Compression Testing Apparatus

By

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GOAL
Compression Apparatus

- Build a device that can test materials for their resistance to compression
- To provide students with a visual demonstration of how material are tested and selected for building stable bridges.

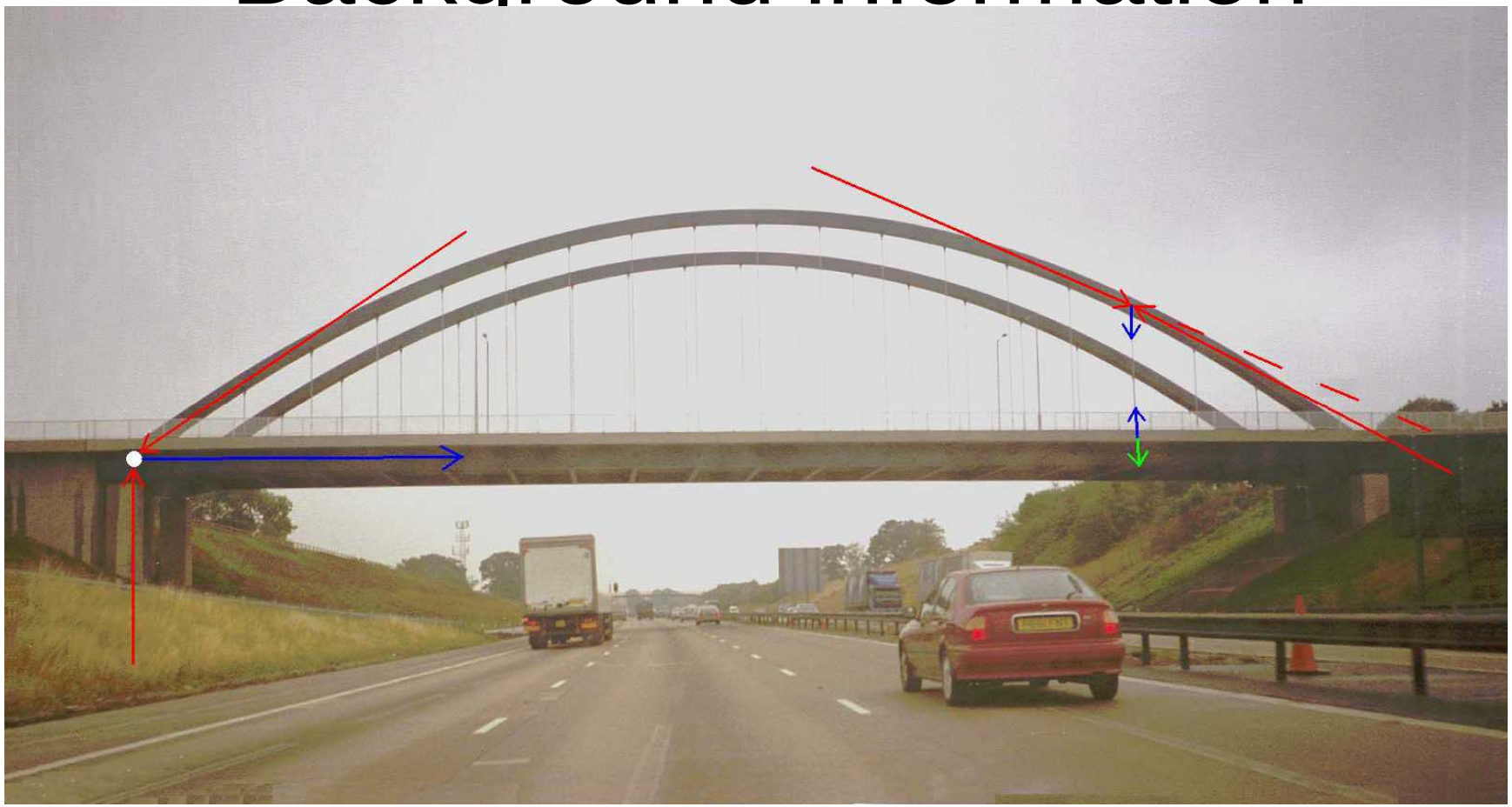
Background information

- When designing and constructing a bridge, engineers have to consider many factors .They need to know which material and structure is best for a stable bridge? Many forces act on a bridge. The two most important ones are :
  - Tension
  - Compression

Compression/Tension

Compression is a force that acts to compress or shorten the object it is acting on it.
Tension is the force that acts to extend or expend the object it is acting on.

Background information



The blue arrows represent tension
The red arrows represent compression
The green arrows represent force of gravity

A bad analysis may have disastrous consequences

Minneapolis, Mississippi Bridge I-35W -- July 2007

materials

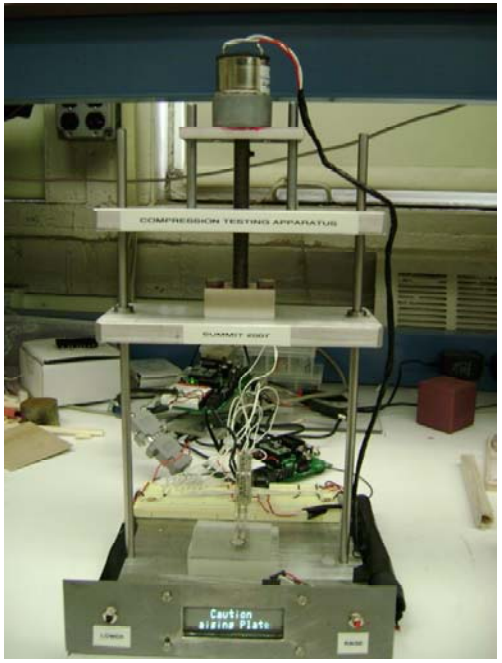
- Board of Education (BOE)
- FlexiForce Sensor
- Piezo Speaker
- 12 Volt Gear Head DC motor
- Micro Dual Serial Motor Controller
- Push Button:
- Capacitor
- Resistors
- Parallax Serial LCD

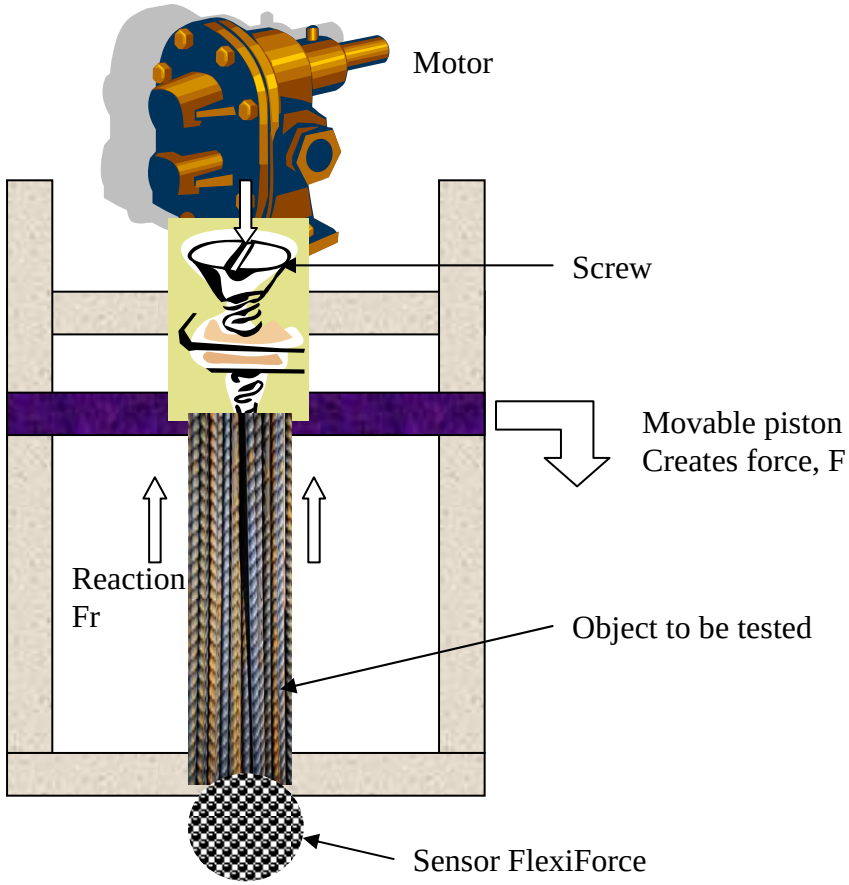
The device

At equilibrium:
Force = Force Fr

IF
FORCE F> REACTION FORCE Fr

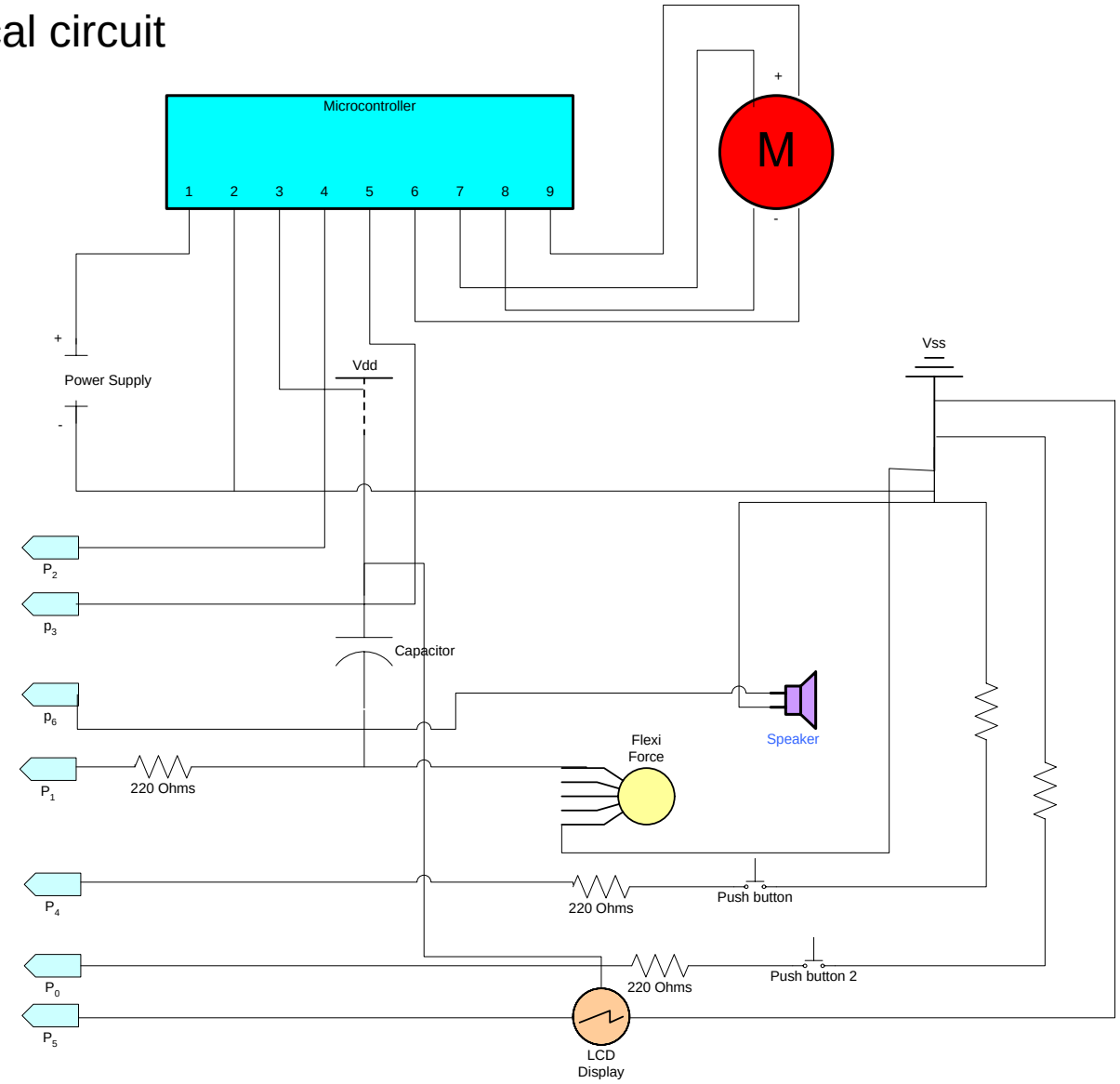
the object will buckle.





Compression testing apparatus

Electrical circuit



Compression Apparatus Circuit

Activities

- Explain how forces acting on an object are balanced, when the motion of the object does not change.
- Identify all the forces acting on a single object.
- Determine what factors need to be considered in building a stable object.
- Determine what structure is more suitable for building a stable bridge.
- Compare and contrast the pros and cons of various bridge building materials.
- Graph interpretation.
- Newton third Law of motion : for every action there is an equal and opposite reaction
- Analyze data.

Curriculum Correlation: NY State standards

Physical Science

- STANDARD **4:** investigate the use of common forces (push and pull) on objects.
- Standards 5: matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity

Technology:

- Standard 5: students will apply technology knowledge and skills to design, construct, use and evaluate product and systems to satisfy human and environmental needs

Curriculum Correlation: NY State standards

Interdisciplinary

- Standard 6: students will understand the relationships and common themes that connect mathematics, science and technology.
- Standard 7: student will use the knowledge of thinking skill of mathematics, science and technology to address real life problems and make informed decisions.

Future work

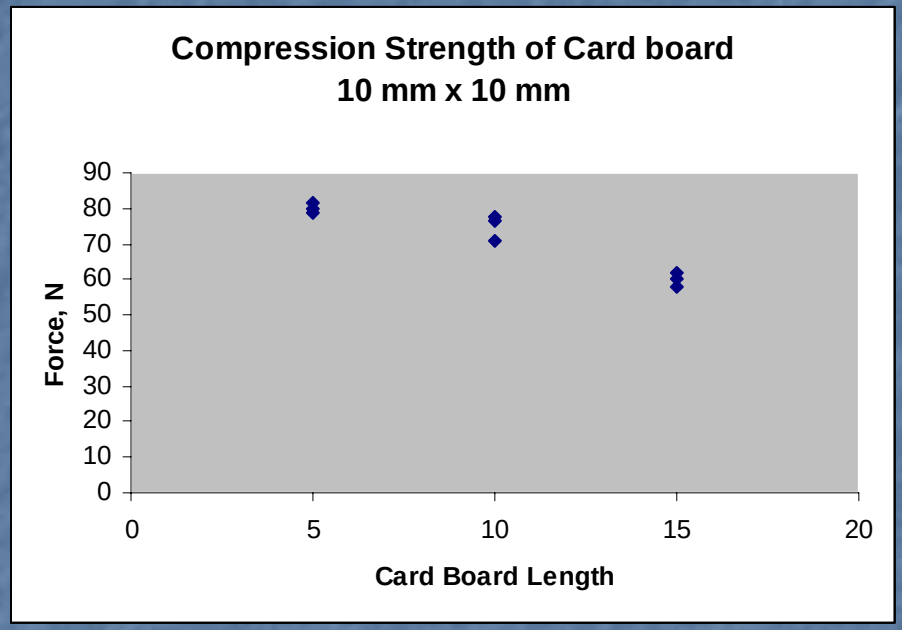
- Design a device that will test how much an object can extend (measure tension)
- see if there is any type of relation between compression and the tension of the same object

How it works

- The flexi force whish is connected to a capacitor acts like a resistor. When the sensor is unloaded its resistance is very high (the RCTime will be low). When a force is applied to the sensor, its resistance decreases (the RCTime will be).
- .
- The computer will read the input from the flexi force as raw number. A command in the programming will change this raw number into a Newton. Using a the RCTime of a known mass (in our case 1 Kg)
- The black push button starts the motor that will rotate forward turning the screw the pushes the piston down.
- The red push button will end the program and will make the motor rotate backward making the piston go up.
- The motor that is controlled by the microcontroller will increase the compression on the load (object tested) until the object buckles.
- The result (the highest compression) is displayed in the LCD

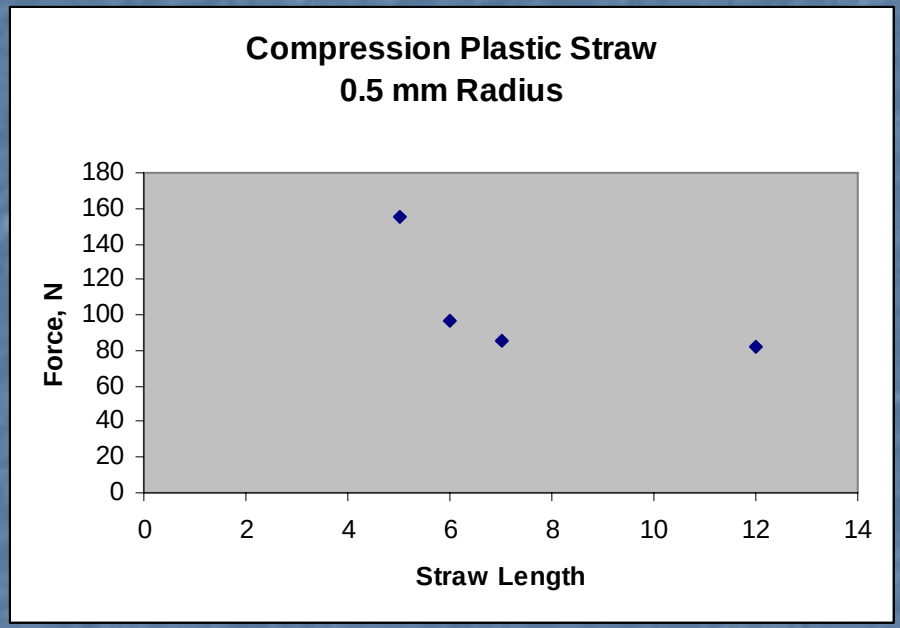
Results

Test Number	Size	Length	Compressive Strength
	(mm)	(cm)	(N)
C1	10 x 10	5	79.63
C1	10 x 10	5	78.48
C1	10 x 10	5	81.54
C2	10 x 10	10	70.71
C2	10 x 10	10	77.84
C2	10 x 10	10	76.72
C3	10 x 10	15	60.2
C3	10 x 10	15	62.15
C3	10 x 10	15	58.12
C4	6 x 10	5	
C4	6 x 10	5	
C4	6 x 10	5	
C5	6 x 10	10	39.55
C5	6 x 10	10	
C5	6 x 10	10	
C6	6 x 10	15	
C6	6 x 10	15	
C6	6 x 10	15	



Results

Plastic Straws	Radius	Length	Force
	cm	cm	newtons
circular	0.5	5	155.14
circular	0.5	6	96.4
circular	0.5	7	85.38
circular	0.5	12	82.42
Triangle		6	32.7
Triangle		12	11.97
Wood	Radius	Length	
circular	0.5	6	52.4
Triangle		6	36.5



Conclusion & Future Work

Throughout this project, our goal was to provide students with a visual demonstration of the procedure engineers use to test materials for their strength using a compressor. Our compression testing apparatus is a smaller scale model that operates and replicates what actual compressors run and test in the industry standards. We believe this experiment conducted in our school lab will confer our students with clear idea of the actual procedures, and hence will help them make decisions and planning regarding their what-about their would be exposed later if they were to opt for this rapidly growing engineering field.

Design a device that will test how much an object can extend (measure tension) and see if there is any type of relation between the compression and the tension of a same object

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