Iowa State University
College of Engineering
Lab Tour Script

Fall 2015

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Howe Hall

Pre-Tour Activity & Demos – First floor, main entrance

Students from Material Advantage may be doing demonstrations in the lobby of Howe Hall as guests are gathering for the tours. They should stop their demos at ten minutes after the hour so that the tours can begin. We are not able to include Materials Engineering Labs on these tours, so the group is there to help represent the department.

Make sure to hand out safety glasses to guests. These will need to be collected after the tour ends.

Introductions:

- Name
- Major
- Hometown
- Fun Fact (if you want)

Welcome to the College of Engineering at Iowa State University. We currently have twelve different majors that reside in eight different engineering departments. During this tour, we will be walking through a variety of lab spaces. We ask that you please make sure that your safety glasses are on when entering lab spaces. Does anyone have any questions before we begin?

We are currently in Howe Hall. Engineering Student Services is one of the areas on the second floor of this building. This area includes services such as engineering international programs, scholarships, classification, recruitment, and undeclared engineering academic advising.

Make to Innovate (M:2:I) – Ground floor

0618 & 0620 Howe Hall

[If class is in session, have guests just look into 0618 – do not interrupt the class. Take the guests into 0620 near the 3D printers to talk].

Although based in aerospace engineering, the Make to Innovate or M:2:I program is a multidisciplinary program designed to give students hands on experience in engineering. Projects range from underwater to space and everything in between and involve students from nearly every engineering program on campus. Students working in the M:2:I lab have created a Mars Rover, built an autonomous boat. They fly payloads to over 100,000 feet, and are preparing to launch a small satellite into space in 2016.

The aerospace engineering department teaches a course in the lab that we just went through for first-year aerospace engineering students. Students use MATLAB to do engineering programming and problem solving for projects like making a lighter than air vehicle. This course also includes guest lectures – for example Clayton Anderson, former astronaut and current faculty member was a recent guest.

The 0620 lab is a workspace that M:2:I students can use for the design and fabrication of their projects It also features a rapid prototyping area with printers that can print moving parts as well a printer that can print with two materials at one time to create a 3D object. [Can show examples if there is time].

Exit through main entrance on first floor of Howe
Black Engineering

Walk the guests into the doors on the North side of Black, between Hoover and Black.

1070 Black

Stop outside the door and talk about 1070. You can then have one guide “snake” the line in a tight loop into the lab and then back out again.

Mechanical and Industrial engineering courses use this lab. There is equipment for a metrology lab, plastic welding, robotic welding, casting, as well as the measurement of parts. The main materials used are 6061 aluminum and 1018 steel.

Students can also do:

- Plastic Injection Molding
- Metal Forming
- Manual Machining

1072 Black

Talk about 1072 Black in the Hallway. Tell the guests that the next two labs are connected. As the guests follow through the lab (single file), ask them to be silent if class is in session.

There are 16 computers with dual monitors. Some of the main software programs used in this lab include:

- AutoDesk Suite (AutoCAD, Inventor, Mechanical Simulation)
- SolidWorks
- MasterCam
- MasterCam for SolidWorks
- Magmasoft

*A complete list of software programs used in 1072 Black is on the last page of this script, in case anyone has questions.

1076 Black

You can talk about 1076 Black inside this room. If it appears that there is a class using the space, take the group back out to the hallway to talk.

This part of the lab features four computer numerical control—or CNC—machines that were brand new in 2012.

Students first develop the tool path and generate the code in the computer classroom. They then use the simulator to test the code, and then make the actual parts with the CNC machines. One of the class projects is to make a pen/pencil holder. [There should be a sample you can show].

Exit Black by retracing your steps to the North door.
Hoover Hall

Enter Hoover Hall through the middle South doors, between Hoover and Black. If anyone is not able to take steps, a secondary guide can take them to the ramp, and then have them meet back up with the group inside.

Caterpillar Lab Talk in the hallway.

Design is a major component of mechanical engineering education at Iowa State University. At least four mechanical engineering courses focus on a semester-long design project in which students apply their knowledge of engineering science to real problems.

The first few weeks of class is teaching the theories and processes of designing in which the teams conceptualize their designs utilizing the computers that have been integrating into their work benches. The students will then start the hands-on portion of the design class where they build what they've designed.

Students will take pieces they have worked on in the fabrication area (which we will see next), and use this area for testing and assembly. The students gain access to the hand tools and testing equipment kept in the Grainger cabinets after the students have passed the required safety modules online. Testing equipment ranges from simple spring scales to a variety of highly accurate computer integrated load cells. So you could measure the power generated by peddling a bicycle-operated battery charger, and then in turn be able to charge a cell phone.

Measuring Tools:

- Force Gauges
- Volt Meters
- Tension and Compression Load Cells are hooked up to a computer to measure forces. For example, you could attach them to a handle of a bucket that goes down into a 30 foot well to measure the amount of force it takes to pump the water out.
- Spring Scales measure how much force is needed to pull something. You could determine if the tool you created to be used in a third world country would require a burly man to pull on the tool, or if a small woman, who would actually need to use the tool, would be able to maneuver it.
Hoover Hall

Boyd Lab (FABRICATION LAB)

*Walk through the northwest corridor and back around to the Boyd Lab window with all of the projects. Talk in the hallway by the Boyd Lab window.*

Equipment is used for:
- Woodworking
- Metalworking
  - Including manual mills, lathes, and a welding shop

Boyd Lab supports classes and any ISU related projects, as long as they are not personal:
- Sophomore Design Course
  - ME 270 projects aim to support economic activity in developing regions.
- Senior Design Courses
  - ME 415 projects are industrial-sponsored projects giving students a hands-on experience solving applied industrial problems.
  - ME 466 projects connect multi-disciplines such as mechanical, electrical and aerospace engineers in the solution of a single design problem (a lot of times Industrial Design is involved too with some of the projects in this class in the past).

Examples in the Window:
- Solar car and Baja car teams often make parts for their vehicles in this lab—they will first CAD a part and then use one of the 3D Printers to make a rapid prototype. After proving concept with the plastic part they will then use the CNC Mill to make the final part using aluminum.
- A Peanut Sheller designed for a village in Africa that uses peanuts as its cash crop
- A simple machine that condenses a paper and wood slurry down into a coal that burns hotter than the raw materials in their original states
- Peanut butter maker. Previously, the women in this particular African village were using a mortar and pestle to grind the nuts into butter.
- Electricity Hand Crank

Materials Science Engineering Teaching Labs

You may have noticed the students from the Materials Advantage student organization doing demonstrations. The teaching laboratories in the materials science and engineering department in Hoover Hall are equipped to support a breadth of materials engineering investigations and projects. High-tech ceramics, metal alloys, and polymeric/plastic materials can be examined using techniques such as electron microscopy, optical microscopy, x-ray diffraction, thermal analysis, and spectroscopic analysis.

Students get hands-on experience with these devices and learn to develop protocols to evaluate how practical materials are as well as to assess the design of new materials for use in industries including manufacturing, automotive, and aerospace. A recent senior capstone design project, for example, evaluated a new generation of lead-free electronic solder materials for their resistance to corrosion.

*Exit Hoover through the main North doors, towards the water tower*
Coover Hall

Enter Coover through East doors and briefly mention CYRIS (the multi-touch display in the entrance that students get to program apps for). Walk through Coover and stop inside the TLA space. If it is being used heavily, talk outside the room, but still walk through.

Transformative Learning Area (TLA)

The Transformative Learning Area is a collaborative learning space designed with functionality in mind. In addition to banks of PCs and Macs, students have access to state-of-the-art lab equipment. For example, to test circuits, there are digital multimeters, oscilloscopes, signal generators, and power supplies. This space is also designed to be adaptive to future changes in curriculum and trends in electrical and computer engineering.

The arcade and pinball machines in the back are former senior design projects – designed and built by student teams.

Civil, Construction, and Environmental Engineering Labs

[Talk outside of Coover while pointing to Town or inside the West Coover entrance in bad weather]

The teaching and research labs in civil, construction, and environmental engineering demonstrate the department’s commitment to hands-on, practical education and research. Students and faculty use the labs to test the strength of bridges and beams, develop new materials, and find out the chemical makeup of by-products.

One example is the Joseph C. and Elizabeth A. Anderlik Teaching Laboratory. About 200 undergraduate and graduate students use this space each year. Every civil engineering undergraduate student is required to take a beginning environmental engineering course in the lab. It also houses several classes for students studying environmental engineering.

The lab has specialized equipment to analyze air, water, and wastewater. This equipment shows students current analytical methods for recognizing and solving environmental problems.

The department also has several computer labs, as well as space for research in design, geotechnical engineering, structural engineering, and transportation engineering.

The Civil & Construction Engineering department also works closely with the Iowa State University Institute for Transportation in identifying research, education and other collaborative opportunities in Iowa’s transportation infrastructure. Known as “InTrans,” this institute is based in the Iowa State University Research Park off Airport Road in Ames.

Exit Coover through the West doors and cross street using the cross walk.
Sweeney Hall

If you have extra time, you can do the Sweeney stop. Because we probably won’t have extra time, you can just point out that Sweeney is the home of Chemical Engineering before entering your next building.

Herbert L. Stiles Undergraduate Teaching Laboratory
Room 1053/2053/2059 Sweeney Hall

This is the Unit Operations Laboratory also known as the Herbert L. Stiles Undergraduate Teaching Laboratory. All undergraduate chemical engineering students are required to take two laboratory courses, which are held in here. As juniors, they do experiments that apply the concepts taught in the fluid mechanics, heat transfer, thermodynamics, and kinetics courses. As seniors, they do experiments that are more complicated, and include topics studied in the mass transfer, separations, reaction engineering, and process control courses.

The courses emphasize applying theoretical concepts learned in the classroom to real process equipment, and understanding of process safety and hazard identification. Many of the measurement devices are from the same manufacturers who supply power plants, oil refineries, paper mills, grain milling plants, and many other processing facilities.

One of the more complicated experiments conducted in this laboratory involves the distillation process. The equipment involved (seen in the background – in the southwest corner of 1053) has two separate components - the distillation column and the control system. The control system is used to monitor and control the column, and it is the same system used in many industrial facilities. The standard, pilot-sized column is the same as one seen in a refinery or chemical plant. Often, universities have a bench-sized column or don’t grant undergraduates access to the equipment. At Iowa State, we want to give our students the most real-world experience we can, so our students work with this equipment and are prepared to handle similar work once they graduate.
**Biorenewables Complex**

*Enter through East doors (main doors) into the Sukup atrium. Do this stop in front of the John Deere Engines lab so guests can look through the windows.*

- **Elings Hall** (south building – pronounced ee-lings). Classrooms and office space for the department of Agricultural and Biosystems Engineering.

- **Sukup Hall** (west building – pronounced soo-cup). Research laboratories, teaching laboratories, student workshops, research workshops, student teaming rooms and student computer labs for the department of Agricultural and Biosystems Engineering.

- **Biorenewable Laboratory** (north building – usually called BRL). Office and laboratory space for the Bioeconomy Institute and the Center for Biorenewable Chemicals. Using biomass (organic material of recent biological origin) for energy, chemicals, and materials.

The three buildings, along with the Sukup Atrium, is called the **Biorenewables Complex**.

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**John Deere Engines Laboratory & Automated Manufacturing Laboratory**

**1219 & 1223 Sukup Hall**

[Look into the two laboratories from the windows facing the atrium.]

DieSEL engines are a critical tool in the world’s economy for improving productivity – in conjunction with other machine systems they are used to haul freight, till fields, move water, harvest crops, and generate electricity around the globe. In this laboratory, students study and learn about diesel engines by disassembling and reassembling the engines. They then design and model an off-road machine utilizing a diesel engine using modern engineering software. In an adjacent lab to this one, students use transmission and engine dynamometers to run tests on the diesel engines to determine engine performance under varying load conditions, using different diesel fuel types, and using a variety of control systems.

The Automated Manufacturing Laboratory contains several large computer numerical control – or CNC – milling machines. CNC machines are common in manufacturing plants around the world. They are used to translate an engineer’s ideas – expressed as a CAD (computer aided design file) – into reality. Just like in industry, students design a part using CAD software and generate a machine code using computer aided manufacturing (CAM) software that will allow the CNC mill to automatically machine the design out of a solid block of material. This process often involves many steps, thousands of lines of code, and multiple tools in order to achieve the final product. Students preparing for careers in manufacturing get hands-on experience using CNC and CAD technology as it applies directly to the production of physical products.

*After this, help families get to their next destination. Make sure to collect the safety glasses!*
**Full List of Software in 1072 Black** [You do not need to go through this list on the tour.]

- Abaqus
- Ansys
- AutoDesk Suite (AutoCAD, Inventor, Mechanical Simulation)
- Chemkin
- Comsol
- CES EduPack
- DFMA (Design for Manufacture and Assembly)
- EES (Engineering Equation Solver)
- FEHT (Finite Elements of Heat Transfer)
- IHT (Interactive Heat Transfer)
- Magmasoft
- Mastercam
- Mastercam for Solidworks
- Mathcad
- Mathematica
- MathType
- Matlab
- Microsoft Office
- Microsoft Visual Studio
- National Instruments LabView
- Polymath
- PTC ProEngineer / Creo
- SolidEdge
- SolidWorks
- Tecplot