Western Engineering Outreach

Floor Plans

Grades 3-5

Meet Today's ENG HERO!

Michael Bartlett - Professor with Western Engineering

Dr. Bartlett is a registered Professional Engineer in 4 provinces and has a PhD in civil engineering from the University of Alberta. His research specializes in structural reliability and rehabilitation of existing structures, especially bridges. He is also involved in the design of new concrete structures as well as updating building code calibration all over Canada. One of his experiments includes the Insurance Research Lab for Better Homes, which tests out simulated extreme weather to examine all aspects of house construction. If you want to learn more about Dr. Bartlett, visit https://www.eng.uwo.ca/civil/faculty/bartlett_m/research.html

Learning Goal:

- Students will learn what a structure is and its ability to maintain stability and strength
- Students will consider how forces play a role in affecting the strength and stability of structures
- Investigate structural stability and all the work that goes into planning a building
- Curriculum Connections: Grade 3 - Strong and Stable Structures and Grade 5: Forces Acting on Structures and Mechanisms

Materials Needed:

- Cardboard
- Straws
- Cups
- Glue and/or Tape
- Construction Paper
- Other building materials
- Access to Home Design 3D app

Engineering and Science Connections:

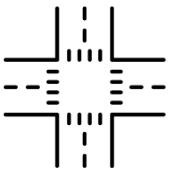
Today we will be talking about structures and infrastructure. We will also be exploring the roles of civil engineers.

Introduction to Civil Engineering

Civil engineering is not all about fancy buildings - it is about maintaining vital infrastructure. When people think of famous civil engineers from the past, they think of Isambard Kingdom Brunel and Joseph Bazalgette, the great engineer of the Victorian age who saved London from cholera by constructing new sewers. Civil engineers have to keep this infrastructure running effectively and adapt it to meet challenges, such as population growth, climate change, and natural disasters.

They must also find ways to deliver the infrastructure needed when there is little money to pay for it. Put simply, civil engineers have to come up with solutions to complex problems and implement them; they literally shape the world people live in.

How Civil Engineers Shape the World



Civil engineers design, build, supervise, operate, and maintain construction projects and systems in the public and private sector, including roads, buildings, airports, tunnels, dams, bridges, and systems for water supply and sewage treatment. Many civil engineers work in design, construction, research, and education.

The duties of a civil engineer may typically include any or all of the following:

- Analyze long-range plans; survey reports, maps, and other data in order to plan projects.
- Consider construction costs, government regulations, potential environmental hazards, and other factors in planning the stages of, and risk analysis for a project.
- Compile and submit permit applications to local, state, and federal agencies, verifying that projects comply with various regulations.
- Test building materials, such as concrete or asphalt for use in particular projects.
- Provide cost estimates for materials, equipment, or labor to determine a project's economic feasibility.
- Use design software to plan and design transportation systems, hydraulic systems, and structures in line with industry and government standards.

- Perform or oversee surveying operations in order to establish reference points, grades, and elevations to guide construction or design.
- Present their findings to the public on topics such as bid proposals, environmental impact statements, or descriptions of projects.
- Manage the repair, maintenance, and replacement of public and private infrastructure.

For all of these tasks, civil engineers must keep in mind the forces that act on all structures.

Forces on Structures

There are forces all around you. They are invisible, but always there. Let's take a look at a few:

- **GRAVITY**: gravity is the force pushing down on all things and keeping them on the earth; it's the "what goes up must come down" theory
- **PUSH/PULL:** the force applied to objects that allow them to move; pulling is easier than pushing because when you push you add downward force that adds to friction; push pull forces act on many things without them moving too
- **FRICTION**: a force affecting the speed of an object; the more friction, the harder it is to move something or the slower it goes
- **TORSION** - a twisting force (the force exerted when you twist an object)

But specifically, there are forces that act on structures, buildings, mechanisms, and machines. These are:

- **TENSION**: the stretching of an object by strings, cables, or a chain
- **COMPRESSION**: a pushing force that "squishes"
- **STRESS**: the internal (inside) pressure acting on a structure
- **TORQUE**: the force that an object creates as it rotates on an axis or a pivot
- **LOAD**: can be the weight of something that works with gravity to decrease structural reliability; too much load can create stress and structural issues

For example, when gravity pushes down on a bridge, it will experience some compression. If that bridge has hanging parts, then it is also under the influence of tension.

Video Recommendation: *What Do Civil Engineers Do?*

https://www.youtube.com/watch?v=cJaRjI7K-Lw

Floor Plans

Before a structure is to be built, it needs to be planned out by the engineers. A floor plan is necessary for every building so that everyone working on the project knows what the final product should look like and are all on the same page every step of the way. This avoids miscommunications and leads to a higher quality final product. Here is an example of a basic house floor plan.

Activity:

Before you start, think about the following questions:

- What do civil engineers need to think about before a house gets built?
- What sort of materials need to be used in order to withstand the force on the structure?

Civil Engineers in Training

There's a new subdivision being built in the London area, but the engineers are swamped and need our help making the floor plans and designs for the last few homes to meet their deadline. Using your building materials, create a floor plan for a house containing the following:

- 1 kitchen
- 2 bathrooms
- 3 bedrooms
- A fenced backyard

Sketch your floor plan on a piece of paper before starting to build. Once your floor plan is completed, use the Home Design 3D app to convert your floor plan to a real house design!

Home Design 3D App: https://apps.apple.com/ca/app/home-design-3d/id1342163391?mt=12 (also available on Google Play)

What Did You Learn?

- Where do you see civil engineering every day?
- What forces need to be taken into account when building?
- How much planning and simulating goes into new buildings? What does this tell you about how many engineers would be involved in a large construction project?
- What other materials would you use to strengthen your building?

Future Learning

- Assign a value to each construction material and set a building budget. Repeat the activity. What needed to change in your design? How does this help better understand the financial constraints faced by civil engineers?
- How do engineers team up and split the work on big projects?

Share your creations!

We would love to see what you made. Email as at discover@uwo.ca or tag us on social media.

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Thanks for discovering with us!