be a great step in that direction. It will aid not only graduate students, but just as importantly, undergraduate students."

MSE alum and advisory board member, John Kroehling and his wife, Joan, made a substantial donation toward the building. Other key donors for VT FIRE include the AFS Piedmont Chapter; industry support, lead by PCC and ETA Engineering Inc.; the College of Engineering, including the Departments of MSE, ISE, ME, and Engineering Education; the College of Architecture, including the School of Visual Arts and the Industrial Design Program. Together, this group committed $1.6 million to this project in funds, equipment, and design work.

The vision of reigniting metal casting at Virginia Tech became a reality when construction began in March 2010. The Kroehling Advanced Materials Foundry opened its doors to students in January 2011 with Professor Alan Druschitz as the new VT FIRE and foundry director. In addition to undergraduate courses, the foundry hosts tours, workshops, and demonstrations throughout the year.

[1]*VT FIRE: Conclusions and Recommendations*, by Mark Briguglio, Anne Coppa, Tobin Gibert, MSE Senior Design Project, Virginia Tech, May 2009.

[2]American Foundry Society website: http://www.afsinc.org/content/view/62/122

[3]*VT FIRE: Conclusions and Recommendations*.

[4] Historical Photos and Map: Col. Harry Temple Collection, Ms88-039, t12-012, ht489, t102. Digital Library and Archives, University Libraries, Virginia Tech. VT ImageBase (http://imagebase.lib.vt.edu/), housed and operated by Digital Imaging, Learning Technologies, Virginia Tech.

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