The course Building Materials is taught based on the belief that students learn best if they are introduced to major building materials through multiple media and contexts, both inside and outside the lecture hall. ARCH 2044 Building Materials, required for every student majoring in architecture, introduces sophomore students to the physical attributes of basic building materials. Knowledge that the students gain through this course is applied to their projects in design studios, a series of labs at the core of every student’s five years of education toward a professional degree in architecture.

Major materials covered in the course include concrete, stone, brick masonry, glass, steel, wood, fabric, plastic, and composite materials. For each one, I present the physical properties of the material, ways in which it came to be used for building construction historically, and current developments to enhance or vary its physical properties. I couple the lectures with a hands-on experimentation project in teams, a visit to a local production plant, and/or a presentation by an expert within the local community.

Learning through Tactility

The combination of learning both through experience and through books and lectures is not unlike the goals of the German modernist design school, Bauhaus. Johannes Itten, one of its core teachers, aimed to develop his students’ design abilities through “subjective experience and objective rationale” (Wick, 2000, p. 124). Another Bauhaus teacher and designer, Lazlo Moholy-Nagy, also advocated for educating designers about materials by means of tactile exercises. In modern times, in which vision dominates all other senses, he saw a place in education to teach through tactility, which remains a valuable means for education today.

When learning about concrete in Building Materials, students were asked to work in teams of three or four to construct a concrete wall that allows light to pass through. Some walls were monolithic with cast apertures, while others were aggregates of multiple units. Grading was based on the following elements:
1. Design: Is the wall stable while allowing light to pass? How well do the modules stack or interlock with each other? Does it challenge the properties of concrete?

2. Execution: How well are the mold and the casts made? Does the wall hold its shape without falling or breaking apart?

3. Diligence: Did the team produce multiple iterations and improve upon the weakness of the previous? Did the team allow enough time to work out the design and technical challenges?

4. Quality of photographs and drawings: How well do the photographs capture transmission of light? Did the team use the drawings not only as a representation, but also as a visualization tool?

5. Site management: How well did the team maintain the “job site” both inside and outside the building? Did the team members put names on their molds and take accountability for keeping a job site that respected their fellow teams and the facilities?

Teamwork is an essential component of this exercise. The scope of work and the allowed time were set up so that the amount of labor would necessitate teamwork and would be neither feasible nor sensible for one person to complete alone.

Each team’s work in progress was reviewed two weeks into the project. I reviewed the progress with each team, and the students were expected to make improvements for the final presentation one week later. The walls from 15 teams were presented on Burchard Plaza and were exhibited outside for another week, which gave the members of the architecture and design community an opportunity to critique their peers’ work and learn from them.

At the completion of the project, the students were asked to respond to these inquiries in a reflective worksheet: How does their wall demonstrate an understanding of concrete’s physical attributes, and what aspects of concrete were revealed to them in executing this project? Some reflected on their discovery of how fragile unreinforced concrete is and how hot concrete gets while curing, and many described the manners in which concrete took on the shape and textures of the mold, from the texture of the tape that lined the mold to the wood grain. These physical qualities of building materials are abstract when read in textbooks, but our bodies remember these qualities through our senses. From this relatively quick project, the students gained a renewed appreciation for the exquisite surfaces of concrete walls by Pritzker Prize laureate Tadao Ando or the exposed texture of rough-wood formwork in Le Corbusier’s buildings.

**Using Distance Learning Technologies**

Technology used for distance learning makes it possible for us to tap into remote, highly valuable resources that are not available to our students otherwise. When teaching about metal, I organized a video conference with TriPyramid Structures in Massachusetts. TriPyramid is a specialized metal fabrication shop with expertise in metallurgy, mechanical engineering, and digital fabrication. The shop applied its knowledge of fabricating metal fittings for racing sailboats to architecture decades ago when glass fittings for I.M. Pei’s glass pyramid at the Louvre were fabricated and, more recently, pristine metal components for Apple Stores worldwide.

During a 50-minute video conference, we passed around metal component samples from TriPyramid’s projects, while Jeff Anderson, an architect and...
project manager from the shop, discussed what metals are used for which applications and why they are selected. Virginia Tech’s Video Broadcasting Services set up the interactive video conference in a classroom equipped for distance learning. Equipment was arranged so that Anderson and the class could navigate TriPyramid’s website on a large screen, he could see our classroom simultaneously, and the students could converse with him from their desks. Video conferencing technology allows us access to exceptional resources in ways that would otherwise not be possible.

Using Local Resources to Learn about Global Context of Materials

Facts and figures of building materials are best understood, retained, and applied if they are presented in the larger context of their production. As MIT architecture professor Sheila Kennedy says in her book *KVA: Material Misuse*, “To be interested in materials is to ask questions about the nature of the real in contemporary culture, in all its complex and contradictory dimensions” (p. X). The contexts under which building materials develop and evolve can affect physical prosperities and, as a result, spatial qualities of a building. For example, as the students saw by visiting Old Virginia Brick, bricks fired with gas have different coloration from those fired with coal. As factories switch from using coal to gas in response to environmental concerns, the difference in energy source results in changes to the color, production time, and energy consumption.

Another resource I have used every year is Virginia Tech’s own Hokie Stone quarry just behind a residential neighborhood 10 minutes from campus. Having seen Hokie Stone, a dolomite limestone, extracted from the earth, sawn with a diamond-tipped blade, cut to smaller pieces with a hydraulic cutter, and finally packaged onto wood pallets ready to be trucked to construction sites on campus, the students learn to connect the building materials they see on campus to the materials’ natural source. They try lifting blocks of stone and feel how heavy they are, and they might remember to
question whether it makes sense to import heavy, exotic stones from foreign countries the next time they have an opportunity to specify stones in an architecture office.

Such contextual information is presented in this course to give students a deeper understanding of how building materials are extracted, how they develop and change over time, and how we might make informed decisions in application of materials.

References


(far left) Aki Ashida teaches class. (top and left) Students outside Burchard Hall exhibit concrete walls. (above) Students learn about a local quarry.