China's Three Gorges Dam and Its Impact on Water Environment

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Background: CE 496 Field Experience

- A student initiated course spending 10 days in China
- Activities include: academic exchange, engineering and historical site visits, and cultural experience
- Yangtze River and the Three Gorges Dam are main focuses
- The course has been offered 3 times since 2005.

Exchange Activities at Beijing University of Civil Engineering and Architecture

Historical Sites

Beijing Olympic Stadiums

Other Sites

Three Gorges and The Dam

The Three Gorges Dam

- The world's largest hydroelectric dam, it generates 11 times as much power as the Hoover Dam
- The Three Gorges Dam consists of a 610-foot (181 m) high wall running 1.3 miles from bank to bank.
- The reservoir extends 360 miles upstream.
- The Three Gorges Dam cost $37 billion to build
- 13 cities, 140 towns, and more than 1,600 villages have been submerged.
- 1.3 million people were relocated.

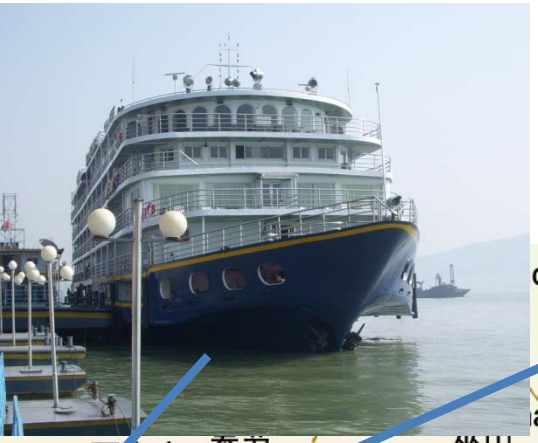
Some Numbers

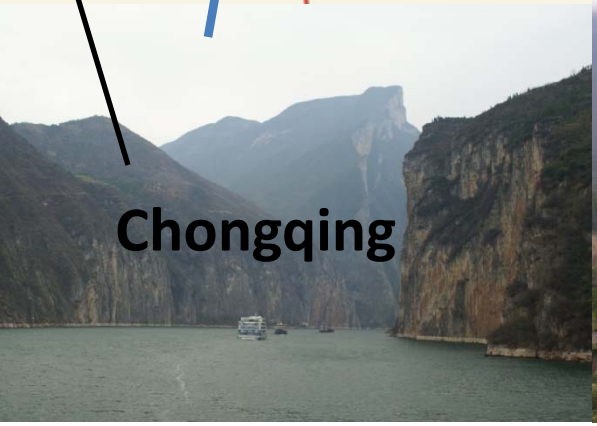
- Earth and rock excavation:
  102.83 million m^3
- Earth and rock embankment:
  31.98 million m^3
- Concrete casted: 27.94 million m^3
- Re-bar used: 463,000 tons
- Metal works: 256,500 tons
- Hydro turbine generators:
  26 (18,200 MW)

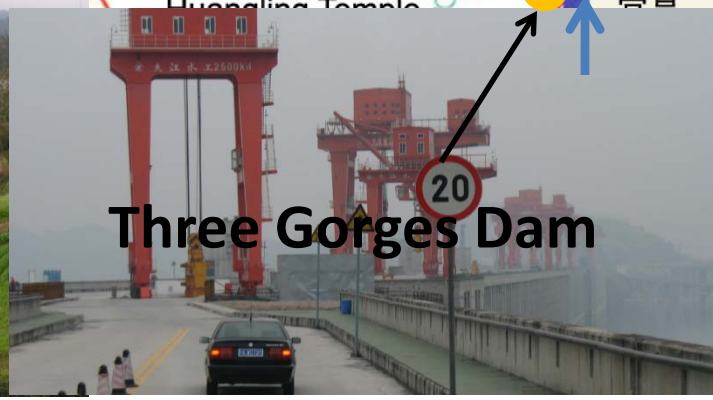
Major Benefits

- **Flood Control**. Reservoir volume 39.3 billion m^3. Volume available for flood protection, 22 billion m^3.
- **Power Generation**. Average annual electricity generation, 84.7 billion kWh.
- **Navigation**. Eliminating shoals and rapids enabling the passage of 10,000 ton ships
- **Tourism**
- **Development-oriented resettlement**. Creating construction and factory jobs.

From Chongqing to the Three Gorges Dam







Rising Water

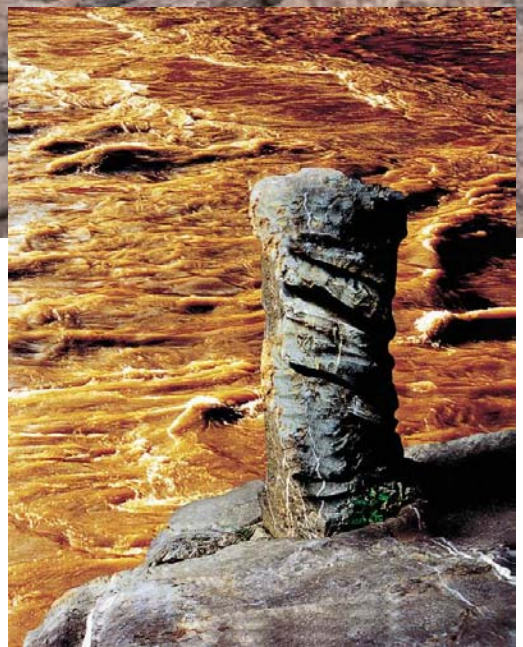
- Fengdu-also known as Ghost City.
- A city with about half million people
- An ancient Buddhist site for nearly 2000 years


Fengdu, 2005


Fengdu, 2007

Fengdu, 2010

Impact on River Traffic



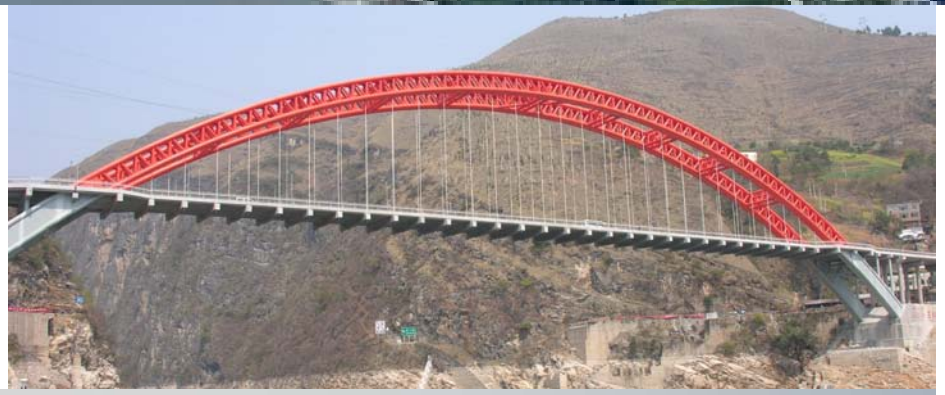
Historical Pictures

River Traffic and Impact

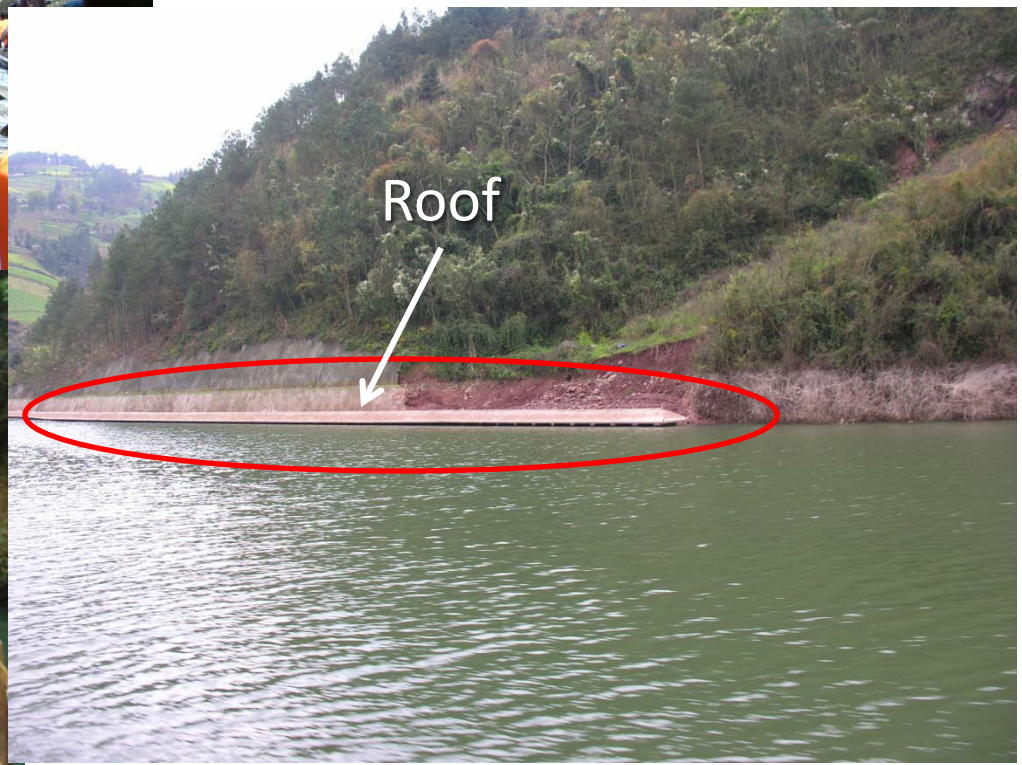
More than 50% wastes are dumped in the river

Booming Economy

- Population increasing
- Cities are expanding
- New constructions everywhere



Small mountain creeks became rivers



Impact or Rising Water on People

- Moved to higher ground
- Farm on steep slope or all the way to the water
- Moved to cities

Impact on water quality

- Lot of money was invested to control erosion, wastewater discharge and solid waste disposal
  - We saw slope protection along the river
  - Many wastewater treatment plants were built
  - 80% solid wastes are disposed on in landfills

Impact on water quality

- However, wastewater discharge, soil erosion, agricultural run off, and improper waste disposal still post great threat to water quality.

SCIENTIFIC AMERICAN™

China's Three Gorges Dam: An Environmental Catastrophe?

Even the Chinese government suspects the massive dam may cause significant environmental damage

By Mara Hvistendahl | March 25, 2008 | 27

三峡库区水环境安全压力很大 存二次污染隐患

2011-01-26 15:32

工人日报

绿色之旅】三峡水库之清关乎三千万人健康舒为群长期从事三峡库区水质研究。他有些担忧，三峡库区蓄水后水流速度减缓，水体自净能力下降。因此，总人口达3100万的这个区域是值得高度关注的生态及人群健康风险区域。

三峡水库有近半的餐饮船，都将污水、生活垃圾直排入江，这会造成很大的污染。”

设计能力超前令当地污水处理厂“吃不饱”，这使得有的污水处理厂折旧成本居然高达80%，亏损严重。据悉，截至去年底，重庆已累计建成105座生活污水处理厂，覆盖了全市40个区县。重庆污水集中处理比例已经达到75%，垃圾卫生填埋处理率达到80%，相当于沿海发达地区水平。

由于设计存在缺陷，三峡库区已经建成的污水处理厂的污泥和垃圾处理场的渗滤液都存在二次污染的隐患。

The New York Times

WORLD BRIEFING | ASIA

China: Water Quality Worsens Near Three Gorges Dam

By KEITH BRADSHER
Published: February 20, 2008

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The Environmental Protection Administration said water quality was barely improving in the main body of water behind the Three Gorges Dam and in the upper reaches of the Yangtze, although the water does meet national standards for drinking, fisheries and swimming. Water quality is worsening in several branches of the Yangtze that drain into the main reservoir, the agency said in a water management plan, echoing previous government documents. The dam has slowed the flow of the Yangtze, and that reduces the ability of the river and its tributaries to flush out polluted areas.

Wastewater Treatment

- The reservoir area has a population of 31 million and over 3000 factories.
- 150 wastewater treatment plant is going to be built with an estimate of $4.8 billion.
- By the end of 2010, 105 wastewater treatment plants were built.
- Problems:
  - Most of the treatment plants are over designed causing operational problems.
  - System upset caused by shock loadings from landfill leachate.
  - Improper sludge handling causing secondary contamination

Algal Bloom

- Low velocity (0.01 – 0.5 m/s) in the reservoir causes siltation.
- Long detention time together with agricultural runoff and wastewater discharge cause algal bloom.

Floating Trash Threatens Three Gorges Dam

- During flood season large amount trash is carried by the river
- 150,000-200,000 tons of trash is collected every year.
- Trash collection costs $1.5 million per year

Summary

- Among other environmental concerns, water quality is a major challenge to the Three Gorges Project and people in the area.
- Siltation problem was well understood and lot of studies were done, but control it is still difficult.
- Floating trash may be reduced by better education and solid waste control.
- Eutrophication did not receive enough attention in the design phase, but is the biggest water quality problem now.
- Over designed wastewater treatment plants could be as bad as no treatment plant. It is important to listen to engineers.

Thank You!