

## OUR MISSION

Virginia Tech's Smart Infrastructure Laboratory's (VT-SIL) mission is to **advance education and research** in topics that utilize sensor information in order to improve the design, monitoring and daily operation of civil and mechanical infrastructure as well as to investigate how humans interact with the built environment. The centerpiece of VT-SIL will be a **full-scale living laboratory** in the new Signature Engineering Building (SEB) on the Virginia Tech campus.

In conjunction with the VT College of Engineering, VT-SIL is currently developing and building this living laboratory, where 136 accelerometer mounts (5 axis per mount capability), along with other sensors, are being placed throughout the entire building. Upon completion, the 160,000 sq ft SEB will be the most instrumented building for vibrations in the world. Come to our website and watch the laboratory come to life with regular construction and research updates!

## OPEN TO ALL

VT-SIL intends to make a significant amount of the data from the SEB living laboratory **open source** in order to serve more than just the Virginia Tech community. Additionally, visitors to the building, from young children to established researchers, will have the opportunity to interact with the instrumentation and



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[www.me.vt.edu/vtsil](http://www.me.vt.edu/vtsil)

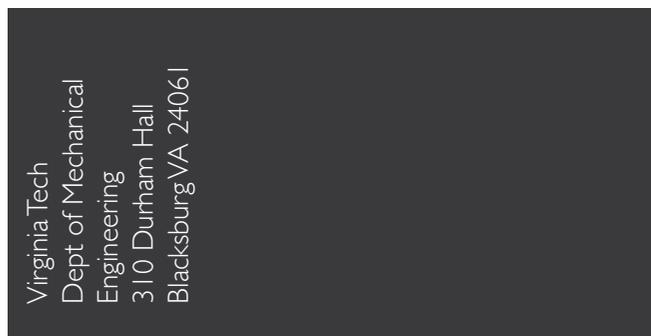
for education,  
research,  
and outreach.



learn about engineering topics, building design and monitoring.

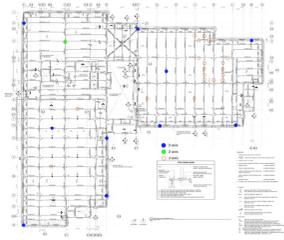
Please **contact us** regarding any collaborative ideas and sponsorship opportunities. Our goal is to create a world-wide community of partners to advance engineering, science and education through Virginia Tech.

[www.me.vt.edu/vtsil](http://www.me.vt.edu/vtsil)



## ABOUT VT-SIL

The new 160,000 sq ft SEB is currently under construction on the Virginia Tech campus. It consists of 5 floors in an "L" shape design, as shown below. The



VT College of Engineering has recognized and seized a unique opportunity to outfit the building with over 200 accelerometers and other sensors (temperature, wind, etc) to study the dynamic response of the

building in real-time and associated applications for the development of smart infrastructure. This test bed enables the study of myriad topics associated with building design and operation from infancy through the useful life of the structure. Topics include structural health monitoring, building occupancy patterns for improving sustainable development, and studies on floor vibrations on human health as well as many other topics showcased throughout the VT-SIL website.

The important and unique aspect of this program is the early instrumentation during the construction phase. This project aims to provide the foundation for a **one-of-a-kind, real world** research tool that allows fundamental research and provides data that will

determining optimized SHM systems. Furthermore, by working hand in hand with the construction company and governmental agencies, new standard practices are being developed. These practices will have a lasting impact on the development and implementation of building instrumentation in the years to come.

Accelerometers have been placed on the structural steel on all floors. By instrumenting a building of this size and magnitude, this system will become a focal point for research in a variety of fields, including:

- Structural Health Monitoring
- Building dynamics
- Digital signal processing
- System identification
- Sensor network design
- Big data analysis



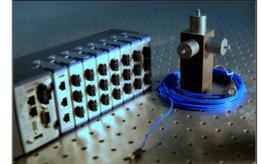
Welded Sensor Mount  
(with 3 accelerometers)

Due to this **unique test bed**, other non-conventional uses of the instrumentation can be explored for the development of smart infrastructure technology. For instance, identifying and tracking movement through human induced seismic vibrations can be used for:

- Building occupancy
- Greener buildings using feedback control
- Security and threat detection

- Computer Science
- Ind & Systems Eng
- School of Visual Arts
- School of Music
- Performing Arts
- Virginia Tech Libraries
- Myers-Lawson School of Construction

In order to accomplish and sustain our goals, the program includes the design and implementation of a modular and expandable instrumentation system. This system can provide continual and synchronized acquisition, streaming, post processing of data from hundreds of sensors, and easy expansion and/or modification of hardware and software as technology advances.



Versatile Data Acquisition System

## EDUCATION

One of the greatest impacts this project will have is in the education of future engineers. The SEB instrumentation program will be utilized extensively in undergraduate and graduate engineering courses at VT – effectively establishing a **real-world living laboratory**. Every year, several hundred VT engineering students will be exposed to the techniques, equipment, and methodologies of real-world engineering practices. These students will go on to their future employers

The Virginia Tech Signature Engineering Building Instrumentation Program:  
Creating a **Real-World, Living Laboratory** for Education, Research, and Outreach

be brought into the classroom by linking real-world problems with education.

## RESEARCH

A direct result of early instrumentation is the refinement of data-driven models. This allows for more accurate damage identification in a SHM system as well as identification of critical sensor locations, which aid in

- Emergency management

These diverse research possibilities have already attracted the participation of numerous companies, who have already made contributions to the effort as well as faculty from multiple departments, within and outside of engineering disciplines. Some multiple disciplines represented by **VT-SIL members include:**

- Mechanical Eng
- Civil & Env Eng

with knowledge and field experience gained through the interaction with this instrumentation project and multidisciplinary environment.

Virginia Tech students will be exposed to topics on design, modeling, and the monitoring of building behavior. The instrumentation program in the SEB will also include demonstrations and monitors for all visitors to the building, with a special focus on K-12 outreach.