

Top 10 Achievements & Millennium Monuments



The anticipation of "the year 2000" and the start of the 21st century also brought on a great deal of reflection about the events and achievements of the 20th century. ASCE demonstrated how civil engineers enhanced the quality of life with two special events: the Millennium Challenge in 1999, and the Monuments of the Millennium in 2000.

The Millennium Challenge canvassed ASCE members in late 1999 to determine the 10 civil engineering achievements that had the greatest positive impact on life in the 20th century. Rather than individual projects, they chose to recognize broad categories of achievements.

The Monuments of the Millennium are international or national projects that represent many of these achievements. The Monuments, chosen in early 2000 by a distinguished panel of civil engineers, demonstrate a combination of technical engineering achievement, courage and inspiration, and a dramatic influence on the development of the communities in which they're located.

Here are the 10 greatest civil engineering achievements as ranked by ASCE's members in 1999, and the related Monuments of the Millennium as selected in 2000. Click on each of the monument names to learn more in depth about each:

Airport Design and Development

Monument: Kansai International Airport

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.

This new concept of design and development of airports with the end-user in mind transformed the use of aircraft technology from a novel form of postal and military transportation into an economic powerhouse. Today, airports employ millions of people worldwide, allow for efficient transport of fresh food, mail, packages and other goods, and provide affordable and convenient business and vacation travel. Through the use of local businesses for airplane maintenance, food catering to airlines, and ground transportation to and from airports, surrounding communities thrive. Retail shops, hotels and restaurants in and around airports ensure that aviation dollars are channeled throughout communities.



Built and based in Osaka Bay, about three miles off the Japanese shore, Kansai International Airport features an extensive variety of user-friendly, modern amenities, including shopping areas, a children's playroom, an automated intra-airport transportation system, and a state-of-the-art ventilation system. Because of its location off shore, it is the only airport in the world that is able to function on a 24-hour basis without violating any noise regulations.
(available in English or Japanese)

The airport serves 24 cities in Japan with 69 departures daily and 71 cities in 30 other countries with 660 departures. Since it opened in September 1994, the annual number of international passengers using Kansai International Airport has increased from 2.5 million to more than 25 million.

Additional Information

<http://www.kansai-airport.or.jp/en/index.asp>

Kansai's Homepage, airport and flight Information also included

Dams

Monument: Hoover Dam

People around the world need and use far more water than societies of the past; people use water for drinking, washing, cooking, waste removal, heating and cooling, and irrigation. 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.



Near Boulder City, Nevada
Constructed 1931-1935

The building of the Hoover Dam provided something positive for the United States to focus on during the years of the Great Depression. 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. 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. The Hoover Dam was designated an ASCE Historic Civil Engineering Landmark in 1984 and was named one of America's Seven Modern Civil Engineering Wonders in 1955. The National Park Service designated the Hoover Dam as a National Historic Landmark in 1984.

Seven Modern Wonders of the World, 1955

Claim to Fame:

The Hoover Dam, a 726-foot high-arch gravity structure, was the greatest constructed project at that time and remains one of the highest concrete dams in the Western Hemisphere.

In 1918, the U.S. Reclamation Service's director and chief engineer Arthur P. Davis proposed a dam of unprecedented height to control the devastating floods on the Colorado River, generate hydroelectric power, and store the river's ample waters for irrigation and other uses. A dam project of this monumental scale had never been built in America: diverting the Colorado River through four massive tunnels blasted out of hard rock; pouring 6.6 million tons of concrete to build the world's largest concrete dam; and building two giant spillways and four intake towers - all in a remote desert region.

In March 1931, the Bureau of Reclamation awarded the contract to a consortium of six large construction firms, called Six Companies, Inc., that bid together on the project because it was larger than any one could handle. Francis T. Crowe, Hon.M.ASCE was construction superintendent for Six Companies, Inc. and probably one of the premier dam construction engineers who ever worked in the United States. Working around the clock, they completed the dam two years ahead of schedule.

Facts

1. Four 56-foot-diameter tunnels were driven through the canyon walls - 2 on either side - to divert the Colorado River around the dam work site. Ultimately, more than 1,500,000 cubic yards of soil and rock were removed from the tunnels.
2. The dam is an arch gravity structure rising 726 feet above bedrock. It is 660 feet thick at its base, 45 feet thick at its crest, and stretches 1,244 feet across Black Canyon.
3. Construction of the dam, powerhouse, and related structures required a total of 4,400,000 cubic yards of concrete, 45,000,000 pounds of reinforcing steel. The size of much of the equipment - including generators and steel plate penstock - was unparalleled.
4. To dissipate the heat generated as the concrete cured, over 650 miles of one-inch pipe were embedded in the concrete to convey refrigerated water. The cooling coils were cut off and filled with grout after each block had cured and cooled.
5. On September 30, 1935, Franklin D. Roosevelt officially dedicated the dam, saying, "*I came, I saw, and I was conquered, as everyone will be who sees for the first time this great feat of mankind.*"
6. The inscription at the base of the Hoover Dam flagpole reads, "*It is fitting that the flag of our country should fly here in honor of those men who, inspired by a vision of lonely lands made fruitful, conceived this great work and of those others whose genius and labor made that vision a reality.*"

Additional Information

<http://www.usbr.gov/lc/hoverdam/>

The U.S. Bureau of Reclamation tells the story of one of America's Seven Modern Civil Engineering Wonders. Visitor information also included.

<http://www.pbs.org/wgbh/amex/hover/>

Chronology of Hoover Dam, searchable database of the people and events that led to the dam's creation and a teacher's guide with maps included.

<http://xroads.virginia.edu/~MA98/haven/hover/front2.html>

In-depth report on Hoover Dam, including slide shows and maps.

<http://hooverdamtourcompany.com/>

All about tours of the site, including bus, helicopter and plane routes.

<http://www.sunsetcities.com/hoover-dam.html>

Information and history about Hoover Dam and the taming of the Colorado River.

http://www.desertusa.com/colorado/lm_nra/hover/du_hoover.html

Guide to Hoover Dam, includes color photos, tour, Visitor Center facilities, rates and fees, seasons and hours.

<http://www.bcmha.org/history.html>

Boulder City's Hoover Dam Museum's homepage and interesting factoids.

Interstate Highway System Monument: The system overall

Established as a national priority by President Dwight D. Eisenhower, the nation's interstate 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 across the United States and into Canada and Mexico. The 42,800-mile system, built on a North-South/East-West grid, has hundreds of bridges, overpasses, interchanges and thousands of miles of pavement.



Courtesy Virginia DOT

Following the prototype of the Pennsylvania Turnpike, completed in 1940, the interstate highway system is fully access controlled, with all intersections at different grades and access provided through interchange ramps. There are more than 55,000 grade separations and other bridges, and curves are engineered for safe turns. The system carries 20 percent of traffic, although it only covers 1 percent of the United States, 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.

Long-Span Bridges

Monument: Golden Gate Bridge

Bridges of increasing size and span have created phenomenal changes in the social patterns and economic conditions of regions 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 spans traversing large, deep bodies of water. As the symbolic soul of cities, bridges shape a city's character and, in turn, are shaped by the lives of the people served by them.



Seven Modern Wonders of the World, 1994

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. When the bridge opened in 1937, with a main suspension span length of 4,200 feet, it was the longest in the world. The engineering obstacles posed 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. Previous ASCE designations for the Golden Gate Bridge include: the National Civil Engineering Landmark (1984) and Seven Wonders of the World (1955). Other significant bridges include the Verrazano-Narrows Bridge, the George Washington Bridge, the Akashi Kaikyo (Japan) and the Humber Bridge (England).

Additional information

<http://www.goldengatebridge.org/>

The official web site for the Golden Gate Bridge, heralded as one of the top ten construction achievements of the 20th Century.

Rail Transportation

Monument: Eurotunnel

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 remains 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 20th century.

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. Three five-foot-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-foot wide double deckers -- travel through the tunnels at 100 mph. Passengers board in automobiles and buses, not on foot. Maintenance and emergency vehicles ply a third tunnel, which is located between the rail tubes. Some 300 miles of cold water piping run alongside the rail tracks to drain off the heat raised by air friction.



Additional Information

http://www.raileurope.com/us/rail/eurostar/channel_tunnel.htm

Description of the Channel Tunnel including diagram and statistics.

<http://www.raileurope.com/us/>

Detailed information on Europasses and similar travel arrangements.

<http://www.hmso.gov.uk/acts/acts1996/1996061.htm>

Information on the Channel Tunnel Rail Link Act of 1996.

http://www.eurotunnel.co.uk/english/explorer_e.htm

Homepage of the high speed transport system which links the UK to France through the Channel Tunnel.

Sanitary Landfills/Solid Waste Disposal

Monument: Sanitary waste disposal advances overall

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. The rural custom of placing waste in fields or beside roadways led to the piling up of garbage in the streets, waterways and vacant lots, and in open pits. This type of garbage disposal brought with it odor, rodents, pestilence, and most importantly, a serious public health problem. 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, including feeding it to hogs, open pit burning, and incineration, led to the widespread use of sanitary landfills.

Skyscrapers

Monument: Empire State Building

In the 19th century, buildings generally did not exceed 16 stories high because the strength and thickness of their mandatory bearing walls limited them. Built upward, instead of outward, skyscrapers of the 20th and 21st century have solved many of the problems of rapid urbanization, including increasing population and land cost. Skyscrapers release land at ground level, opening up space for plazas, fountains and arcades, creating a lively street and outdoor life, and promoting better human interaction. 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.

Seven Modern Wonders of the World, 1955, 1994

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. 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. The precise choreography of the operation revolutionized the tall building construction industry. Previous ASCE designations include America's Seven Modern Civil Engineering Wonders (1955) and Seven Civil Engineering Wonders of the Modern World (1994).



Additional Information

<http://www.esbnyc.com/>

Official site for facts, history, business directory, and a kids section with a printable coloring book.

<http://www.camvista.com/usa/new-york/empire-state-building-cam.php>

Live images of the Empire State Building from the web cam atop Friday's restaurant at 8th Avenue and 34th Street.

<http://www.nyctourist.com/empire1.htm>

A photo tour of New York City's most famous fixture.

Wastewater Treatment

Monument: Chicago Wastewater System

From the earliest times through 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. Few municipalities treated wastewater, as it was widely believed that running water purified itself. Ironically, with the implementation of water treatment supply systems, the need for uncontaminated water supplies decreased, and the nation's waterways became more polluted. 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 remained safe for drinking and fishing. With the advent of wastewater treatment, cities became much more equipped to deal with population influx. Such innovations as activated sludge treatment allow for the maintenance of high levels of water quality. Wastewater treatment led to an increase in life expectancy, reduction in infant mortality and morbidity, control and prevention of communicable diseases, and improvements to the aquatic environment, enabling the public to enjoy water sports and maintain a healthy ecosystem for marine life.

Seven Wonders of the Modern World, 1955



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. More than 28 million cubic yards of glacial drift and 12.9 million cubic yards of solid rock were removed, using conveyers, steam shovels, horse-drawn wagons, dynamite and the labor of thousands of immigrants.

Additional Information

<http://www.chicagoriver.org/>

Official website for the Friends of the Chicago River.

<http://www.earthcam.com/usa/illinois/chicago/field/>

this camera offers many views of the Chicago skyline, including the beautiful shore of Lake Michigan.

<http://www.apwa.net/Resources/Reporter/Articles/2001/7/Top-Ten-Public-Works-Projects-of-the-Century>

A chronological history of the reversal of the Chicago River.

http://en.wikipedia.org/wiki/Chicago_River#Reversing_the_flow

A brief overview of the remarkable feat of reversing the Chicago River's flow.

Water Supply and Distribution

Monument: California State Water Project

The collection, storage, treatment, transmission and distribution of water played a significant role in urbanization, population growth and commercial agriculture and land use. Today, storage and distribution systems enable semi-arid and arid regions to store water for later use during periods of high precipitation. 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. The development and distribution of large water delivery systems, in conjunction with the development of collection, removal and treatment systems, enabled people to move from large cities to suburban communities and helped well-dependant, rural communities to prosper. 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. It is estimated that in the year 2000, 2.2 billion people in developing countries will die due to the lack of safe drinking water. The transfer of civil engineering knowledge to ensure safe water supplies through the collection, treatment and distribution of surface, ground and wastewater is imperative for the continued economic growth and development of nations in the 21st century.



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 with bold imagination by engineers of dedication and courage, a system of aqueducts, dams, reservoirs and plants meets the water resources needs of two-thirds of California's population serving more than 23 million citizens and thousands of businesses daily. 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.

Additional Information

<http://www.dwr.water.ca.gov/>

Comprehensive site done by the California Department of Water Resources. Includes historical overview, links to DWR water facilities, visitor centers and recreation sites including maps, and a listing of state water contractors.

<http://www.water.ca.gov/swp/operationscontrol/>

The Department of Water Resources Operations Control Office directs the overall water and power operations of the California State Water Project. You will also find a comprehensive list of links to related sites.

<http://wwwswpao.water.ca.gov/>

Approximately 20 million Californians depend on the State Water Project for at least part of their water needs. The State Water Project Analysis Office, or SWPAO, helps to ensure that they get that water. Find out how they do this!

Water Transportation

Monument: Panama Canal

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.

Seven Wonders of the Modern World 1955, 1994



The dream of Spanish conquistadors, the Panama Canal is one of civil engineering's greatest triumphs. Some 42,000 workers dredged, blasted and excavated the canal. They moved enough earth and rubble between Colon and Balboa to bury Manhattan to a depth of 12 feet. The canal was finished on time and within budget, but after completion a challenge remained: how to tame the flood waters of Chagres River, known to rise 25 feet in a day during monsoon season. Solution: Civil engineers erected a dam that formed the world's then-largest human-made lake. Today, the canal operates much as it did in 1914. In each transit, 52 million gallons of fresh water is lost, but it is quickly replaced by Panama's heavy rainfall. Previous ASCE designations include International Historic Civil Engineering Landmark (1984) and Seven Wonders of the Modern World (1955 and 1994).

Additional Information

<http://www.pancanal.com/>

Detailed information from the Panama Canal Authority, offering information about current programs and projects, historical trivia and photographs and general information about the intricate workings of the Canal.

<http://www.pancanal.com/eng/photo/camera-java.html>

Web cam provided by the Panama Canal Authority. This camera shows operations at the Miraflores Locks and other points of interest in the Canal.

<http://www.canalmuseum.com/>

This site is perfect for the visual learner. It boasts photographs in chronological order, numerous steps involved in the Panama Canal's construction. Also contains historic data and stories about Panama and its people.