What is Civil Engineering?

Civil Engineering:
The Past, Present, and Future

1

What is Civil Engineering?

Civil Engineering: The Past

From the pyramids of Egypt to the exploration of space, civil engineers have always faced the challenges of the future - advancing civilization and building our quality of life.

2

What is Civil Engineering?

Civil Engineering: The Past

- Engineering has developed from observations of the ways ***natural*** and ***constructed systems*** react and from the development of empirical equations that provide bases for design.
- Civil engineering is the broadest of the engineering fields.
- In fact, engineering was once divided into only two fields -- military and civil.
- Civil engineering is still an umbrella field comprised of many related specialties.

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What is Civil Engineering?

Civil Engineering: The Present

- In modern usage, **civil engineering** is a broad field of engineering that deals with the planning, construction, and maintenance of fixed structures, or public works, as they are related to earth, water, or civilization and their processes.
- Most civil engineering today deals with infrastructure, such as power plants, bridges, roads, railways, structures, water supply, irrigation, environment, sewer, flood control, and traffic.

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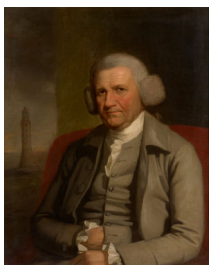
What is Civil Engineering?

Civil Engineering: The Present

The first self-proclaimed civil engineer was John Smeaton (1724 - 1792)



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What is Civil Engineering?

Civil Engineering: The Present

- In 1818, the Institution of Civil Engineers was founded in London and received a Royal Charter in 1828, formally recognizing civil engineering as a profession.
- The first degrees in Civil Engineering in the United States were awarded to William Clement, Jacob Eddy, Edward Suffern, and Amos Westcott by Rensselaer Polytechnic Institute in 1835
- **Elizabeth Bragg** (April 23, 1858 – November 10, 1929) was the first woman to earn a civil engineering degree from an American university.

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What is Civil Engineering?

Civil Engineering: The Present

- In essence, civil engineering may be regarded as the profession that makes the world a more agreeable place in which to live.
- Civil engineering is about community service, development, and improvement.

http://www.asce.org https://www.ice.org.uk/

http://en.wikipedia.org/wiki/Civil_engineering

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What is Civil Engineering?

MemFix 4 – Replacement of four bridges along I-240

https://youtu.be/k5wL11WLJ5Y

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What is Civil Engineering?

Falkirk Wheel – in town of Falkirk in central Scotland

http://en.wikipedia.org/wiki/Falkirk_Wheel

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What is Civil Engineering?

Falkirk Wheel – in town of Falkirk in central Scotland

https://youtu.be/ucg1O-5jsnM

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What is Civil Engineering?

Civil Engineering: The Future

- Our future as a nation will be closely tied to space, energy, the environment, and our ability to interact with and compete in the global economy.
- As the technology revolution expands, as the world's population increases, and as environmental concerns mount, your skills will be needed.
- Whatever area you choose, design, construction, research, teaching, or management, civil engineering offers you a wide range of career choices.

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What is Civil Engineering?

Civil Engineering: The Future

- ASCE estimates that $2.5 trillion is needed from 2020 to 2029 to keep the nation's infrastructure in good condition.
- Establishing a long-term development and maintenance plan must become a national priority.
- But in the short term, small steps can be taken by Congress, as well as state legislatures and local communities, to improve our nation's failing infrastructure.
- See ASCE website: http://www.infrastructurereportcard.org

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What is Civil Engineering?

Civil Engineering: The Future

CUMULATIVE INVESTMENT NEEDS BY SYSTEM BASED ON CURRENT TRENDS, 2020 TO 2029

ALL VALUES IN BILLIONS

Infrastructure System	Total Needs	Funded	Funding Gap
Surface Transportation[1]	$2,834	$1,619	$1,215
Drinking Water / Wastewater / Stormwater[2]	$1,045	$611	$434
Electricity[3]	$637	$440	$197
Airports[4]	$237	$126	$111
Inland Waterways & Marine Ports[5]	$42	$17	$25
Dams[6]	$93.6	$12.5	$81
Hazardous & Solid Waste[7]	$21	$14.4	$7
Levees[8]	$80	$10.1	$70
Public Parks & Recreation[9]	$77.5	$9.5	$68
Schools[10]	$870	$490	$380
Totals	**$5,937**	**$3,350**	**$2,588**

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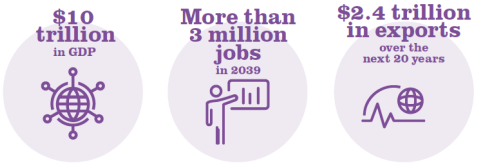
What is Civil Engineering?

Civil Engineering: The Future

- ASCE estimates that by 2039, a continued lack of investment in our infrastructure at current rates will cost:



- By 2039, America's overdue infrastructure bill will cost the average American household $3,300 a year, or $63 a week.

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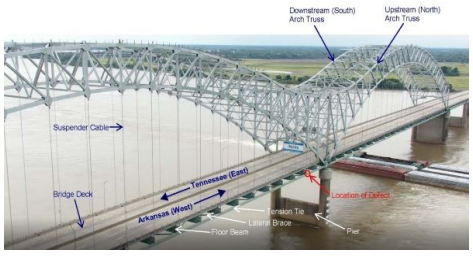
What is Civil Engineering?

The I-40 bridge connecting Memphis and the Arkansas city of West Memphis was shut down on May 11, 2021, after inspectors found a crack in one of two 900-foot (275-meter) horizontal steel beams that are critical for the bridge's structural integrity.

17

What is Civil Engineering?

The I-40 bridge connecting Memphis and the Arkansas city of West Memphis was shut down on May 11, 2021, after inspectors found a crack in one of two 900-foot (275-meter) horizontal steel beams that are critical for the bridge's structural integrity.



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This photo was pulled from 2019 drone footage, according to the Arkansas Department of Transportation.

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TN TDOT Department of Transportation

Hernando de Soto Bridge Repair Plans

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What is Civil Engineering?

The **I-35W Mississippi River bridge** was an eight-lane, 1,907 feet (581 m) steel truss bridge that carried Interstate 35W across the Mississippi River in Minneapolis, Minnesota, United States.

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What is Civil Engineering?

At 6:05 p.m. CDT on Wednesday, August 1, 2007, with rush hour bridge traffic moving slowly through the limited number of lanes, the central span of the bridge suddenly gave way, followed by the adjoining spans.

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What is Civil Engineering?

The primary cause was the undersized gusset plates, at 0.5 inches (13 mm) thick. Contributing to that design or construction error was the fact that 2 inches (51 mm) of concrete were added to the road surface over the years, increasing the dead load by 20%.

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What is Civil Engineering?

Old photos of the Interstate 35W bridge show that two steel connecting plates were slightly bent as early as 2003 - four years before the span collapsed into the Mississippi River, killing 13 people.

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What is Civil Engineering?

What about Tennessee's infrastructure?

Tennessee faces many infrastructure challenges.

- For example, driving on roads in need of repair in Tennessee costs each driver $209 per year
- 20,226 bridges, 4.4% of which are rated structurally deficient
- Drinking water needs in Tennessee are estimated $8.7 billion.
- 276 dams have high-hazard potential
- The state's schools have an estimated capital expenditure gap of $768 million

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What is Civil Engineering?

What about Tennessee's infrastructure?

Tennessee faces many infrastructure challenges

- This deteriorating infrastructure impedes Tennessee's ability to compete in an increasingly global marketplace.
- Success in a 21st-century economy requires serious, sustained leadership on infrastructure investment at all levels of government.
- Delaying these investments only escalates the cost and risks of an aging infrastructure system, an option that the country, Tennessee, and families can no longer afford.

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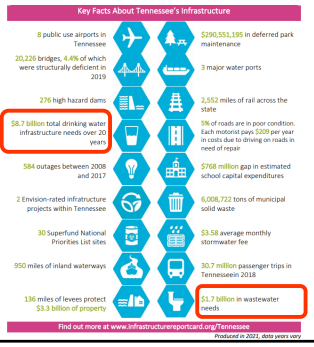
What is Civil Engineering?

What about Tennessee's infrastructure?



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What is Civil Engineering?

Civil Engineering: Technical Specialties

- Construction Engineering
- Environmental Engineering
- Geotechnical Engineering
- Structural Engineering
- Transportation Engineering
- Urban Planning
- Water Resources

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What is Civil Engineering?

Construction Engineering

- The construction phase of a project represents the first tangible result of a design.
- Using your technical and management skills, you will help turn designs into reality -- on time and within budget.
- You will apply your knowledge of construction methods and equipment, along with principles of financing, planning, and managing, to turn the designs of other engineers into successful facilities.

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What is Civil Engineering?

Environmental Engineering

- Environmental engineers translate physical, chemical, and biological processes into systems to remove pollutants from water, reduce non-hazardous solid waste volumes, eliminate contaminants from the air, and develop groundwater supplies.
- In this field, you might be called upon to resolve problems of providing safe drinking water, cleaning up sites contaminated with hazardous materials, cleaning up and preventing air pollution, treating wastewater, and managing solid wastes.

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What is Civil Engineering?

Geotechnical Engineering

- Almost all the facilities that make up our infrastructure are in, on, or with earth materials, and geotechnical engineering is the discipline that deals with applications of technology to solve these problems.
- Examples of facilities in the earth are tunnels, deep foundations, and pipelines. Highway pavements and many buildings are supported on the planet.

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What is Civil Engineering?

Structural Engineering

- As a structural engineer, you will face the challenge of analyzing and designing structures to ensure that they safely perform their purpose.
- They must support their weight and resist dynamic environmental loads such as hurricanes, earthquakes, blizzards, and floods.
- Stadiums, arenas, skyscrapers, offshore oil structures, space platforms, amusement park rides, bridges, office buildings, and homes are a few of the many types of projects in which structural engineers are involved.

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What is Civil Engineering?

Transportation Engineering

- Because the quality of a community is directly related to the quality of its transportation system, your function as a transportation engineer will be to move people, goods, and materials safely and efficiently.
- You will design, construct, and maintain all types of facilities, including highways, railroads, airfields, and ports.

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What is Civil Engineering?

Water Resources

- Water is essential to our lives, and as a water resources engineer, you will deal with issues concerning the quality and quantity of water.
- You will work to prevent floods, to supply water for cities, industry, and irrigation, to treat wastewater, to protect beaches, or to manage and redirect rivers.

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What is Civil Engineering?

Urban Planning

- Concerned with the full development of a community.
- Analyzing a variety of information will help you coordinate projects, such as projecting street patterns, identifying park and recreation areas, and determining areas for industrial and residential growth.

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What is Civil Engineering?

ASCE's members ranked the 10 greatest civil engineering achievements as:

1. Airport design and development
2. Dams
3. Interstate highway
4. Long-span bridges
5. Rail transportation
6. Sanitary landfills/solid waste disposal
7. Skyscrapers
8. Wastewater treatment
9. Water supply and distribution
10. Water transportation

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Airport Design

- Before 1945, any level field was looked upon as a viable landing strip for airplanes, and it was generally believed that the presence of a gas pump made an airport ready for commercial traffic.
- After World War II, the advent of integrated, engineered systems of paved landing surfaces, flood-lit runways, and terminal complexes made passenger convenience, airline efficiency, economy in construction, and operational safety the cornerstones for the rehabilitation and development of airports worldwide.

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Airport Design

Kansai International Airport

Located in Osaka Bay, approximately three miles offshore, Kansai International Airport features an extensive variety of modern amenities.

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Airport Design

Kansai International Airport

Because of its location offshore, it is the only airport in the world that can function on a 24-hour basis without violating any noise regulations.

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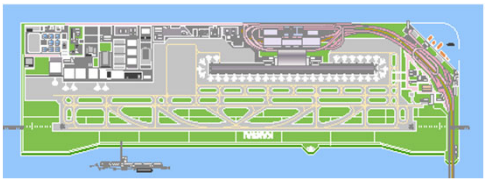
Airport Design

Kansai International Airport

The airport serves 24 cities in Japan with 69 departures daily and 71 cities in 30 other countries with 660 departures.



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Airport Design

Kansai International Airport

Start of the airport island seawall construction (January 1987)

Completion of the airport island seawall (June 1989)

Completion of reclamation work on the airport island (December 1991)

Completion of the Passenger Terminal Building (June 1994)

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Airport Design

Kansai International Airport

Satellite photo of Kansai Airport in Osaka Bay

Closeup of the artificial island

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Airport Design

Kansai International Airport

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Dams

- During the 20th century, harnessing water by building dams was recognized as a way to meet an unprecedented demand for low-cost, widely available energy sources to aid in the production of goods and services for the consuming public.
- Dams continue to play an integral role in our daily lives, providing a range of benefits including flood control, hydroelectric power, and water for irrigation, recreation, and fish and wildlife enhancements.
- Dams spur industrial growth and provide navigation routes in developing nations. As the world's population increases and the need for food multiplies, it is likely that, even in the face of increased environmental sensitivity, dams will continue to be built during the 21st century.

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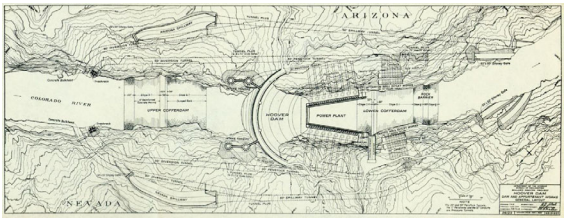
Dams

Hoover Dam

The construction of the Hoover Dam provided a positive focus for the United States during the Great Depression.



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Dams

Hoover Dam

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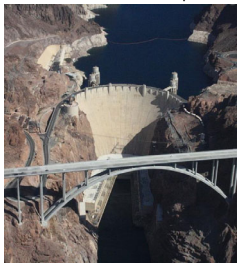
50

Dams

Hoover Dam

Completed in 1935, the 726-foot-high structure was the highest dam in the world, by 300 feet, at the time of construction. It is still the highest concrete dam in the Western Hemisphere.

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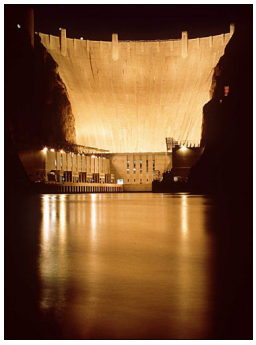
Dams

Hoover Dam

Today, it continues to regulate the flow of the Colorado River.

It provides a range of benefits, including electricity for more than 1.3 million people and irrigation for 1.5 million acres of land in the United States and Mexico.



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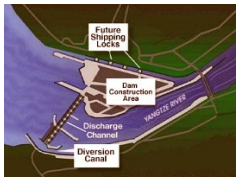
Dams

Three Gorges Dam

- The Three Gorges Dam is modern China's most ambitious and controversial construction project. It is also China's largest construction project since the building of the Grand Canal in the 10th century.
- From start to finish, the project cost about $37 billion.



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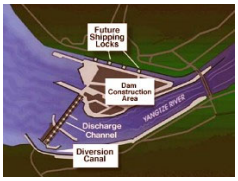
Dams

Three Gorges Dam

- The dam wall is made of concrete and is about 2,309 meters (7,575 ft.) long and 101 meters (331 ft.) high.
- The wall is 115 meters (377.3 ft.) thick on the bottom and 40 meters (131.2 ft.) thick on top.



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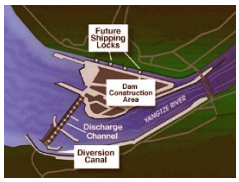
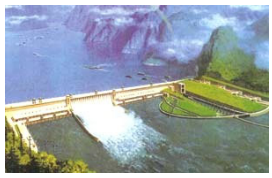
Dams

Three Gorges Dam

The project used 27,200,000 m^3 (35,600,000 yd^3) of concrete and 463,000 tons of steel, enough to build 63 Eiffel Towers, and moved about 102,600,000 m^3(1.342x10^8 yd^3) of earth.





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Dams

Three Gorges Dam

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Dams

Three Gorges Dam

57

Interstate Highway System

- The Interstate Highway System was established as a national priority by President Dwight D. Eisenhower in the Federal-Aid Highway Act of 1956.
- In 1919, then Lt. Colonel Eisenhower traveled in an 80-vehicle military convoy from Washington, DC to San Francisco. The trip took 62 days, inspiring him to create the system.
- The 48,756-mile system (as of 2020), built on a North-South/East-West grid, has hundreds of bridges, overpasses, interchanges, and thousands of miles of pavement.

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Interstate Highway System

- The highway system revolutionized travel, economies, and the daily standard of living in North America by providing an efficient means of direct, high-speed transportation for individuals and businesses in the United States, Canada, and Mexico.

- The Interstate Highway System is both the most extensive highway system in the world and the largest public works project in history (costing approximately $500 billion).

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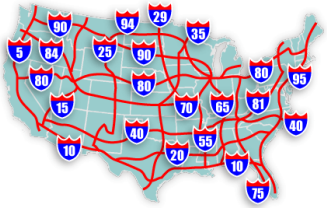
Interstate Highway System

The system carries nearly 26% of all vehicle miles in the U.S. and is credited with saving more than 187,000 lives and preventing 12 million injuries. It is estimated that the Interstate Highway System saved $6 for every $1 spent on its construction.



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