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.

3

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 was awarded to William Clement, Jacob Eddy, Edward Suffern and Amos Westcott by Rensselaer Polytechnic Institute in 1835
- The first such degree to be awarded to a woman was granted by Cornell University to Nora Stanton Blatch in 1905.

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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

  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

9

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What is Civil Engineering?

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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 to a 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 the 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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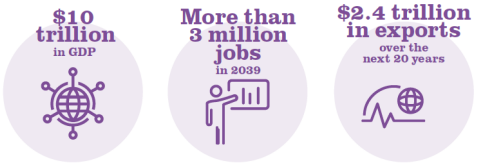
What is Civil Engineering?

Civil Engineering: The Future

- ASCE estimates that by 2039, a continued under 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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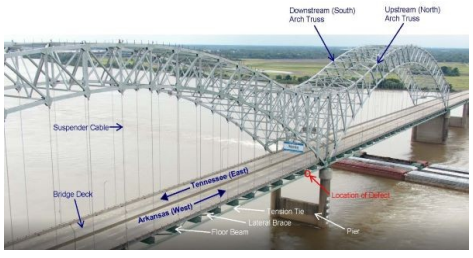
What is Civil Engineering?

The I-40 bridge connecting Memphis and the Arkansas city of West Memphis was shut down 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 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.



18

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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

22

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23

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 under-sized 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%.

26

What is Civil Engineering?

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27

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 an estimated $8.7 billion.
- 276 dams are 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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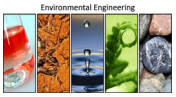
What is Civil Engineering?

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 earth.

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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 own 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.

37

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

- As a professional in this area, you will be 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

40

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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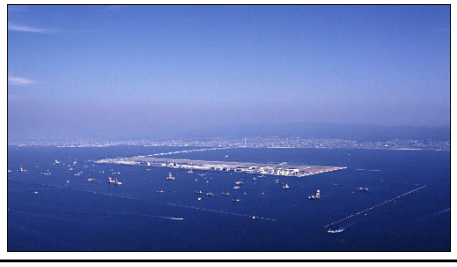
Airport Design

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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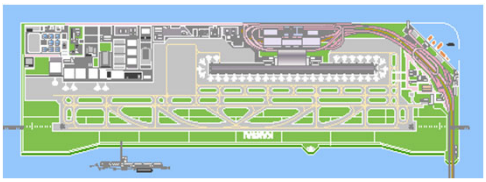
Airport Design

Kansai International Airport

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



44

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

46

Airport Design

Kansai International Airport

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Dams

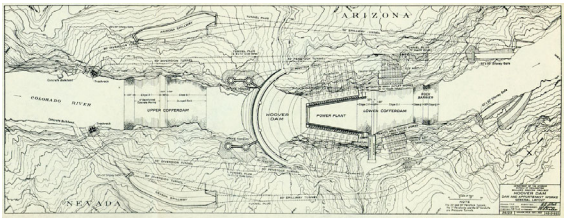
- During the 20th century, harnessing water by building dams was recognized as a way to meet an unprecedented demand for low-cost, widely available energy sources to aid in the production of goods and services for the consuming public.
- Dams continue to play an integral role in our daily lives, providing 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, even in the face of increased environmental sensitivity, which dams will continue to be built during the 21st century.

48

Dams

Hoover Dam

The building of the Hoover Dam provided something positive for the United States to focus on during the years of the Great Depression.



49

Dams

Hoover Dam

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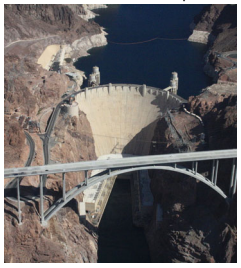
50

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.

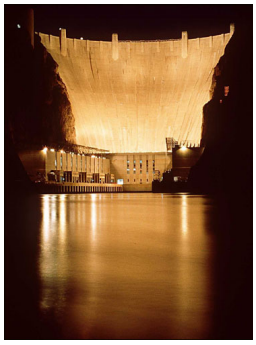



51

Dams

Hoover Dam

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

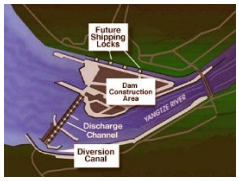


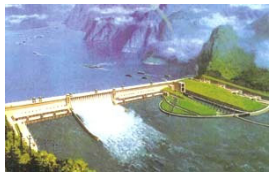
52

Dams

Three Gorges Dam

- The building of the Three Gorges Dam is modern China's most ambitious construction project, and one of the most controversial in the world. 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 will cost $37 billion.





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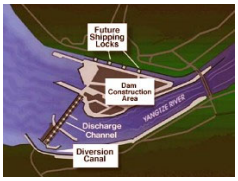
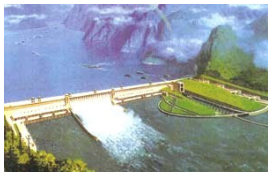
Dams

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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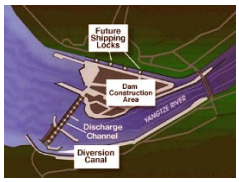
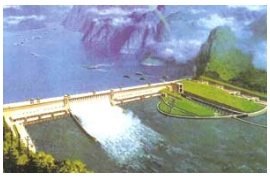
Dams

Three Gorges Dam

The project used 27,200,000 m^3 (35,600,000 yd^3) of concrete, 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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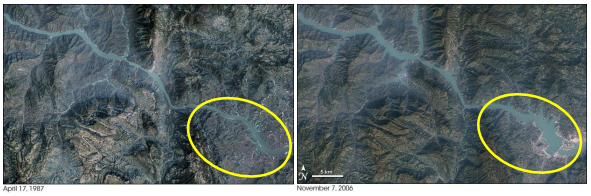

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Dams

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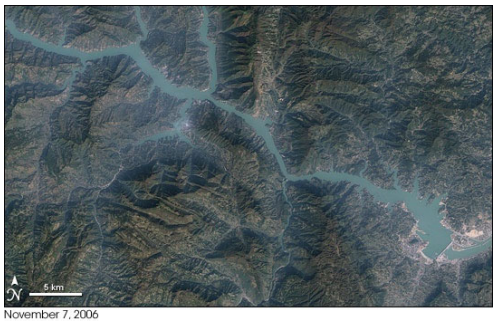

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Interstate Highway System

- 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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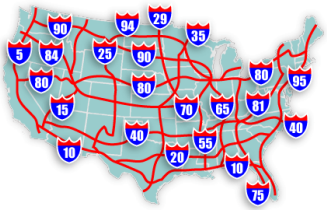
Interstate Highway System

- 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 largest highway system in the world and the largest public works project in history (cost approximately $500 billion).

59

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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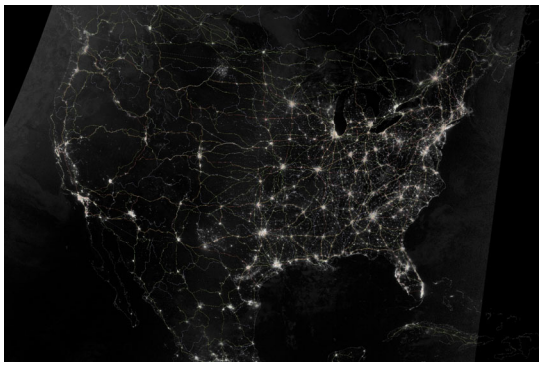
Interstate Highway System



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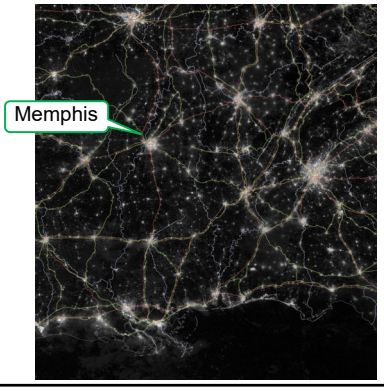
Interstate Highway System



62

Long-Span Bridges

- Bridges of increasing size and span have created phenomenal changes in the social patterns and economic conditions of areas by effectively eliminating water barriers between communities.
- They open new routes of communication between disintegrated and isolated communities, provide safe and efficient access to work, schools and recreation for people, and spur economic growth by facilitating trade within and between regions.
- From the late 19th century through the early 20th century the use of steel enabled the production of increasingly longer, continuous main span traversing large, deep bodies of water.

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Long-Span Bridges

Golden Gate Bridge

One of the most recognized landmarks in the world, the Golden Gate Bridge, connects geographically isolated areas of California to the north, in Marin and Sonoma counties, with San Francisco.

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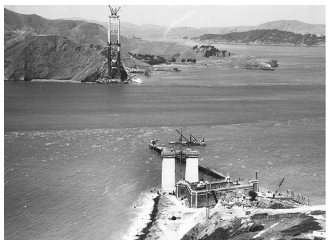
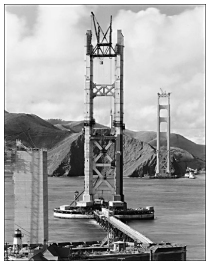
Long-Span Bridges

Golden Gate Bridge

When the bridge opened in 1937, with a main suspension span length of 4,200 feet, it was the longest in the world.





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Long-Span Bridges

Golden Gate Bridge

The engineering obstacles poised by the mile-wide, turbulent Golden Gate Strait led engineers to devise a bridge that required four years to build, 83,000 tons of steel, 389,000 cubic yards of concrete, and enough cable to encircle the earth three times.

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Long-Span Bridges

1915 Çanakkale Bridge

The bridge is the longest suspension bridge in the world—with a main span of 2,023 m (2.023 km; 1.257 mi), the bridge surpasses the Akashi Kaikyo Bridge (1998) in Japan by 32 m (105 ft).


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Long-Span Bridges

1915 Çanakkale Bridge

The year "1915" in the official Turkish name honors an important Ottoman naval victory against the navies of the United Kingdom and France during World War I.


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Long-Span Bridges

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Long-Span Bridges

1915 Çanakkale Bridge

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70

Rail Transportation

- Rail transportation was the first efficient cross-country mode of transportation for both passengers and cargo.
- Rail remains a major method of transporting goods throughout the nation, and in many developed nations is the primary mode of passenger travel.
- Rail transportation generated hundreds of spin-off industries, ranging from rail cars and signal equipment; to toy trains, and contributed to the growth and dominance of the U.S. iron and steel industries in the early part of the century.

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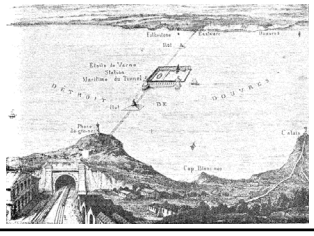
Rail Transportation

Eurotunnel Rail System

The Eurotunnel Rail System fulfilled a centuries-old dream to link Britain and the rest of Europe. More than a tunnel, it rolls infrastructure and immense machinery into an underwater tunnel system of unprecedented ambition.

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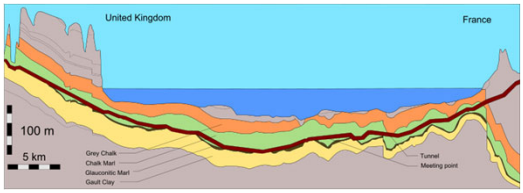

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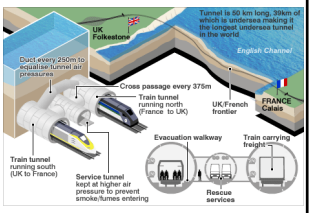
Rail Transportation

Eurotunnel Rail System

- Three five-feet-thick concrete tubes plunge into the earth at Coquelles, France, and burrow through the chalky basement of the English Channel, re-emerging at Folkstone, behind the white cliffs of Dover.



- The broadest trains ever built (14 feet wide double deckers) travel through the tunnels at 200 mph. Passengers board in automobiles and buses, not on foot.

74

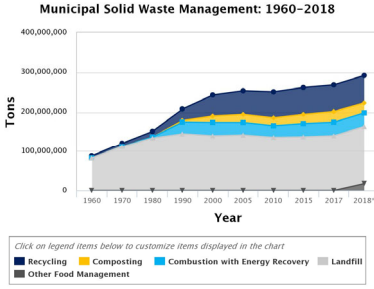
Sanitary Landfills/Solid Waste Disposal

- As American society changed from an agrarian culture to an industrialized nation, people moved to cities for work, in hopes of improving their quality of life.
- The subsequent increase in urban population density had a great impact on garbage disposal practices.
- By 1946, the responsibility for garbage disposal shifted from scavengers to scientifically minded civil engineers whose experimentation with various ways to properly dispose of waste which led to the widespread use of sanitary landfills.

75

Sanitary Landfills/Solid Waste Disposal

Americans generate trash at an astonishing rate of about 4.9 pounds per day per person, which translates to almost 300 million tons per year!



76

Sanitary Landfills/Solid Waste Disposal

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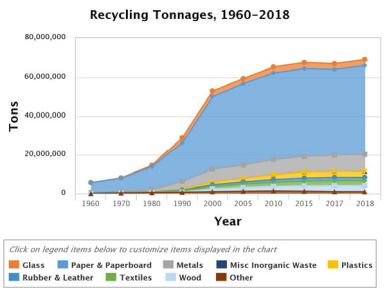

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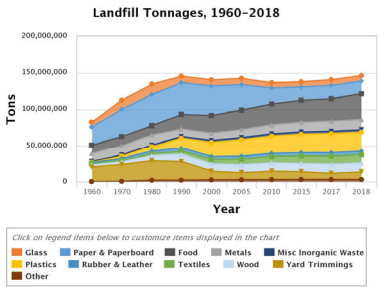

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Sanitary Landfills/Solid Waste Disposal

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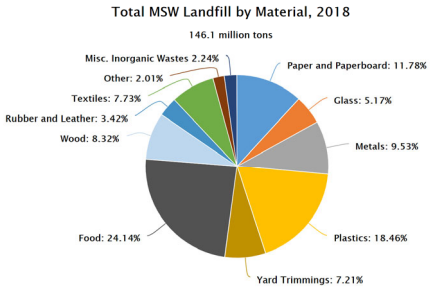


79

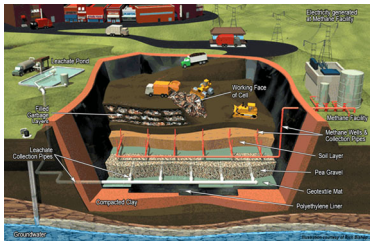
Sanitary Landfills/Solid Waste Disposal

Some trash gets recycled or recovered and some is burned, but the majority is buried in landfills.

80

Sanitary Landfills/Solid Waste Disposal

A landfill's major purpose and one of its biggest challenges is to contain the trash so that the trash doesn't cause problems in the environment. The bottom liner prevents the trash from coming in contact with the outside soil, particularly the groundwater



81

Sanitary Landfills/Solid Waste Disposal

The Fresh Kills Landfill on Staten Island is set to officially close on July 4, 2001, after more than 50 years in operation.

82

Sanitary Landfills/Solid Waste Disposal

It consists of four mounds which range in height from 90 to approximately 225 feet and hold about 150 million tons of solid waste. The archaeologist Martin Jones characterizes it as "among the largest man-made structures in the history of the world."

83

Sanitary Landfills/Solid Waste Disposal

New York's New Parkland at Fresh Kills will be one of the most ambitious public works projects in the world.

84

Skyscrapers

- Nineteenth century buildings generally did not exceed 16 stories in height because the strength and thickness of their mandatory bearing walls limited them.
- Built upward, instead of outward, skyscrapers of the 20th century have solved many of the problems of rapid urbanization, including increasing population and land cost.
- Tall buildings were made possible by such innovations as the electric elevator, advances in structural steel making, and advances in heating, ventilation, air conditioning and electrical systems.

85

Skyscrapers

Empire State Building

At 1,250 feet, the Empire State Building is the best-known skyscraper in the world and was the tallest building in the world for more than 40 years. The building's most astonishing feat, however, was the speed at which it rose into the New York skyline.

86

Skyscrapers

Empire State Building

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87

Skyscrapers

Empire State Building

- Construction was completed in only one year and 45 days, without requiring overtime.
- Ironworkers set a torrid pace, riveting the 58,000-ton frame together in 23 weeks.
- Just below them, masons finished the exterior in eight months, plumbers laid 51 miles of pipe and electricians installed 17 million feet of telephone wire.
- The building was so well engineered that it was easily repaired after a bomber crashed into it in 1945.

88

Skyscrapers

Tallest structure in the World?

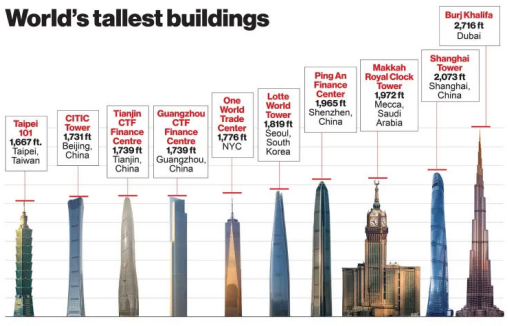
- Freestanding structure
- Freestanding structure on land
- Building – to top of antenna
- Building – to highest point
- Building – to architectural top
- Building – to top of roof
- Building – to highest occupied floor

- 2,717 feet high

Burj Khalifa known as Burj Dubai prior to its inauguration, in Dubai, United Arab Emirates

89

Skyscrapers



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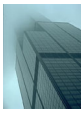
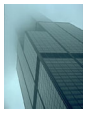


Skyscrapers

Tallest Building in the World

https://youtu.be/PuTqWxuAazI?t=8

91



Skyscrapers

Tallest Building in the World Under Construction

Burj Mubarak Al Kabir (2030) - 3,284 ft. Jeddah Tower (2018) - 3,281 ft.

92

Wastewater Treatment

- Throughout the 19th century people lived in filth, disposing of garbage and raw sewage by dumping it into streets, alleys and waterways.
- As a result, they often suffered from such deadly diseases as cholera and typhus.
- Until the early 1900s, America's urban wastewater, including industrial waste, was dumped into the nation's waterways.
- As recently as 1968, the city of St. Louis discharged 300 million gallons per day of raw waste into the Mississippi River.
- By 1972, only one-third of U.S. waterways were safe for drinking and fishing. With the advent of wastewater treatment, cities became much more equipped to deal with population influx.

93

Wastewater Treatment

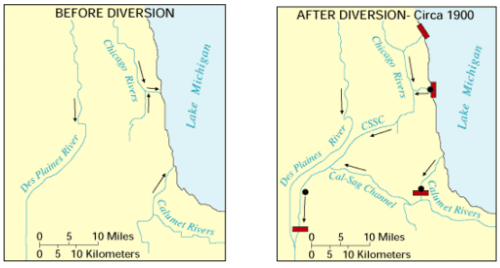
Chicago Wastewater System

- The reversal of the Chicago River, completed in 1900, enabled Chicago to continue its growth and progress after the Great Chicago Fire of 1871.
- Before the reversal, the safety of the Lake Michigan drinking water supply was constantly threatened by untreated sewage flowing directly into the river, which then flowed back into the lake.
- The Chicago Sanitary District, as it was known then, undertook a monumental task when it built a 28-mile-long channel that would connect the Chicago River with the Des Plaines River to reverse the flow of the river away from Lake Michigan.

94

Wastewater Treatment

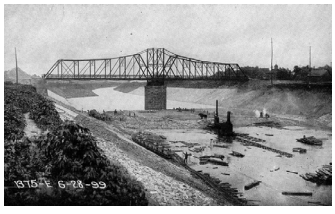
Chicago Wastewater System



95

Wastewater Treatment

Chicago Wastewater System



96

Water Supply and Distribution

- The collection, storage, treatment, transmission and distribution of water played a significant role in urbanization, population growth and commercial agriculture and land use.
- Clean, potable water piped from afar led to the development of such large cities as Las Vegas, and the suburban areas around Chicago and Los Angeles.
- During the 20th century, water supply and distribution systems have led to an increase in life expectancy, reduction in infant mortality and morbidity, and improvements in environmental quality in developed countries.

97

Water Supply and Distribution

California Water Project

- The California State Water Project was selected as much for its remarkable engineering aspects, as for the positive impact it has had on regional economic trade and development.
- Conceived more than 50 years ago, a system of aqueducts, dams, reservoirs and plants meets the water resources needs of two-thirds of California's population.

98

Water Supply and Distribution

California Water Project

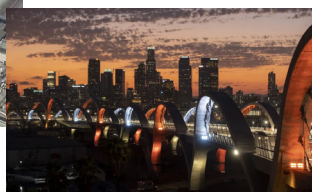
Features of the project include 32 storage facilities, reservoirs and lakes, 17 pumping plants, three pumping-generating plants, five hydroelectric power plants, and 660 miles of open canals and pipelines.


99

Water Supply and Distribution

California Water Project

6th street viaduct in Los Angles, CA

100

Water Transportation

- The impact of canals and ports on economic and commercial development around the world is unsurpassed.
- Passageways between bodies of water connect continents and create efficient interstate portals for cargo ships.
- Canals and ports harness the capacity of water to carry extra large, bulky cargo, spurring economic growth, agricultural development, commerce and trade in all nations.
- As cargo ships increase in size, engineers are developing new ways to expand ports, including dredging.

101

Water Transportation

The Panama Canal

The dream of Spanish conquistadors, the Panama Canal is one of civil engineering's greatest triumphs. Forty two thousand workers dredged, blasted and excavated the canal.

102

Water Transportation

The Panama Canal

They moved enough earth and rubble between Colon and Balboa to bury Manhattan to a depth of 12-feet.

103

Water Transportation

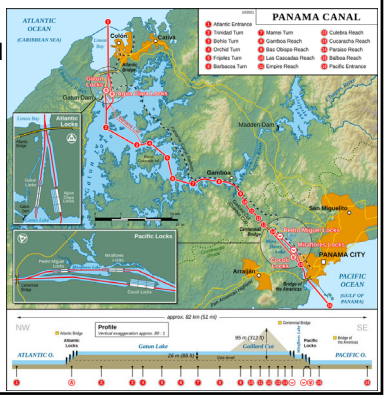
The Panama Canal

- The Third Set of Locks Project is a mega-project that will expand the Panama Canal.
- The expansion will be greater than at any time since the canal's construction.
- Panamanian President Martín Torrijos presented the plan on April 24, 2006, and Panamanian citizens approved it in a national referendum by 76.8% of votes on October 22, 2006.
- The project will double the canal's capacity and allow more traffic.

104

Water Transportation

The Panama Canal



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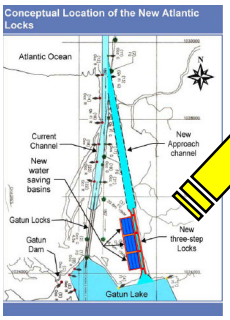
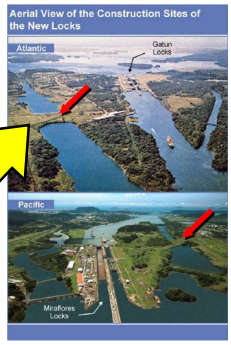
Water Transportation

The Panama Canal





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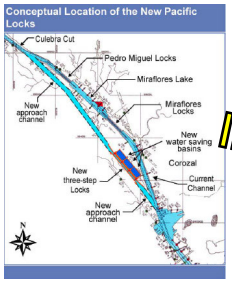
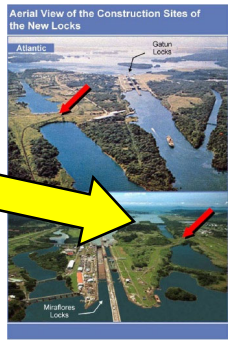
Water Transportation

The Panama Canal





107

Water Transportation

The Panama Canal

108

Water Transportation

The Panama Canal

109

Water Transportation

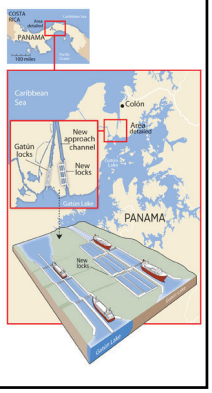
The Panama Canal

110

Water Transportation

The Panama Canal

The Panama Canal's expansion opened for commercial traffic in June 2016.



111

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

112

What is Civil Engineering?

Any Questions?

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