

INTRODUCTION TO CIVIL ENGINEERING



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This presentation deals with

- ▣ Introduction to Civil Engineering
- ▣ Scope of Different fields of Civil Engineering
 - Architecture & Town Planning
 - Building Materials
 - Construction Technology
 - Environmental Engineering
 - Geotechnical Engineering
 - Hydraulics, Water Resource & Irrigation Engineering
 - Remote Sensing & GIS
 - Structural Engineering
 - Surveying
 - Transportation Engineering

This presentation also deals with

- ▣ Roads
 - Basic definition
 - Cross Section of road
 - Components of Road
 - Types of Road and their Functions
- ▣ Bridges
 - Definition
 - Functions
 - Classification
- ▣ Dams
 - Definition
 - Functions
 - Classification

This presentation also deals with

- ▣ Infrastructure
- ▣ Types of Infrastructure
- ▣ Role of Civil Engineers in Infrastructure Development
- ▣ Effect of Infrastructure on economic development of a country

Engineering

- ▣ *Ingenious* means 'Clever person' in Latin
- ▣ Engineer cleverly uses the available natural resources for the benefit of mankind
- ▣ Provides comfort to mankind and makes life comfortable.
- ▣ Application of scientific and mathematical knowledge and rational thinking to improve living standards

Civil Engineering

- ▣ Oldest branch of engineering, next to Military engineering. All engineering works other than for military purposes were grouped in to Civil Engineering. Mechanical, Electrical, Electronics & present day Information technology followed it.
- ▣ A professional engineering discipline that deals with the analysis, design, construction and maintenance of infrastructural facilities such as buildings, bridges, dams, roads etc.
- ▣ Constructions are against nature.
- ▣ Application of physical, mathematical and scientific principles for the convenience of civilization.
- ▣ Began b/w 4000 BC and 2000 BC (during Ancient Egypt, Mesopotamia, Indus Valley Civilizations).
- ▣ *John Seaton* was the first self proclaimed Civil Engineer who built Eddy stone Light House in 1771.

Civil Engineering is Everywhere



Why? **61% are clueless about engineering**

Civil Engineering is a composite of many specific disciplines that include structural engineering, water engineering, waste material management and engineering, foundation engineering etc. among many.

Building Big!!!!

Buildings & Structures: Cities

Infrastructure: Transportation

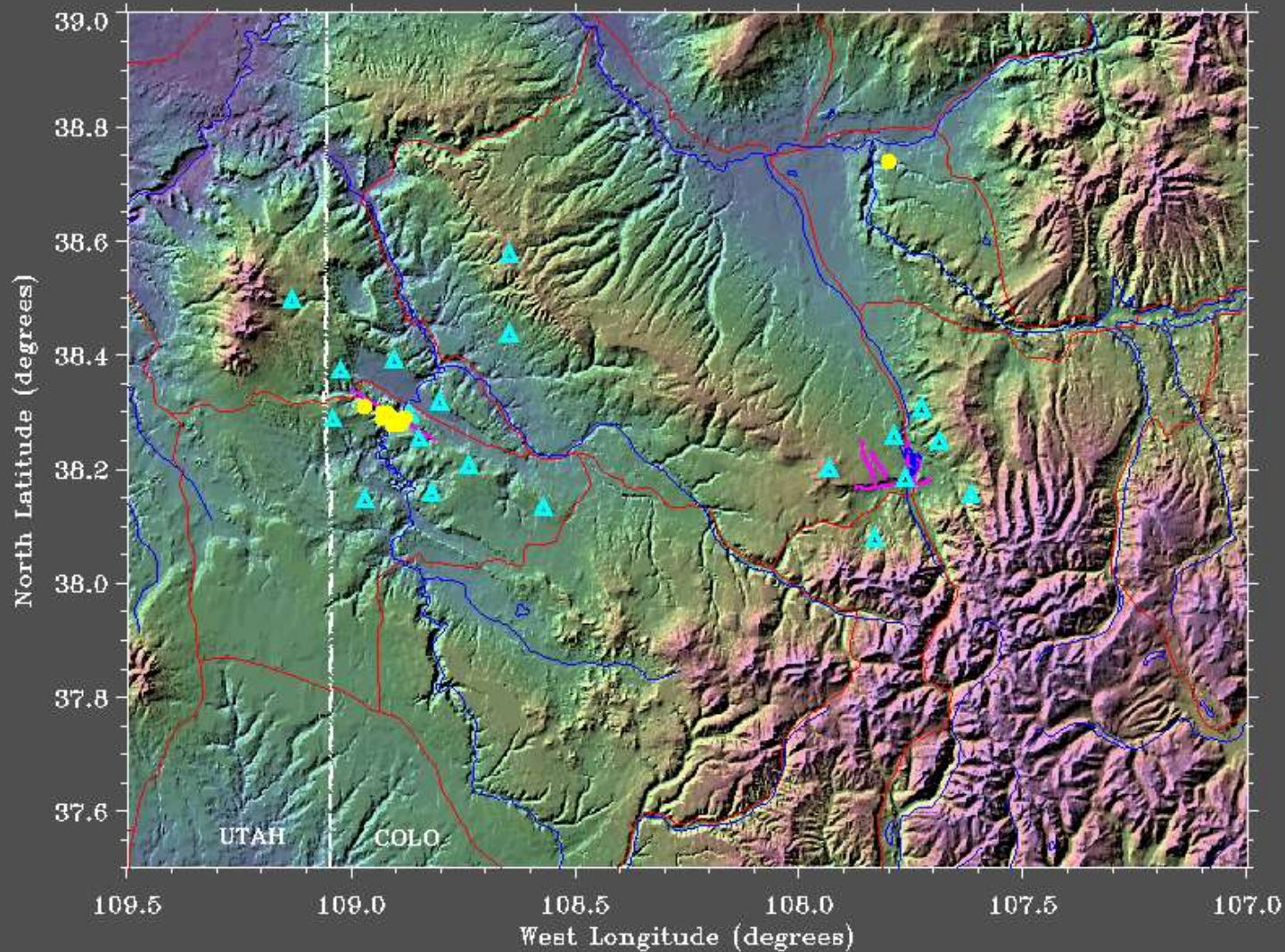
Culture: Art: Architecture

The Future: Without Limit!

[Link: Building Big Site](#)

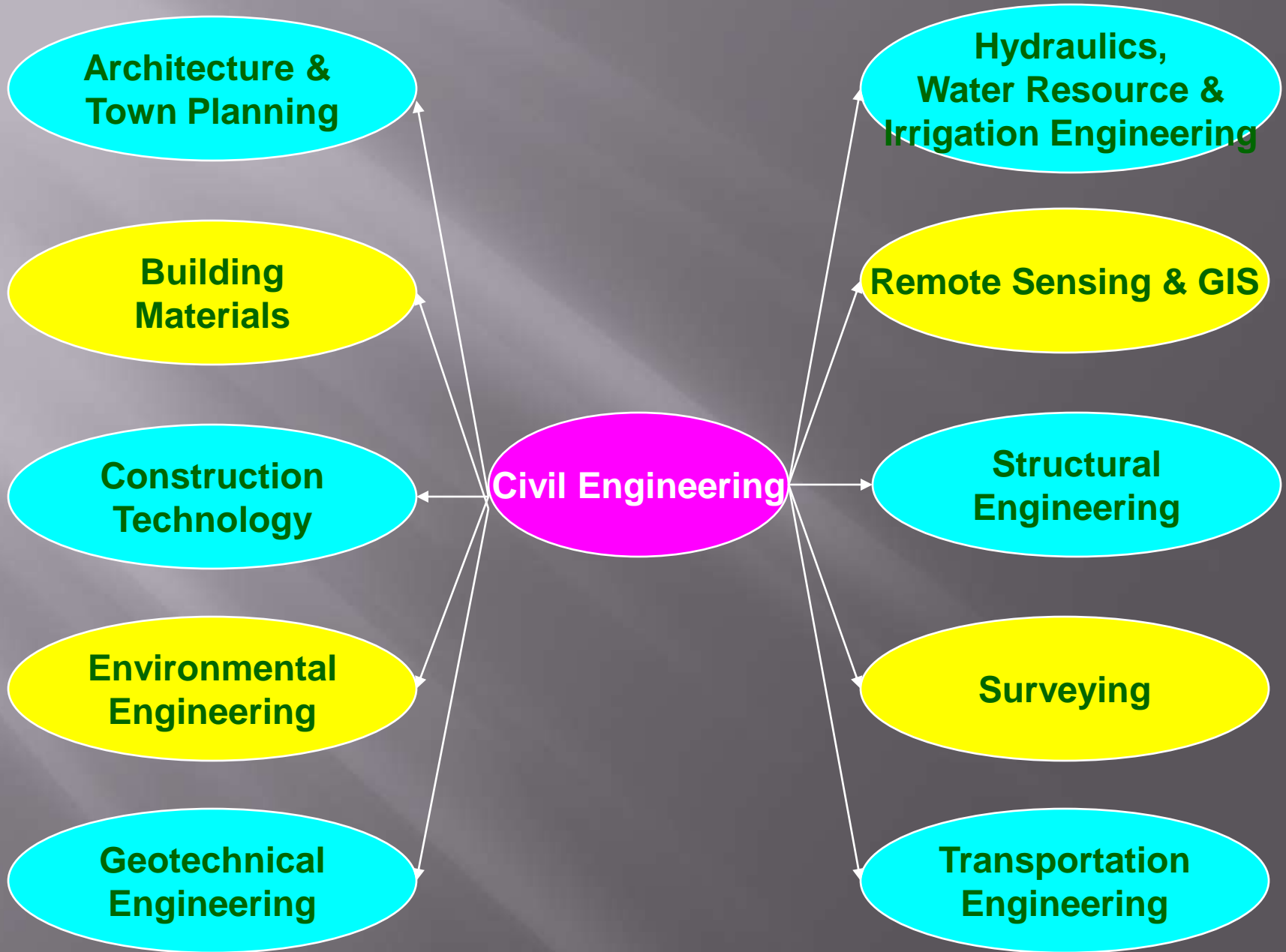


Natural Disasters & Civil Engineering



U.S. Bureau of Reclamation – Paradox Valley Seismographic Network

DISCIPLINES OF CIVIL ENGINEERING



Architecture & Town Planning

- ▣ Giving beauty to buildings is architecture
 - Enhancing the appearance
 - Maintaining heritage
- ▣ Proper planning of towns & cities
 - Planning the layout
 - Planning the road
 - Separating the commercial, residential, academic and industrial areas
 - Planning green belt
 - Planning sewage disposal units
 - Planning water treatment plants and water storage units

Presently separated from Civil Engineering

Building Materials Technology

- ▣ This deals with materials used for construction. Brick, tiles, soil, cement, stone, sand, steel, aggregates, glass, wood, plastics etc. include construction materials. Some are natural and many are man made.
- ▣ This deals with the proper use of desired material economically and safely.
- ▣ The mechanical properties of these materials shall be sufficient to avoid failure and excessive deformation and provide durability.
- ▣ The chemical properties shall be to maintain good environment.

Construction Technology & Management



- ▣ Deals with planning, scheduling and execution of construction activity related to a project.
- ▣ Comprises of men, material, time and money management.
- ▣ Emphasis will be on new construction practice, use of appropriate and local technology, safety of men and material, utilization of marginal materials etc.

Construction Technology & Management

- ▣ Construction managers:
 - Review contracts,
 - Order materials,
 - Hire and schedule sub-contractors.
- ▣ The job of a construction manager is to:
 - Provide quality control and insure project is completed on time and.
 - Within budget.



Environmental Engineering

- Environment is the available nature around us. It includes the life support system such as water, air and land/Soil.
- Environmental engineering deals with the technology to save nature from human and natural abuse and pollution.
- The study involves balanced compromise between environment and safety.
- It deals with,
 - Technique of water collection, purification and supply
 - Waste water collection, treatment and disposal
 - Control of all types of pollution

Environmental Engineering



**Environmental
Vs
Environmental
Engineer**



Geotechnical Engineering

- ▣ All structures are founded on ground. Forces from structure are safely transferred to soil. Essential to understand ground behavior and interaction between soil and structure.

- ▣ Involves

- ▣ Foundations
- ▣ Slopes
- ▣ Retaining Structures
- ▣ Highway pavement design
- ▣ Embankments and earth dams
- ▣ Tunnels, underground structures and deep cuts

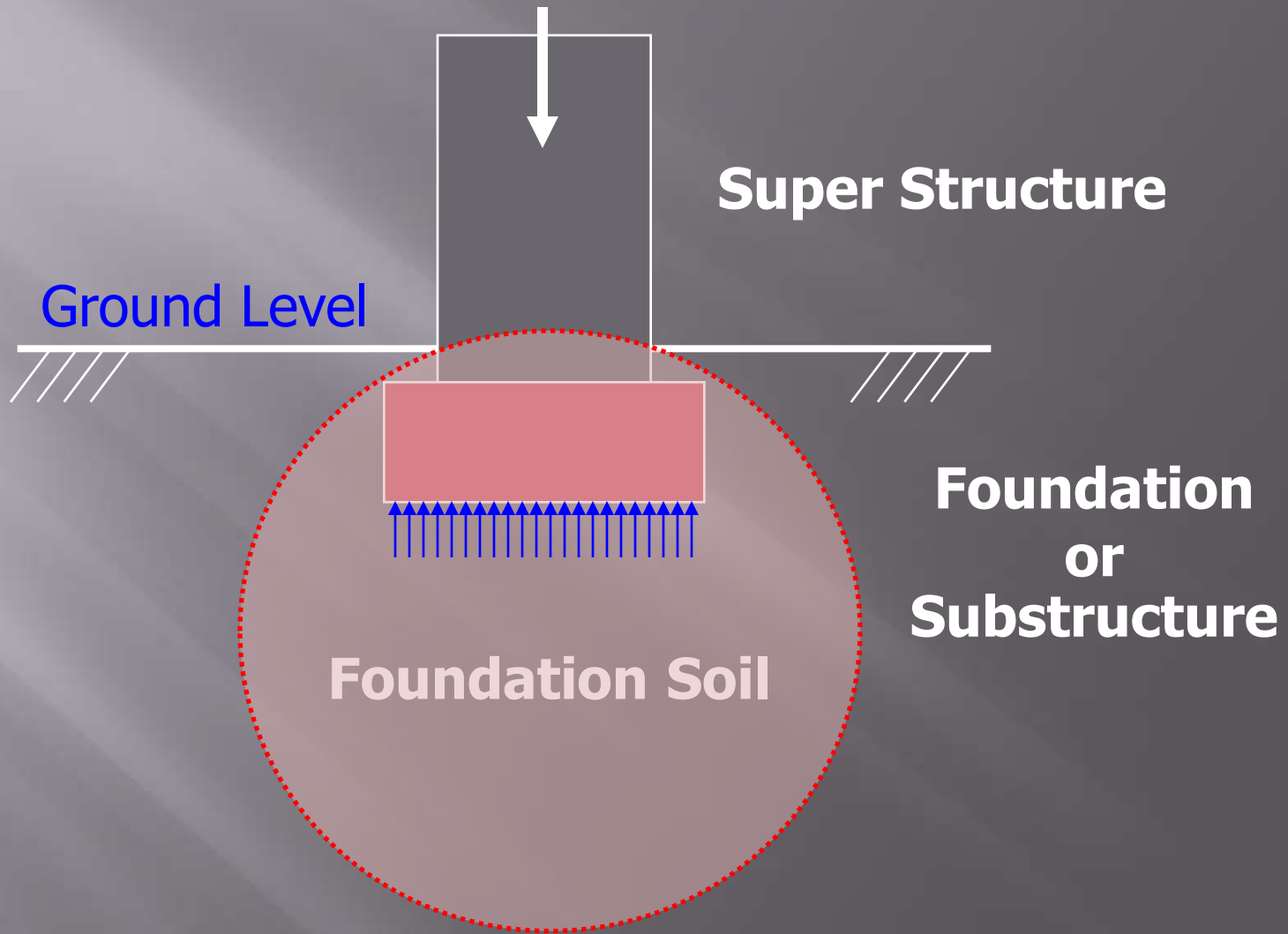


Geotechnical Engineering

- ▣ To assess the quality of soil or rock to carry the structure
- ▣ Proper knowledge of geotechnical engg is necessary for safety and stability of structures



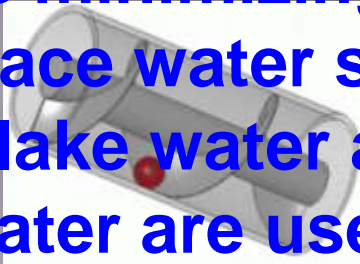
For a geotechnical engineer,



Foundation Soil and sub-structure should resist forces without failure or excessive deformation

Hydraulics, Water Resource & Irrigation Engineering

- Hydraulics deals with mechanics of water (fluid) flow.
- Water resource engineering deals with identification & utilization of available water resources minimizing the loss. Surface water such as river and lake water and ground water are usefully managed.
- This also deals with ground water utilization, ground water recharge and rain water harvesting.



Hydraulics, Water Resource & Irrigation Engineering

- ❑ Irrigation engineering deals with water management for agriculture purpose.
- ❑ Dams are constructed at the desired locations to store water in reservoir when the supply from river is good and to utilize for useful purpose during draught. Canals are built for the purpose. During excess input, water is allowed to main river through the body of dam to avoid flooding.



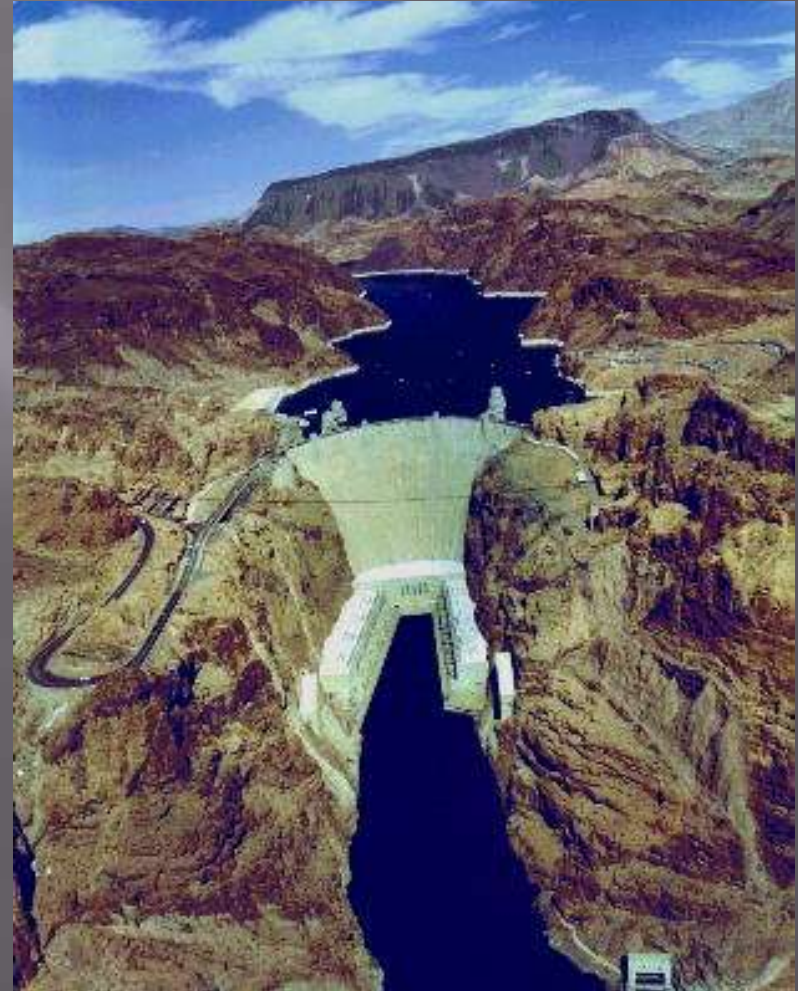
Falkirk Wheel in Scotland



Hoover Dam in USA

Hydraulics, Water Resource & Irrigation Engineering

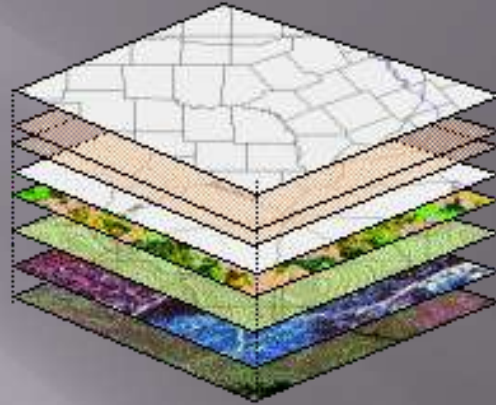
- ▣ Water management involves the use of hydrologic and hydraulic principles to design:
 - Drainage systems,
 - Detention/retention ponds,
 - Navigational waterways, and
 - Flood control levees, dams, and lakes.



Remote Sensing & GIS

- ▣ This is one of the new fields.
- ▣ The improvement in space technology, availability of GPS enhanced the scope of geographic information system.





- Good mapping technique helps to get required information accurately and quickly to effectively manage and monitor the available resources for optimal use.
- GIS is an hightech equivalent of map. It represents a means to locate ourselves in relation to world around us. It deals with measurement, mapping, monitoring and modeling of geographic information around us.

Structural Engineering



Burj Dubai

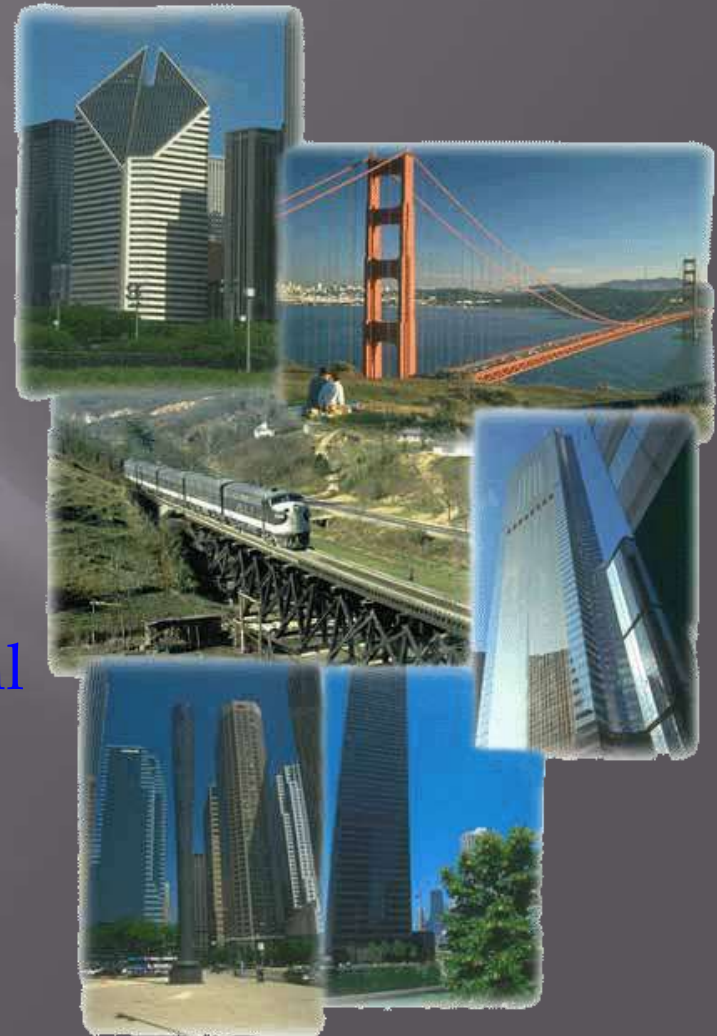


Petronas

- ▣ Structure is the assemblage of two or more basic elements such as beam, slab, column, truss, frame, shells etc.
- ▣ Deals with the requirements considering design for limit states of collapse and serviceability.

Structural Engineering

- ▣ Involves determination of support reactions, member forces and moments, deflection and deformations.
- ▣ Deals with planning of positions/layout of different elements and design (determination of size, shape and material) of component such that safety and serviceability requirements are not sacrificed, yet economy is considered.
- ▣ Repair, rehabilitation and maintenance is part of structural engineering.
- ▣ Dams, Bridges, Stadiums, Auditoriums, Multi-storeyed buildings are analysed & designed



Surveying

- ▣ Activity involved in collection of topographic features of a location for future construction.
- ▣ Feasibility survey, alternate and most suitable method is evolved
- ▣ Helps in environmental impact assessment



Surveying



Objectives of Surveying

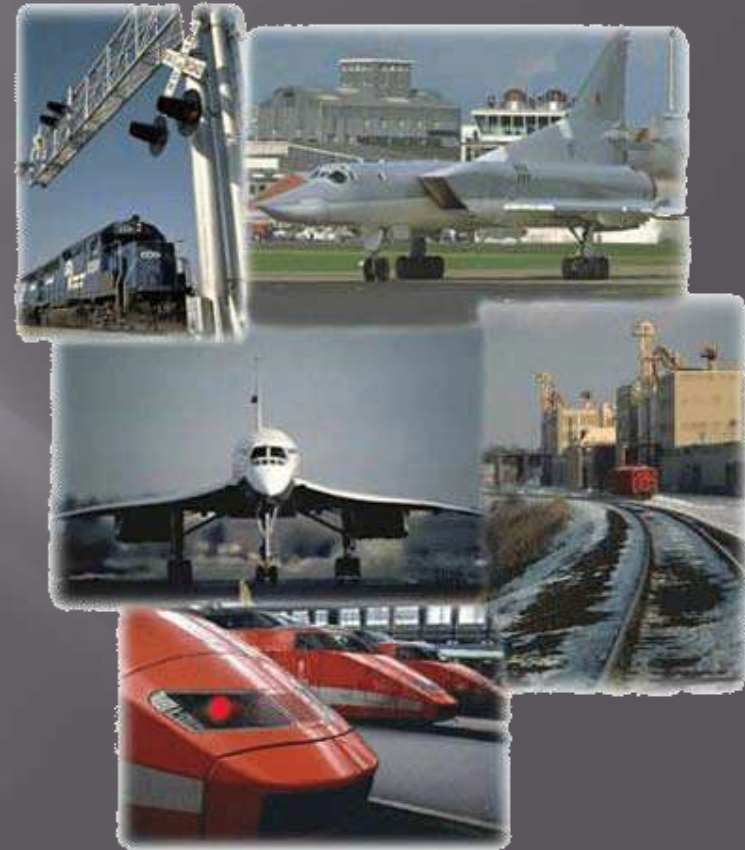
- Execution of survey to collect topographic data
- Calculation and analysis of data, plotting survey data to create design maps
- Provision of line, grade and other layout works



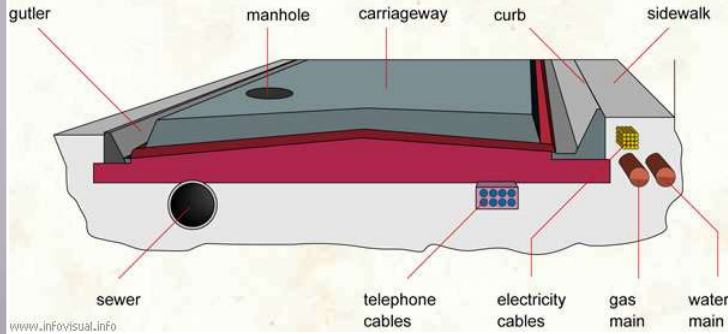
Total Station

Transportation Engineering

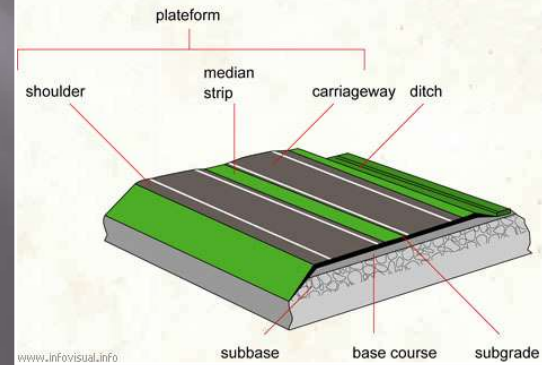
- ▣ Application of scientific approach (planning, design, operation and management) of transportation systems such as roads, railway, sea/river & air transports.
- ▣ It involves planning, design, construction/operation and maintenance of transportation facility.
- ▣ In air strip runways, roads and railway, the study includes the design of pavement system.
- ▣ Maintenance and upgradation of docks, harbors, airports, railway system based on requirements, population growth is a part of this discipline.



CROSS SECTION OF A ROAD



CROSS SECTION OF A ROAD



**Deals with Transportation system
Planning And high way material design**

Roads, Bridges & Dams

Road

- ▣ A road is an identifiable route, way or path between two or more places
- ▣ Roads are typically smoothed, paved, or otherwise prepared to allow easy travel
- ▣ A "road" was simply any pathway fit for riding.
- ▣ The United States has the largest network of roadways of any single country in the world with 6,430,366 km (2005).
- ▣ India has the second largest road system in the world with 3,383,344 km (2002).
- ▣ People's Republic of China is third with 1,870,661 km of roadway (2004).

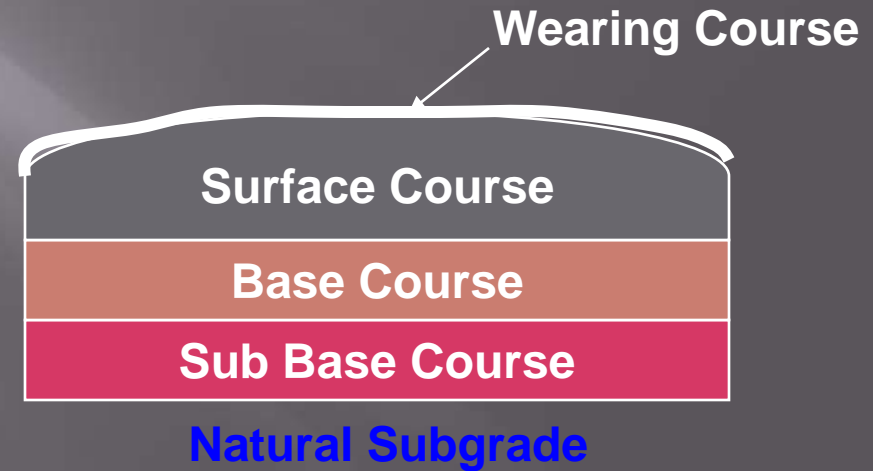
Classification of Roads

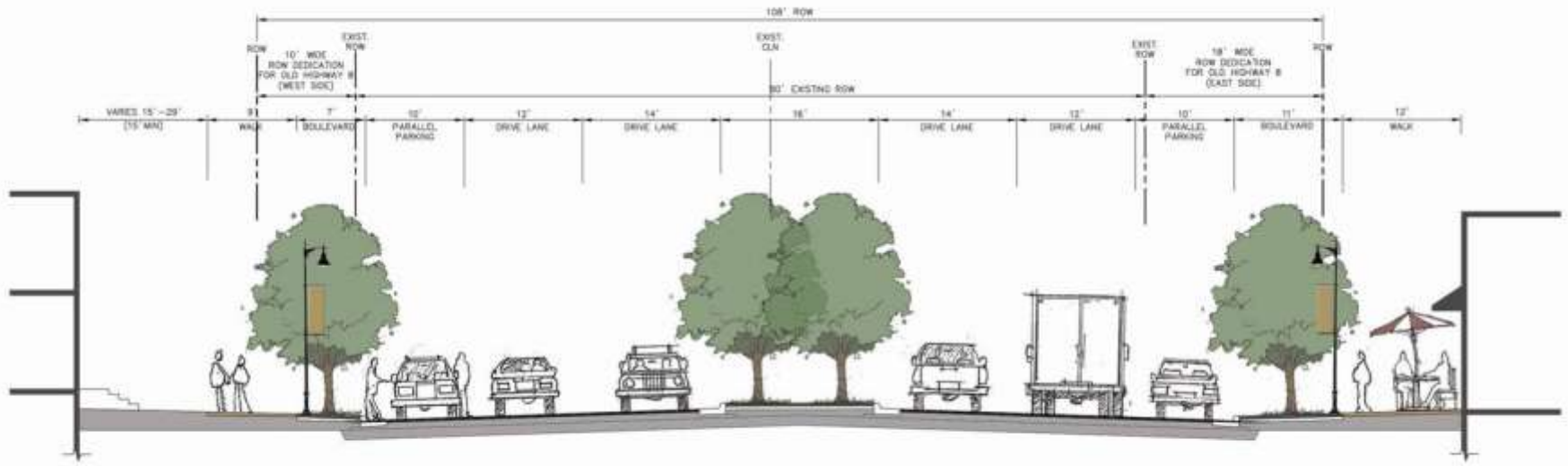
- ▣ Based on Size
 - Single, Double, Four, Six Lane Roads etc.
- ▣ Based on (Nagpur Road Plan) national principles
 - National Highways
 - State Highways
 - Major District Roads
 - Minor & Other District Roads
 - Village Roads
- ▣ Based on type of road surface
 - Bituminous Road
 - Concrete Road
 - Water bound macadam road
 - Mud Road



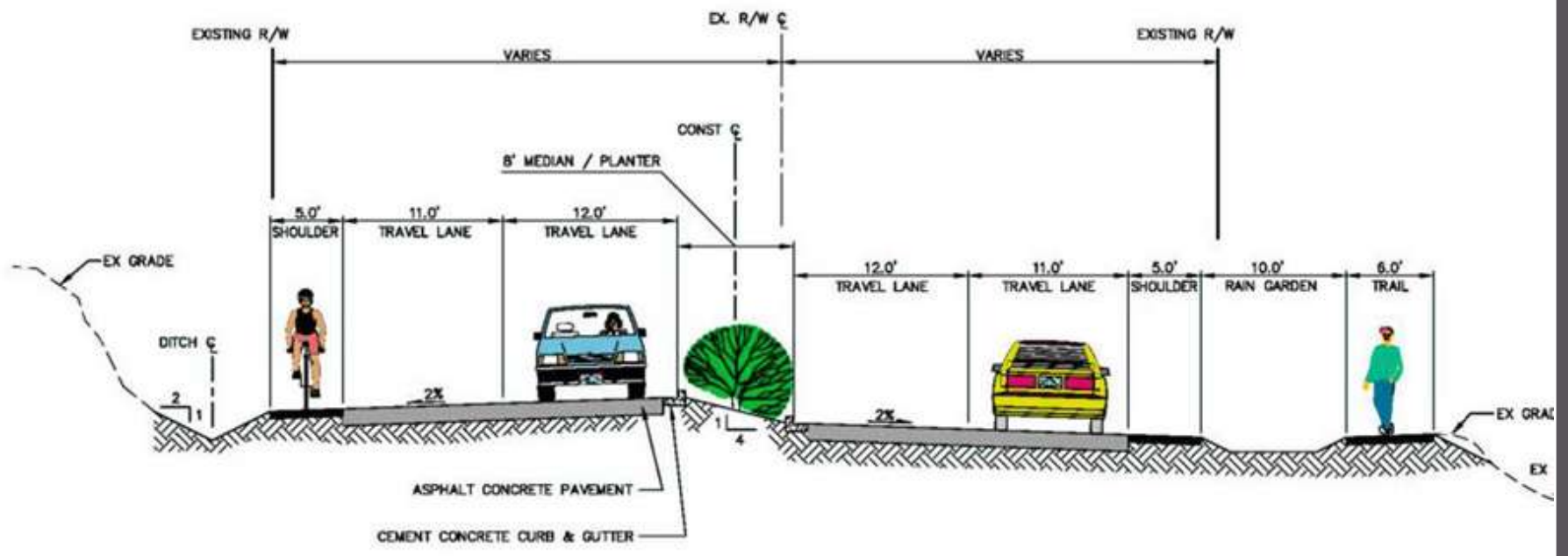
Components of Road

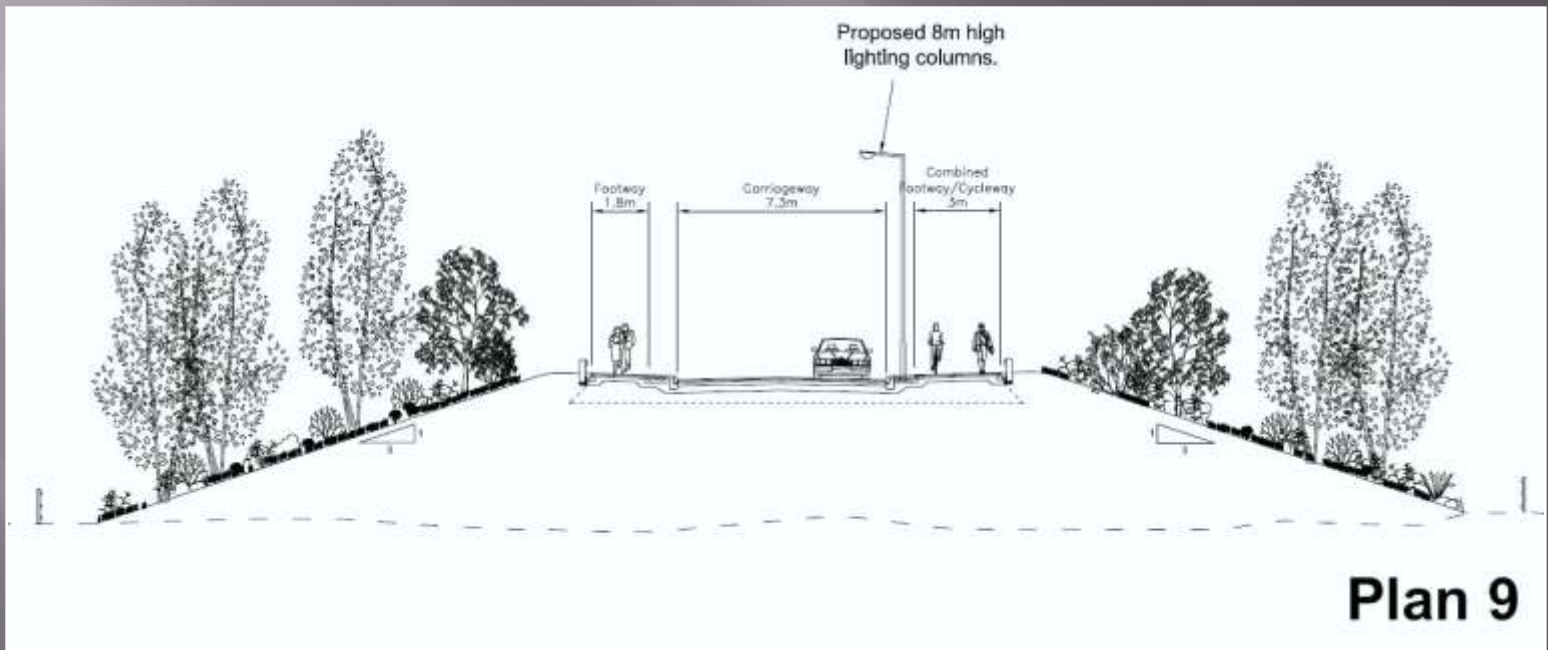
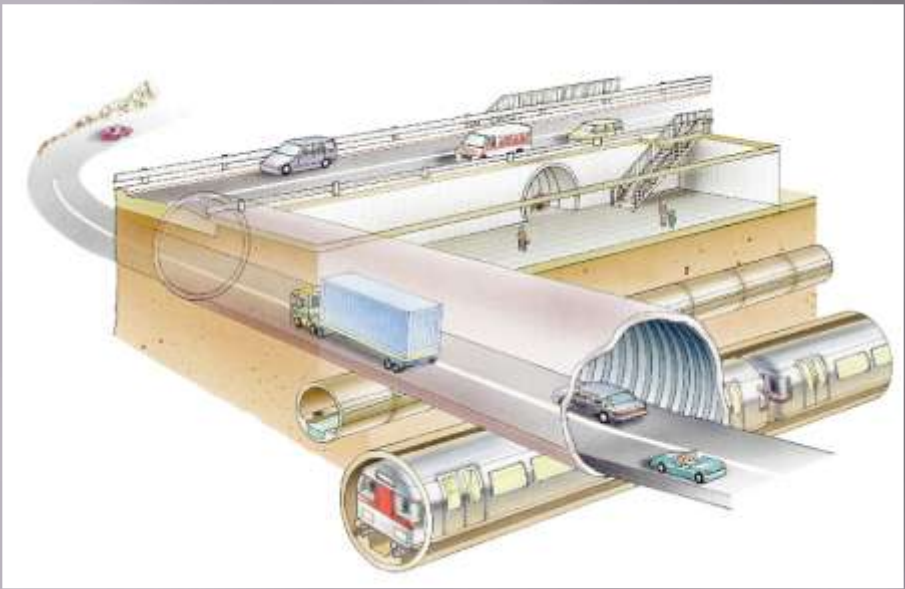
- ▣ Carriageway
- ▣ Berm / Kerb
- ▣ Drain
- ▣ Shoulder
- ▣ Footpath
- ▣ Cycle Track

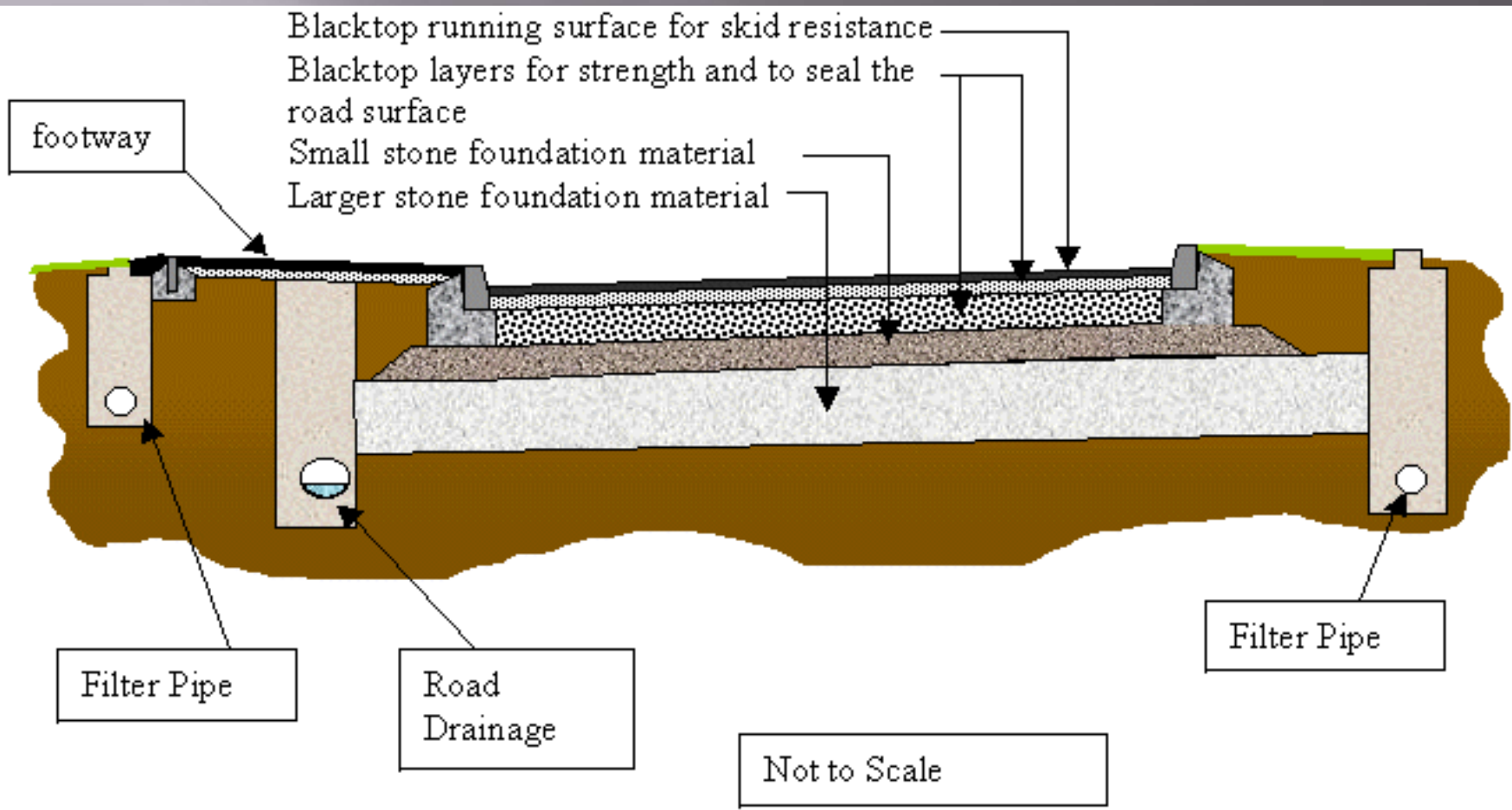


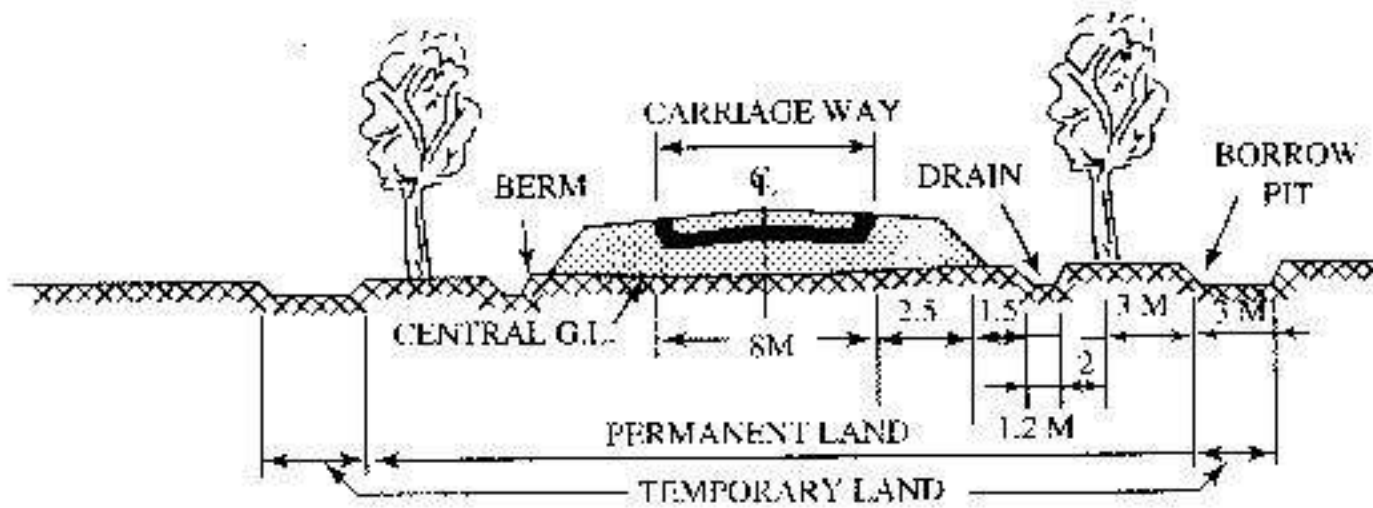


OLD HIGHWAY B - OPTION 2

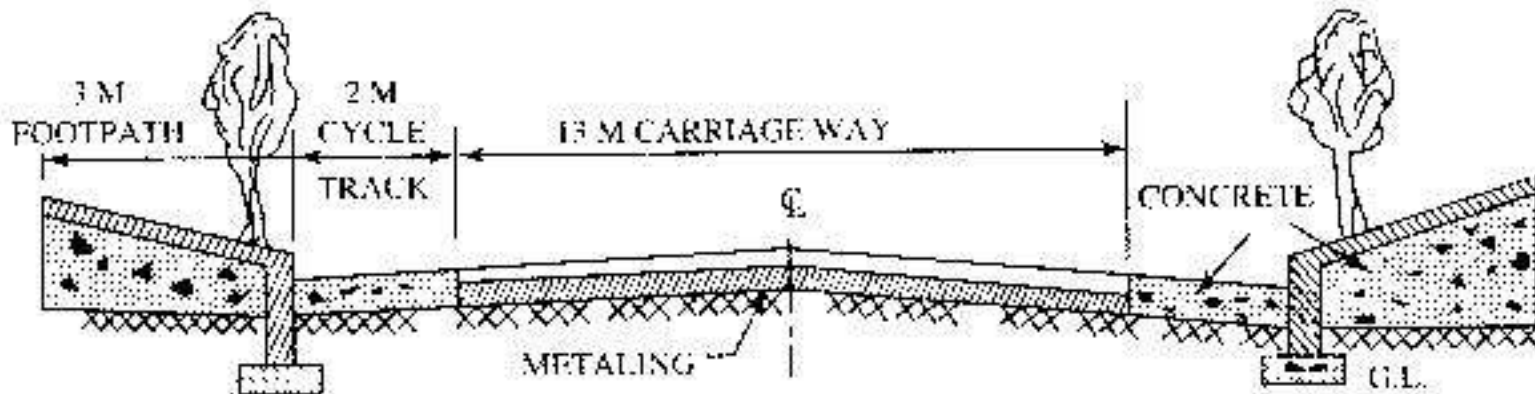




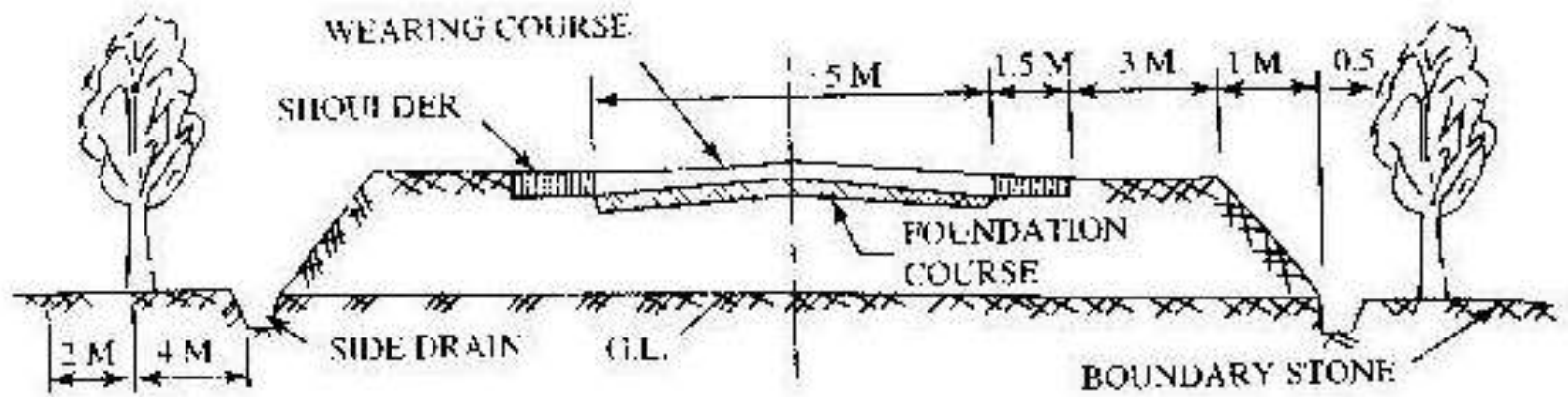




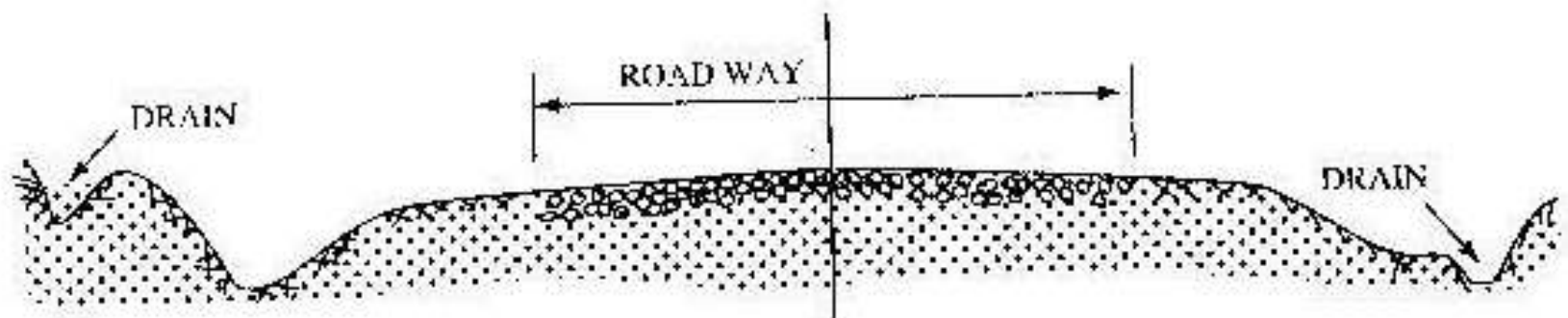
National Highway.



District Road.

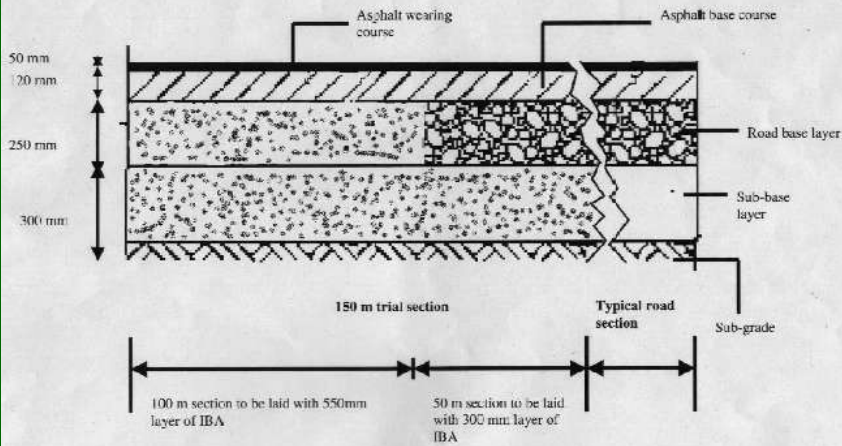


Other District Road.

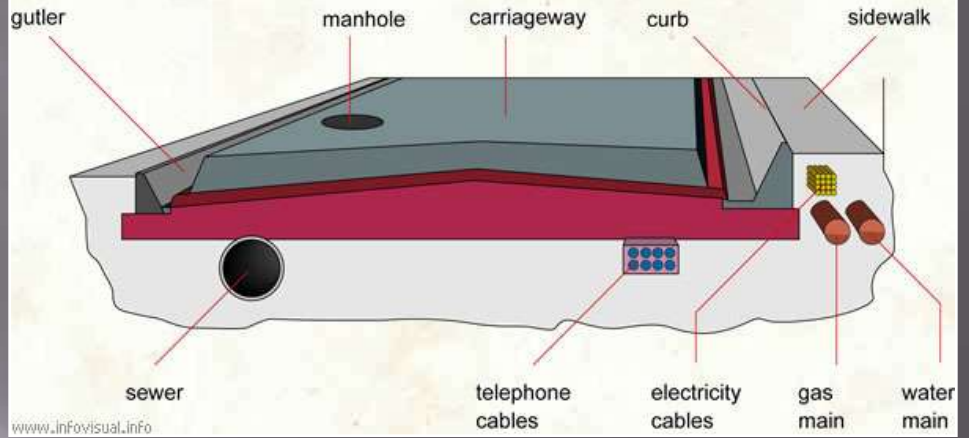


Village Road.

IBA Trial Road Section at Jalan Buroh/Penjuru Road

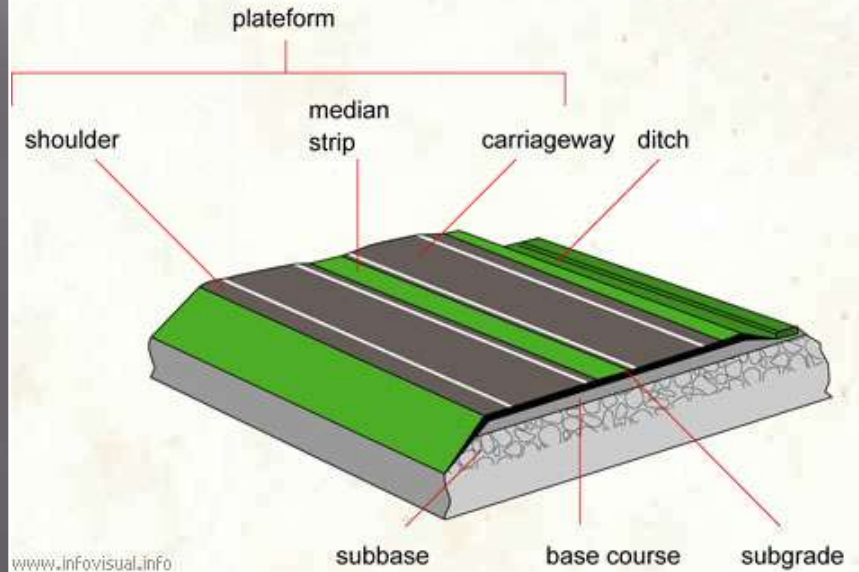


CROSS SECTION OF A ROAD



www.infovisual.info

CROSS SECTION OF A ROAD



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Bridges

- ▣ A bridge is a structure built to span a gorge, valley, road, railroad track, river, body of water, or any other physical obstacle.
- ▣ A bridge is designed for trains, pedestrian or road traffic, a pipeline or waterway for water transport or barge traffic.
- ▣ An aqueduct is a bridge that carries water, resembling a viaduct, which is a bridge that connects points of equal height.
- ▣ A road-rail bridge carries both road and rail traffic.
- ▣ A bridge's *structural efficiency* may be considered to be the ratio of load carried to bridge mass, given a specific set of material types.
- ▣ A bridge's *economic efficiency* will be site and traffic dependent, the ratio of savings by having a bridge (instead of, for example, a ferry, or a longer road route) compared to its cost.

Classification of Bridges

Based on Action

- ▣ Beam bridges
- ▣ Cantilever bridges
- ▣ Arch bridges
- ▣ Suspension bridges
- ▣ Cable-stayed bridges
- ▣ Truss bridges

Classification of Bridges

Based on Material used

- ▣ Concrete Bridge
- ▣ Steel Bridge
- ▣ Timber Bridge
- ▣ Composite Bridge

Classification of Bridges

Based on purpose

- ▣ Road Bridge
- ▣ Rail Bridge
- ▣ Rail & Road Bridge
- ▣ Pedestrian Bridge
- ▣ Aqueduct

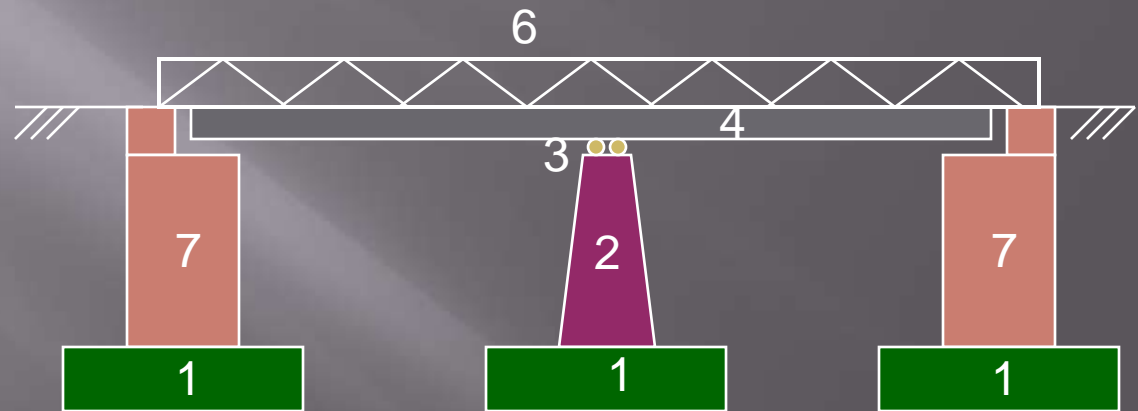
Classification of Bridges

Based on type of Support

- ▣ Simply Supported Bridges
- ▣ Continuous Bridges
- ▣ Fixed Bridges
- ▣ Cantilever Bridges

Components of Bridge

1. Caisson/Raft
Foundation
2. Bridge Pier
3. Bearing
4. Deck Slab
5. Roadway
6. Railing
7. Abutment





Arch Bridge



Beam Bridge



Cable Stayed Bridge



Cantilever Bridge

The Basic Bridge Types



Beam / Girder Bridge



Arch Bridge



Truss Bridge



Cable Stayed Bridge

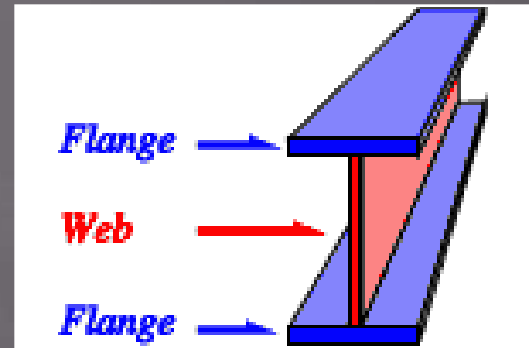
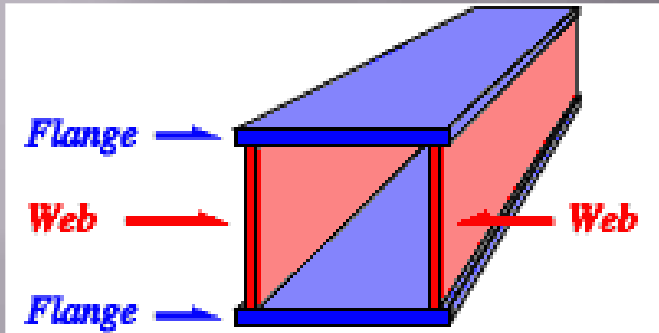


Rigid Frame Bridge



Suspension Bridge

GIRDER BRIDGE



Namihaya Bridge, Osaka, Japan

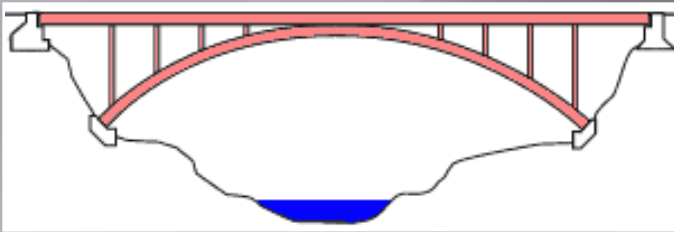
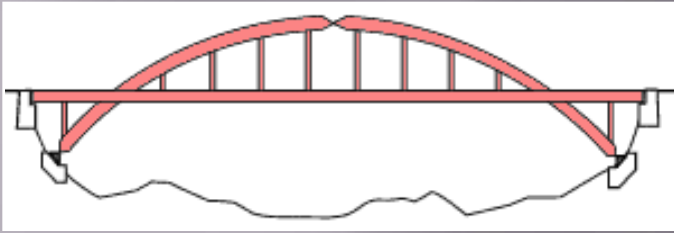
Typical Span Lengths

10m - 200m

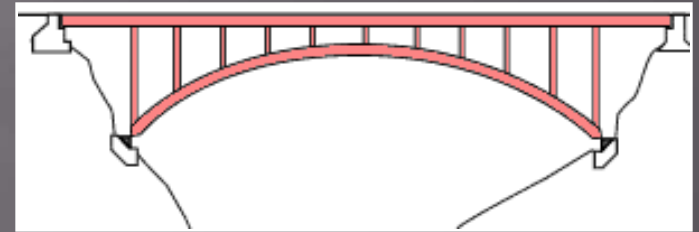
World's Longest

Ponte Costa e Silva,
Brazil

| | |
|--------------|------|
| Total Length | 700m |
| Center Span | 300m |
| | |
| | |



ARCH BRIDGE



Meiwa Bridge, Edogawa-Ku, Tokyo

Typical Span Lengths

40m - 150m

World's Longest

New River Gorge Bridge, U.S.A.

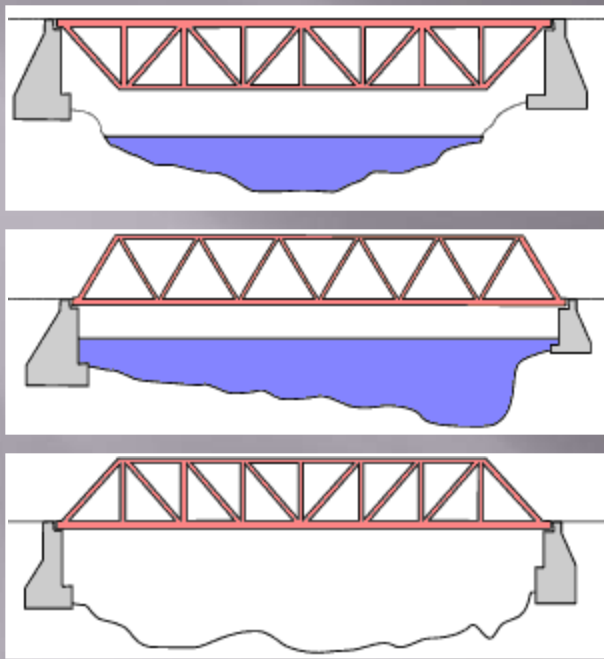
Total Length

924m

Center Span

518m

TRUSS BRIDGE



Typical Span Lengths

40m - 500m

World's Longest

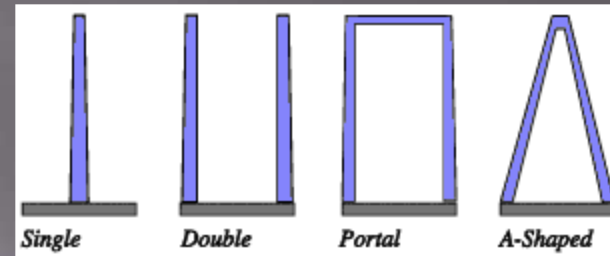
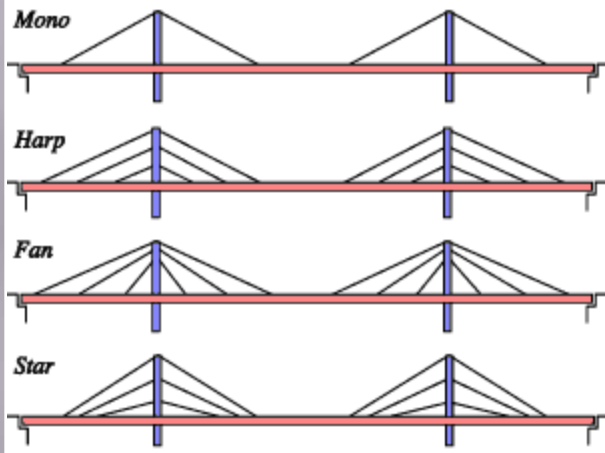
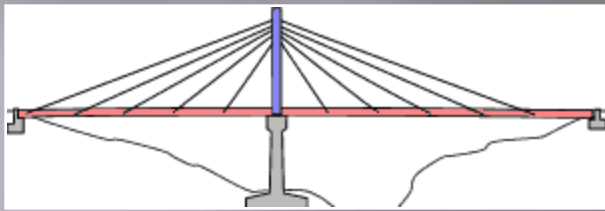
Pont de Quebec

| | |
|--------------|------|
| Total Length | 863m |
| Center Span | 549m |
| | |
| | |

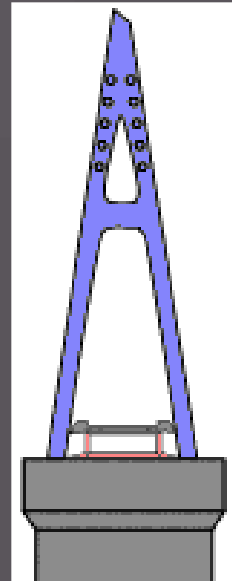


2nd Mameyaki Bridge, Saitama, Japan

Cable Stayed Bridge



Pylon



Tsurumi Tsubasa Bridge

Typical Span Lengths

110m - 480m

World's Longest

Tatara Bridge, Japan

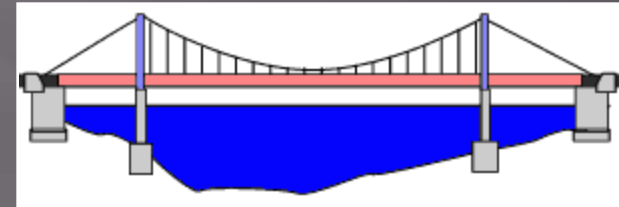
Total Length 1,480m

Center Span 890m

Suspension Bridge

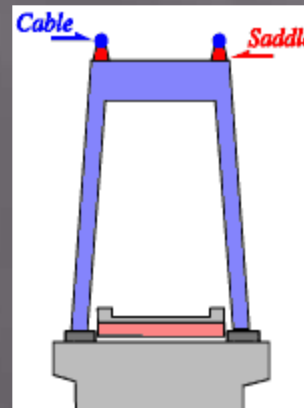


Ohnaruto Bridge



Hakucho Bridge

Pylon



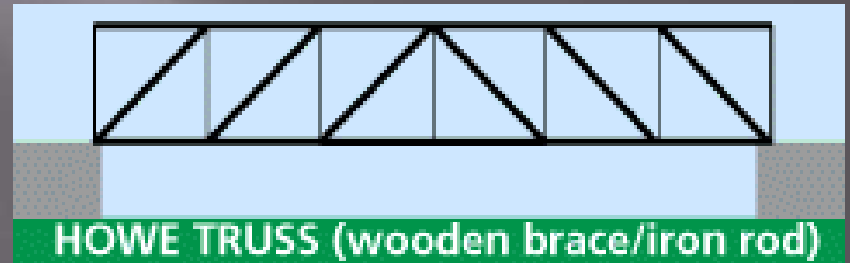
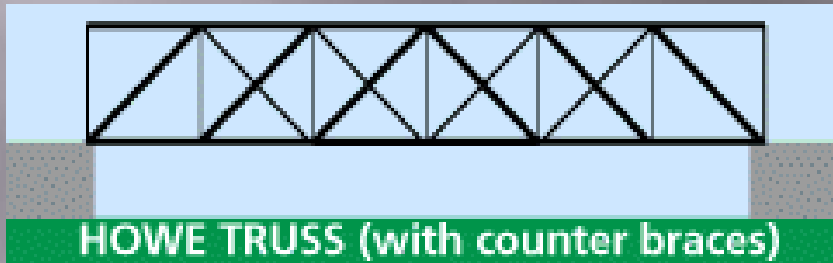
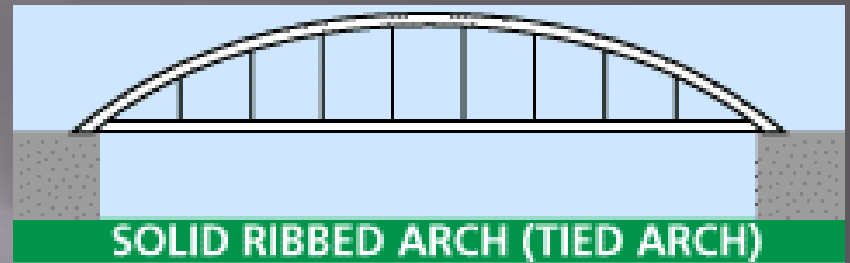
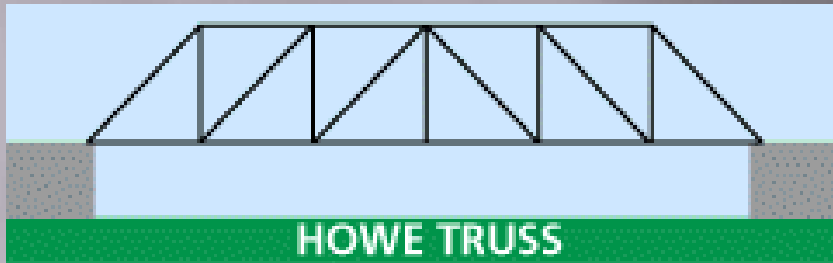
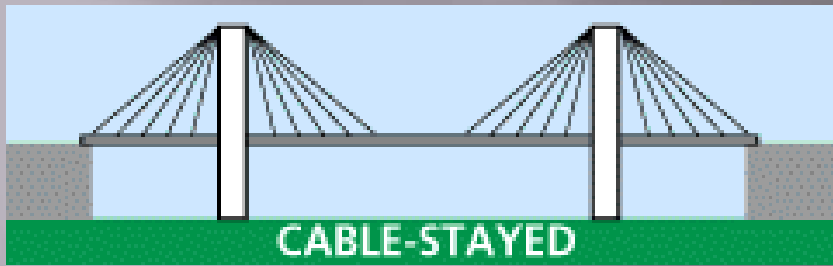
Typical Span Lengths

70m - 1,000m+

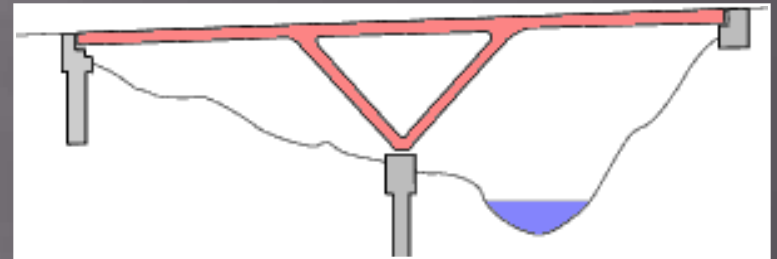
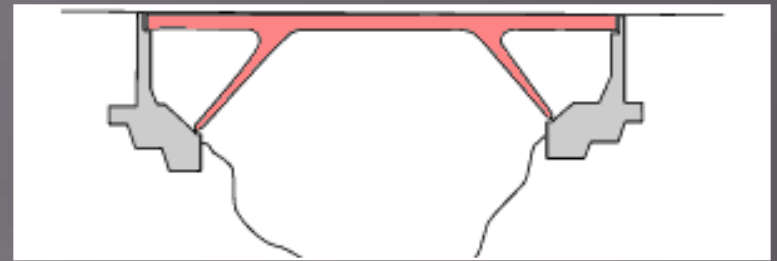
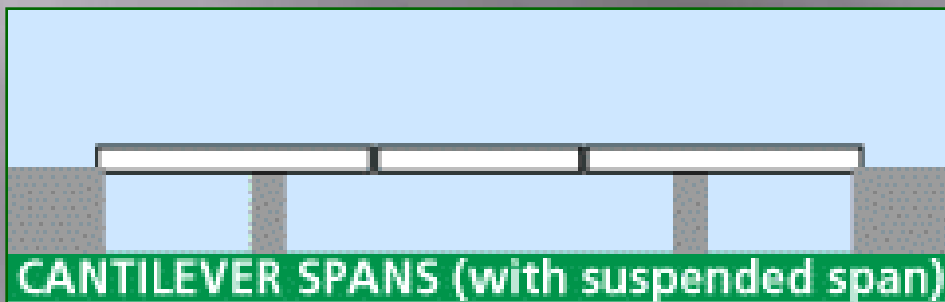
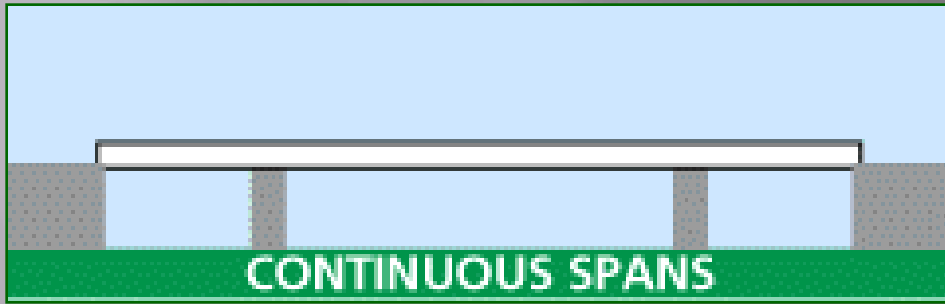
World's Longest

Akashi Kaikyo Bridge,
Japan

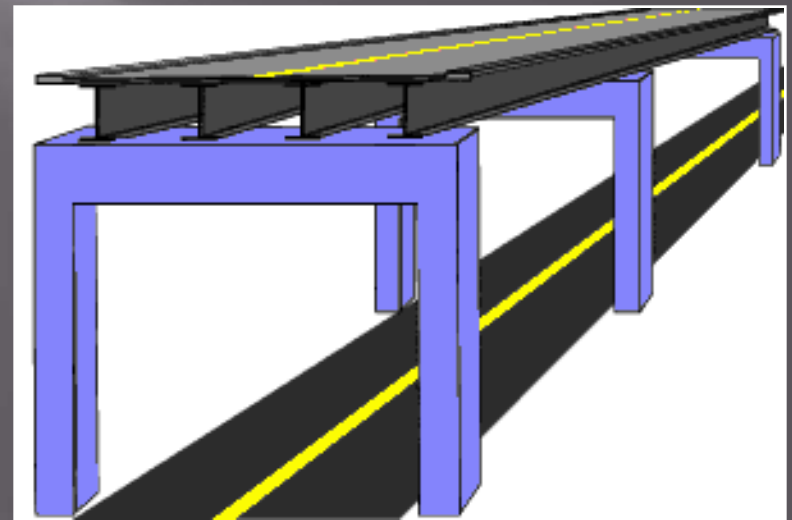
| | |
|--------------|--------|
| Total Length | 3,911m |
| Center Span | 1,991m |



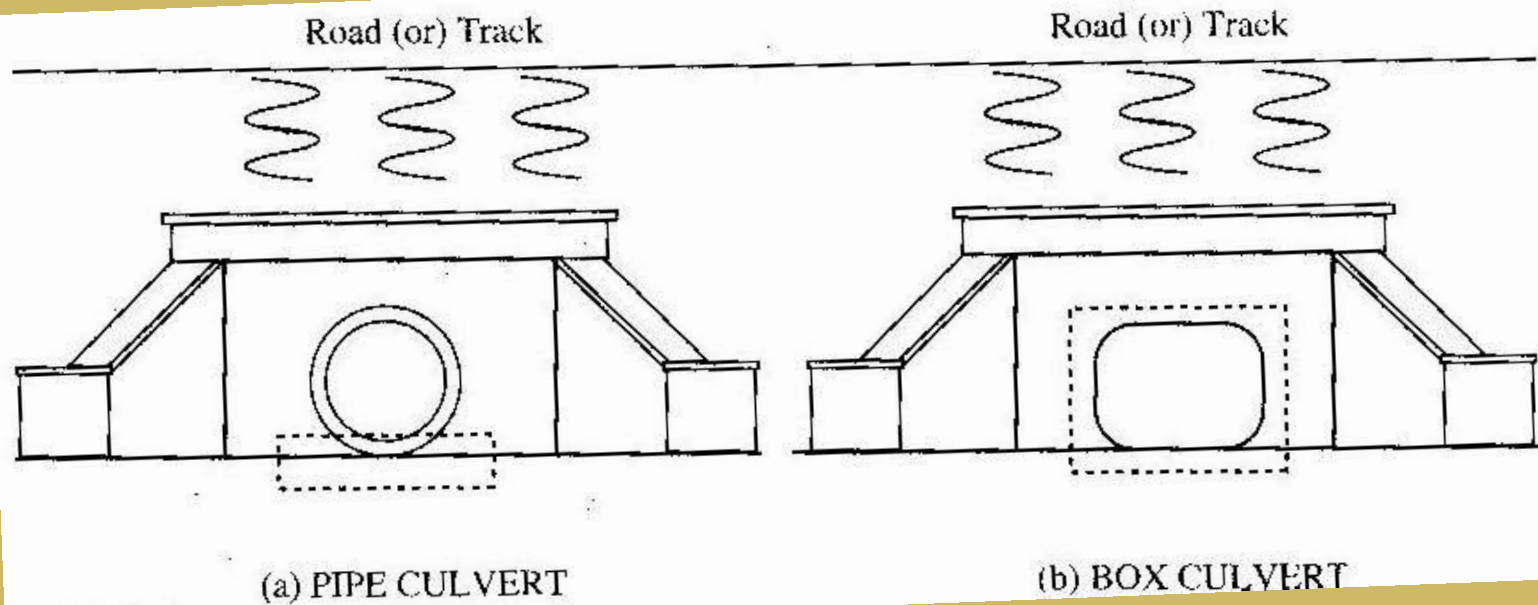
Types of Bridges



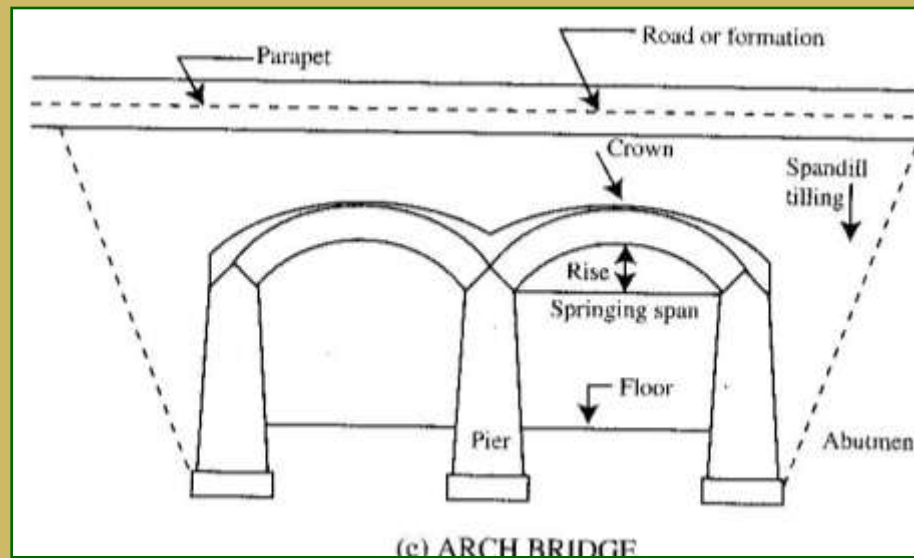
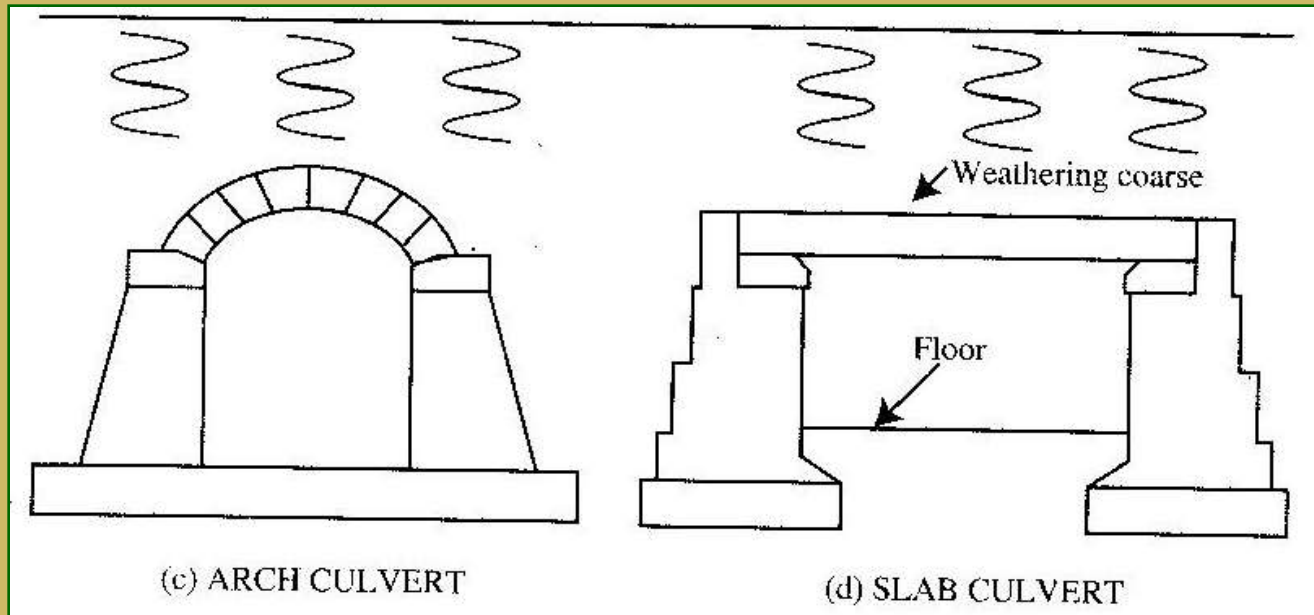
Types of supports

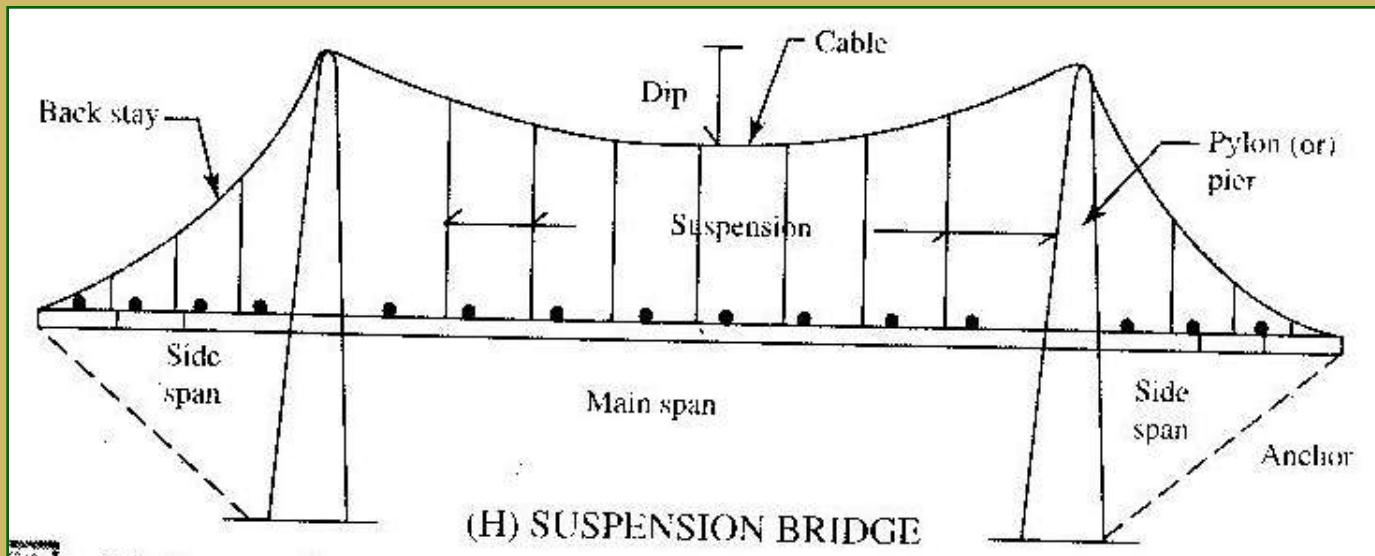
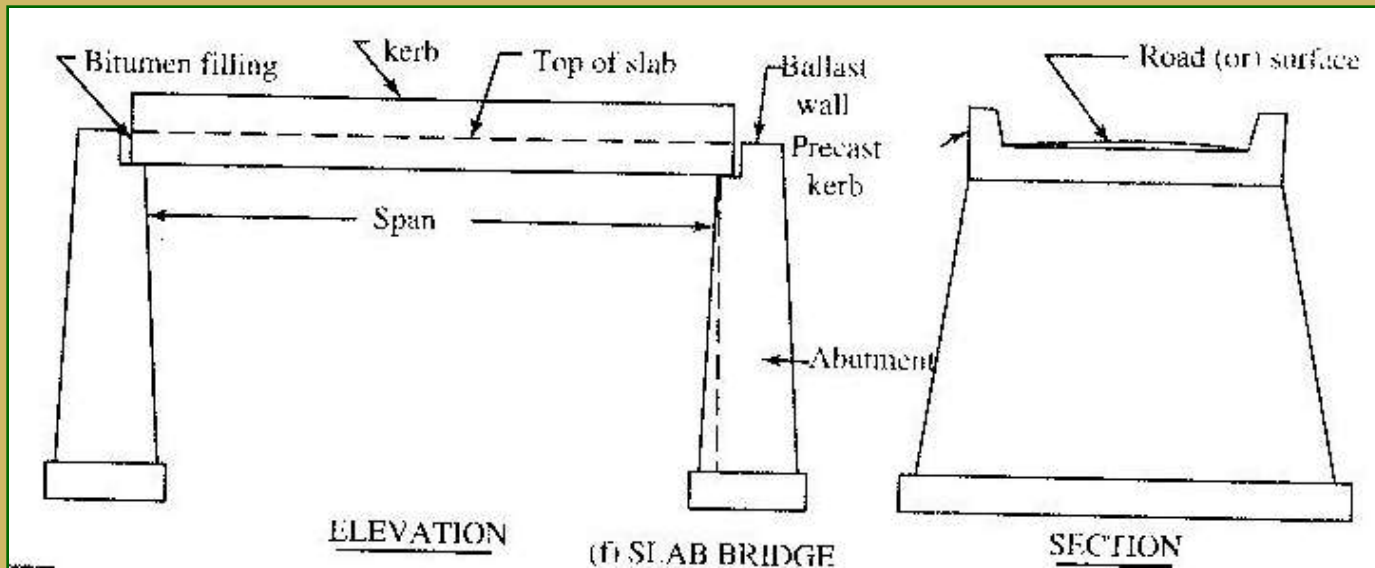


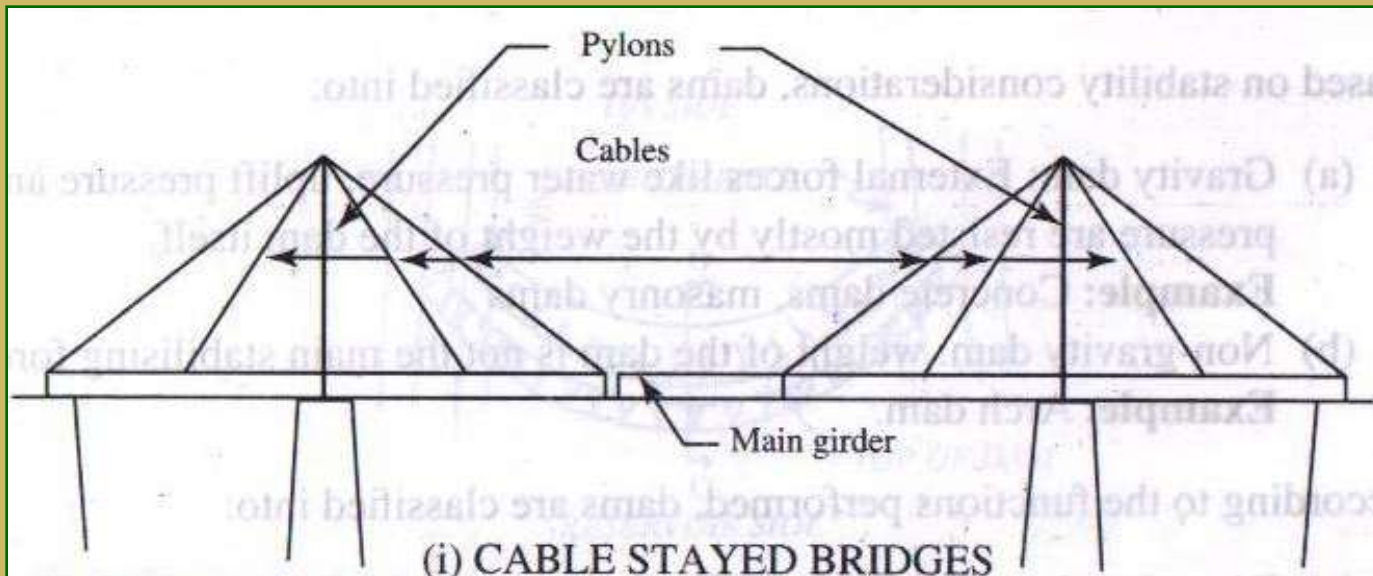
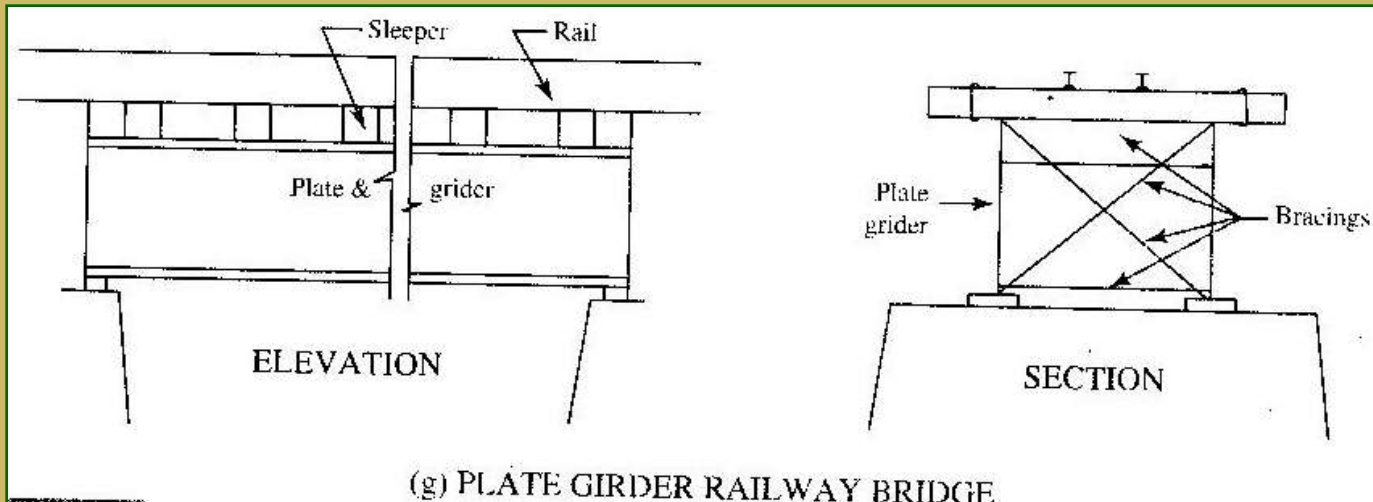
Beam/Girder Bridge



Culverts are smaller bridges, normally with one span built across small streams, drains or sewer carrying road on top







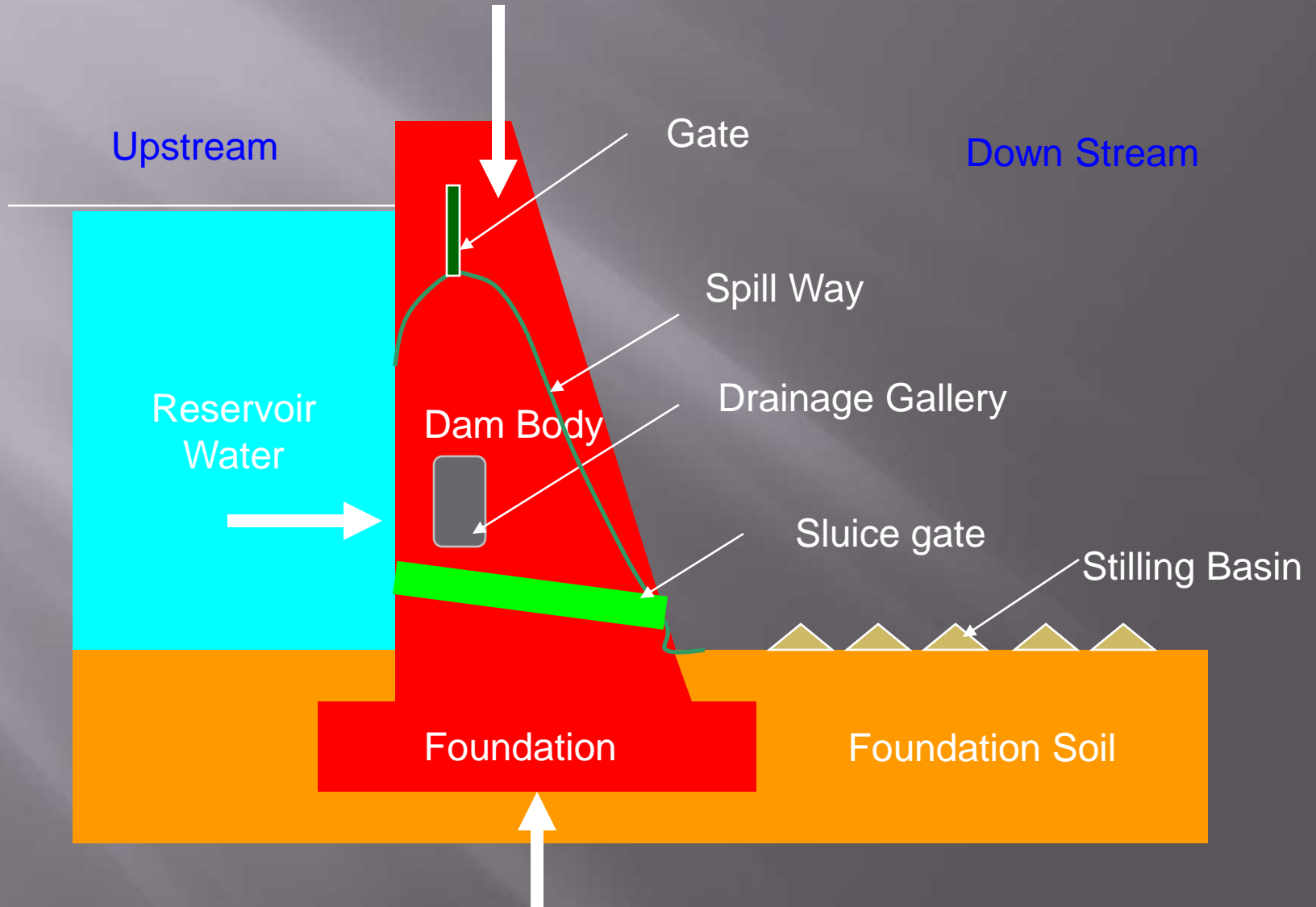
Dam

- ❑ Barrier that stores water at two levels.
- ❑ The primary purpose of dam is to store water whenever available in plenty for use during scarcity.
- ❑ Built across rivers
- ❑ Excess water is released to river and useful water is transferred thro canals

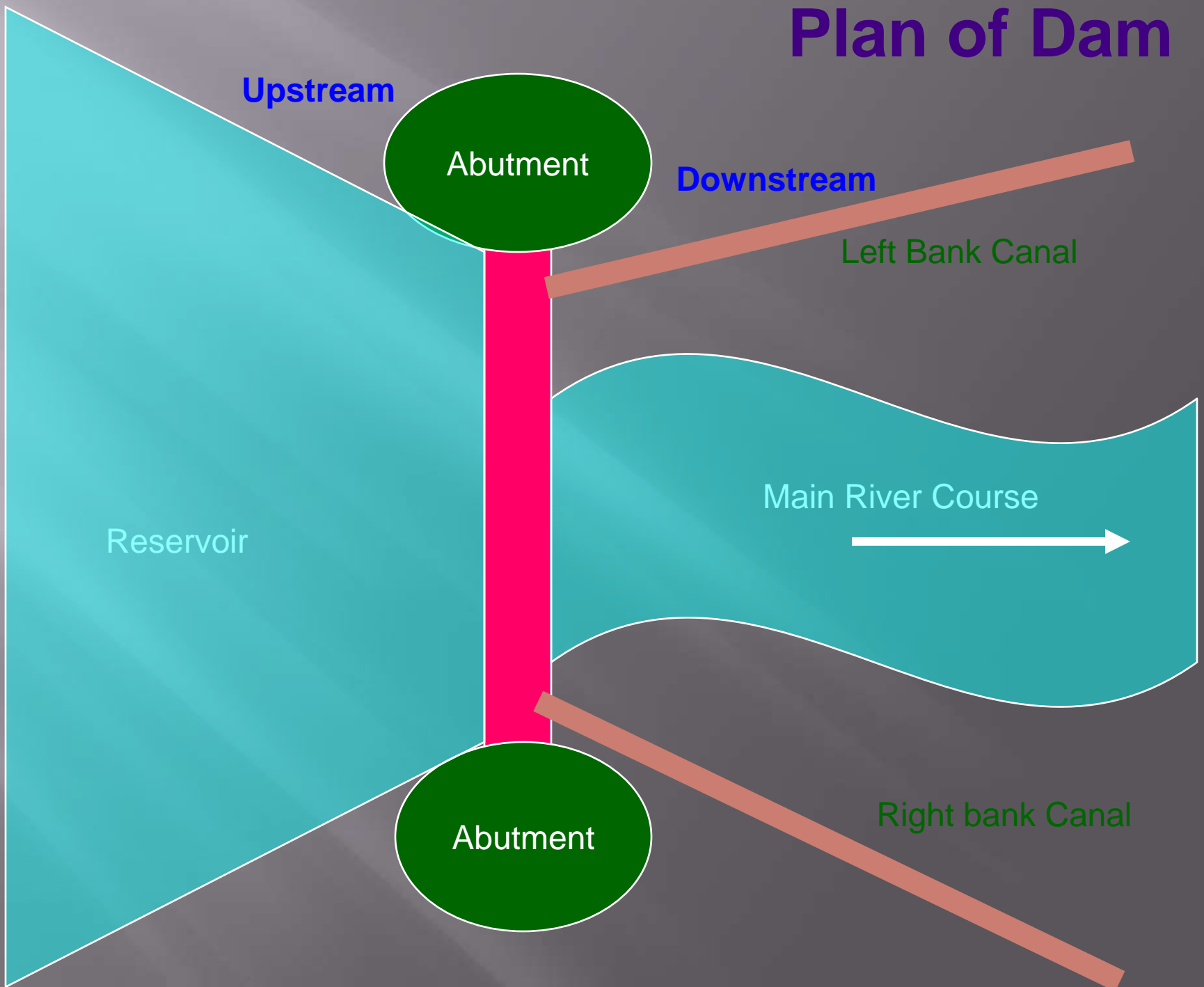
Components of Dam

- ▣ Body of Dam
- ▣ Foundation
- ▣ Top road
- ▣ Gates and lifting devices
- ▣ Spill way or Sluice
- ▣ Canal
- ▣ Reservoir
- ▣ Main river course
- ▣ Stilling Basin
- ▣ Drainage gallery

Components & Forces in Dams



Plan of Dam



FUNCTIONS OF DAMS

| Function | Example |
|-----------------------------------|---|
| Power generation | <u>Hydroelectric power</u> is a major source of electricity in the world. many countries have rivers with adequate water flow, that can be dammed for power generation purposes. For eg, the <u>Itaipu</u> on the <u>Paraná River</u> in <u>South America</u> generates 14 <u>GW</u> and supplied 93% of the energy consumed by <u>Paraguay</u> and 20% of that consumed by <u>Brazil</u> as of 2005. |
| Stabilize water flow / irrigation | Dams are often used to control and stabilize water <i>flow</i> , for <u>agricultural</u> purposes and <u>irrigation</u> . They can help to stabilize or restore the water <i>levels</i> of inland lakes and seas. They store water for drinking and other direct human needs. |
| Flood prevention | Dams are created for flood control. |
| Land reclamation | Dams (often called <u>dykes</u> or <u>levees</u>) are used to prevent ingress of water to an area that would otherwise be submerged, allowing its <u>reclamation</u> for human use. |
| Water diversion | Dams are used for the purpose of diversion. |

Classification of Dams

- ▣ Based on Size
- ▣ Based on function
- ▣ Based on material used

Classification based on Size

- ▣ Small Dam (<10 m high)
- ▣ Medium size Dam (10 – 25 m high)
- ▣ Large Dam (>25 m high)
- ▣ Major Dam (>150 m high)

Classification based on Purpose

- ▣ Hydro-electric dam
- ▣ Irrigation dam
- ▣ Water supply dam for city for the purposes of drinking water, recreation, navigation thro canals, industrial use.
- ▣ Flood Control
- ▣ Habitat dam for fishes & wild life
- ▣ Effluent containing dams from industry, mine, factory etc.
- ▣ Multi-purpose dam

Classification based on Material of construction

- ▣ Masonry Dam
- ▣ Concrete Dam
- ▣ Timber Dam
- ▣ Steel Dam
- ▣ Earth Dam
- ▣ Rockfill Dam
- ▣ Composite Dam

Classification based on action

- ▣ Gravity Dam
- ▣ Arch Dam
- ▣ Saddle Dam
- ▣ Check Dam
- ▣ Diversion Dam
- ▣ Overflow Dam
- ▣ Cofferdam



Gravity Dam



Timber Dam



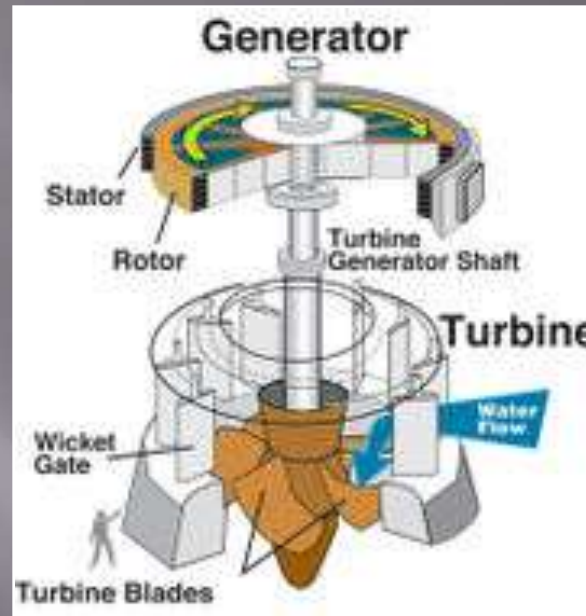
San Luis Dam near Los Bonos, California – an Embankment Dam



Steel Dam



Cofferdam

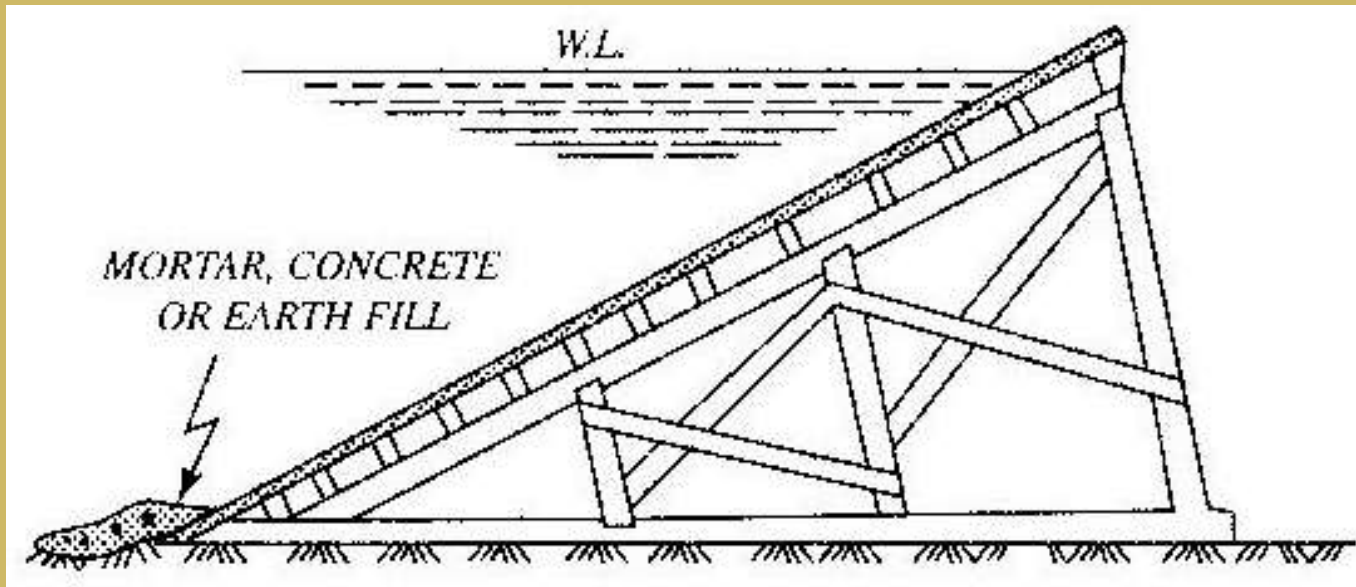


Power generation Plant

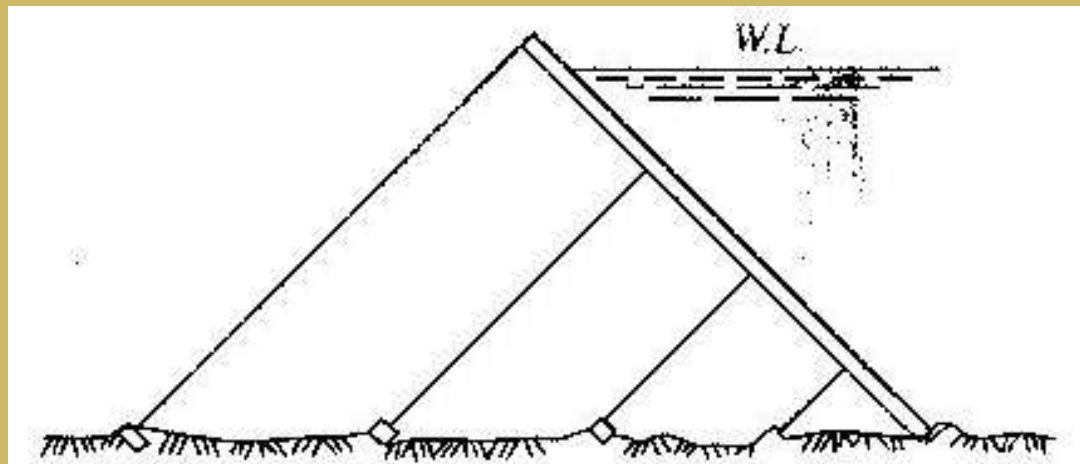


Spillway

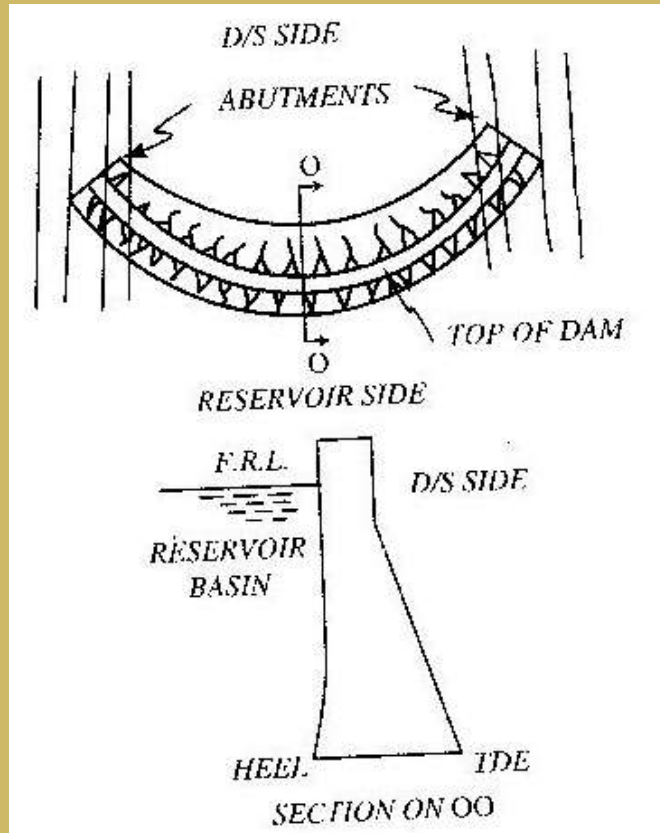
Hoover Arch Dam



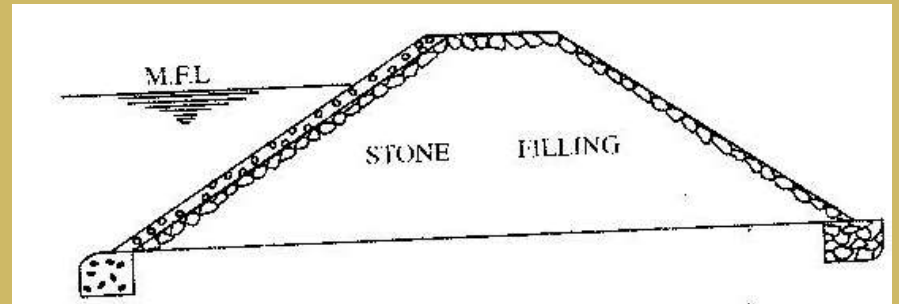
Timber Dam



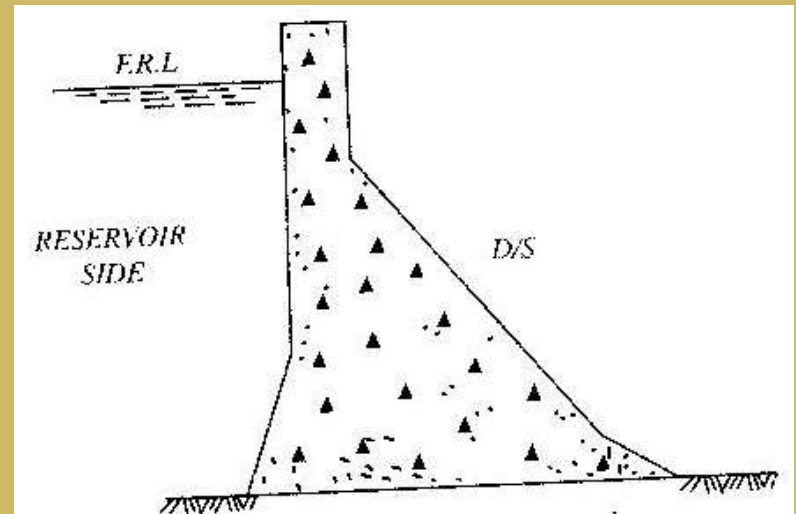
Steel Dam



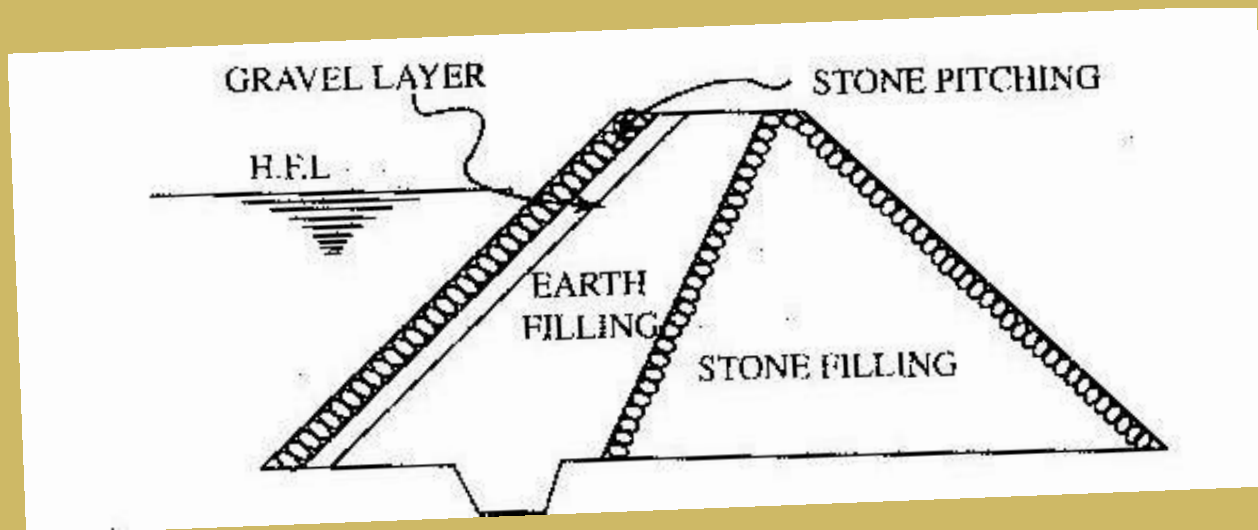
Arch Dam



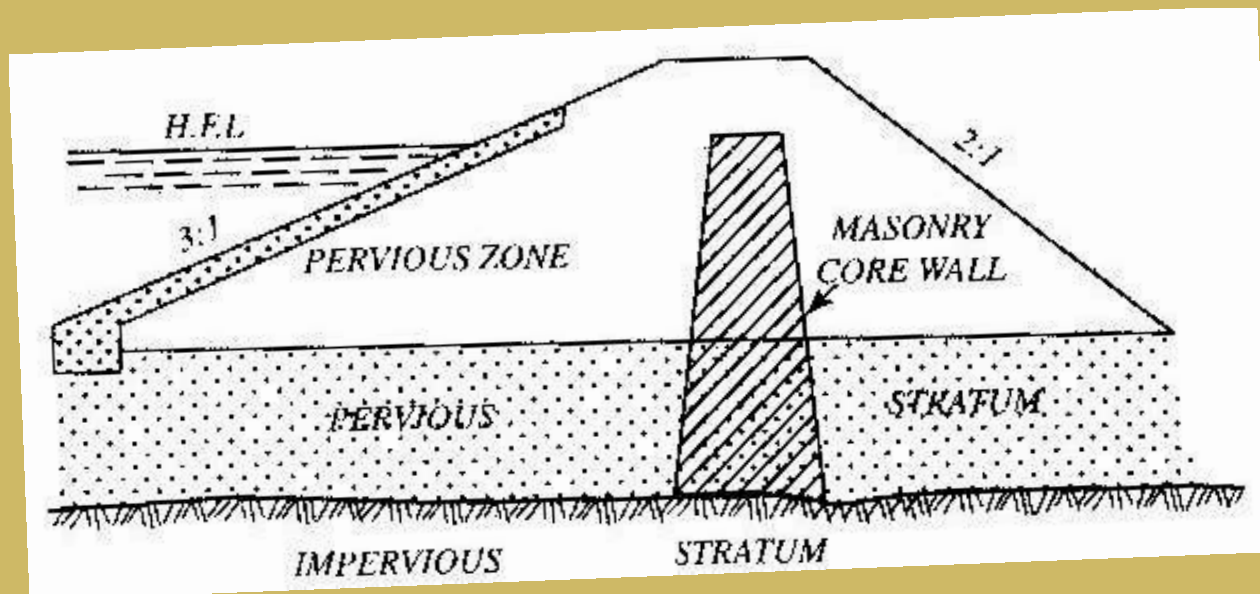
Rockfill Dam



Solid Gravity Dam



Combined Earth & Rockfill Dam



Earth Dam

Infrastructure

Infrastructure

Interstate 80, the second-longest U.S. Interstate highway, runs from California to New Jersey



- **Infrastructure** is the framework of supporting system consisting of roads, airports, bridges, buildings, parks and other amenities for the comfort of mankind.
- Economically, infrastructure are the structural elements that allow for production of goods and services without themselves being part of the production process, e.g. roads allow the transport of raw materials and finished products.
- The word is a combination of "infra" and "structure". The term came to prominence in the United States in the 1980s following the publication of *America in Ruins* (Choate and Walter, 1981), which initiated discussion of the nation's "infrastructure crisis" caused by inadequate investment and poor maintenance of public works.

Infrastructure deals with

- **Transportation**
 - **Road Network**
 - **Railway**
 - **Ports & Harbors**
 - **Air travel and Airports**
- **Television Network**
- **Telephone Network**
 - **Landline connections**
 - **Mobile phone connections**
- **Energy Sector**
 - **Electrification**
 - **Reduction in energy loss**
 - **Use of renewable energy such as Solar, Wind, Biogas plants**
- **Agricultural Activity**
 - **Largest economic investment**
- **Construction Activity**
 - **Second largest economy in India**
 - **Lifelines**



India's Infrastructure policy

- ▣ Additional power generation capacity of about 70,000 MW
- ▣ Construction of Dedicated Freight Corridors between Mumbai and Delhi, and Ludhiana and Kolkata
- ▣ Capacity addition of 485 million MT in major ports, 345 million MT in minor ports
- ▣ Modernisation and redevelopment of 21 railway stations
- ▣ Development of 16 million hectares through major, medium and minor irrigation works
- ▣ Modernisation and redevelopment of 4 metro and 35 non-metro airports
- ▣ Six-laning 6,500 km of Golden Quadrilateral and selected National Highways
- ▣ Construction of 1,65,244 km of new rural roads, and renewing and upgrading existing 1,92,464 km covering 78,304 rural habitations
- ▣ Infrastructure growth at 15 % P.A
- ▣ Construction sector to be the biggest beneficiary. Second largest after agriculture, 11% of Gross Domestic Product (GDP) & 50 % of Gross Fixed Capital Formation (GFCF), 65 % of total investment

Why infrastructure growth ?

- ▣ Political will
- ▣ Funding from multi-lateral agencies such as ADB, World Bank, Japan Bank etc.
- ▣ Increased private participation
- ▣ Innovative modes of funding
 - Cess on petrol & diesel
 - Special tax on air travel
 - Levying tonnage tax on ships
 - Infrastructure tax in Bangalore
- ▣ Build Operate Transfer (BOT) projects

Recent Statistics about Indian Infrastructural progress

| (Rs. bn) | Budgetary Grant | Debt | | Internal Accruals | Privatisation/ BOT | Funding not tied up | Total | Construction Component | |
|------------------------------------|--------------------|------------------|----------------------|----------------------|-----------------------|---------------------------|--------------|---------------------------|--------------|
| | | Multi lateral | Market borrowings | | | | | (%) | (Rs. bn) |
| Power | 245 | 175 | 1,274 | 413 | 885 | – | 2,973 | 53.9 | 1,803 |
| Roads | 368 | 296 | 167 | – | 1,286 | 350 | 2,466 | 100.0 | 2,466 |
| Ports | 100 | – | – | – | 150 | – | 250 | 50.0 | 125 |
| National Maritime Dvlpt Program | 69 | – | – | 30 | 235 | – | 335 | 60.0 | 201 |
| Railways | 248 | 241 | – | 50 | 211 | – | 749 | 42.0 | 315 |
| Airport | 7 | – | 5 | 5 | 212 | – | 228 | 42.0 | 96 |
| Pipelines | – | – | 250 | 150 | – | – | 400 | 40.0 | 160 |
| SEZ | 10 | 5 | 10 | – | 91 | – | 116 | 45.0 | 52 |
| Irrigation & Water supply | 156 | 181 | 81 | 8 | 35 | – | 461 | 45.0 | 207 |
| Bus Terminals | – | – | – | – | 9 | – | 9 | 70.0 | 8 |
| Urban Infra | 67 | 195 | 33 | 35 | 300 | – | 630 | 60.0 | 378 |
| Total | 1,269 | 1,092 | 1,821 | 691 | 3,394 | 350 | 8,618 | 65.1 | 5,609 |

Source: SSKI, September 2005

Impact of infrastructural development of a country

- ▣ Increase in food production
- ▣ Protection from drought, famine, flood
- ▣ Healthy and comfortable housing facility
- ▣ Safe domestic and industrial water supply
- ▣ Safe and scientific waste disposal
- ▣ Improvement in communication and transportation
- ▣ Generation of electricity from, nuclear, hydel, thermal, solar or wind energy
- ▣ Improved, wealth, prosperity, standard of living
- ▣ Overall growth of a nation

Impact of infrastructural facility on socio-economic growth of a nation

- ❑ Large scale budget allocation for infrastructure leads to agricultural and industrial developments.
- ❑ Provide employment, eradicates poverty and enhances per capita income.
- ❑ Urban growth only can lead to population drift from rural sectors leading to explosion in population in cities and inadequate development of villages and improper care for agricultural sector.
- ❑ Use of infrastructural facility only by upper class leads to imbalance.

Role of Civil engineers in Infrastructural development

- ▣ Construction of roads, railway, ports, harbors and airports
- ▣ Construction of dams and proper utilization of water resources.
- ▣ Construction of Housing, commercial and industrial complexes
- ▣ Maintenance of facility
- ▣ Rebuilding, Rehabilitation, Retrofitting and Repair

Road development

- Golden Quadrilateral – 6000 km (New Delhi, Kolkata, Chennai & Mumbai)
- North-South & East-West (NSEW) corridor – 7300 km (Srinagar-Kanyakumari, Silchar-Porbandar)
- Port connectivity & other projects
- Pradhana Mantri Bharath Jodo Pariyojana – 10000 km
- Pradhana Mantri Grameena Sadak Yojana – connectivity to 160000 rural habitation

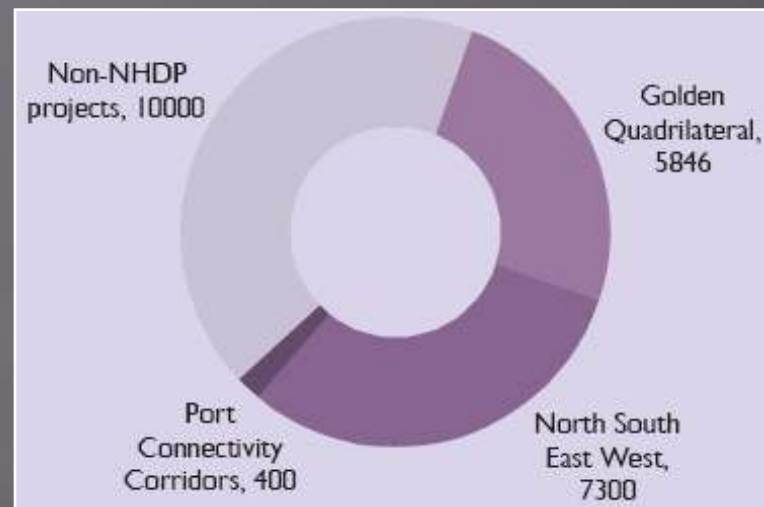
India's Road Infrastructure (May 05)

| Types of Road | Length (km) | Percentage of Total |
|-------------------------|------------------|---------------------|
| National Highways | 65,569 | 2.0 |
| State Highways | 131,899 | 4.0 |
| Major District Roads | 467,763 | 14.1 |
| Village and Other Roads | 2,650,000 | 79.9 |
| Total | 3,315,231 | 100 |

(Source: National Highway Development Authority)

Road Projects under execution

| Scheme | Period 2001-2011 | | Period 2011-2021 | |
|---|------------------|----------------------|------------------|----------------------|
| | Length (km) | Amount (Rs. million) | Length (km) | Amount (Rs. million) |
| A. Expressways | 3000 | 300,000 | 7000 | 700,000 |
| B. National Highways | | | | |
| i) Four Laning/Six Laning | 16,000 | 640,000 | 19,000 | 760,000 |
| ii) Two-Laning with hard shoulders | 15,000 | 187,500 | 7,000 | 87,500 |
| iii) Strengthening Weak Pavements | 20,000 | 150,000 | 24,000 | 180,000 |
| iv) Bypasses, bridges, over bridges, safety and drainage measures | Lump sum | 72,500 | Lump sum | 92,000 |
| v) Expansion of NH System | 10,000 | 150,000 | 12,000 | 180,000 |
| Total for National Highways | | 1,200,000 | | 1,30,000 |
| C. State Highways | | | | |
| i) Four Laning/Six Laning | 3,000 | 100,000 | 7,000 | 250,000 |
| ii) Two-Laning with hard shoulders | 35,000 | 280,000 | 60,000 | 500,000 |
| iii) Strengthening Weak Pavements | 30,000 | 220,000 | 40,000 | 300,000 |
| iv) Bypasses, bridges, over bridges, safety and drainage measures | Lump sum | 100,000 | Lump sum | 100,000 |
| v) Expansion of SH System | 10,000 | 50,000 | 20,000 | 100,000 |
| Total of State Highways | | 750,000 | | 1,250,000 |



Port Development



Model For Privatization

| Models | Asset Ownership | Operations & Maintenance | Capital Investment | Duration | Areas |
|---------------------|------------------|--------------------------|--------------------|-------------|---|
| Service contract | Public | Public/Private | Public | 1-2 years | Towage, Dredging, Equipment and crafts |
| Management Contract | Public | Private | Public | 3-5 years | Canteen Operations |
| Concession | Public | Private | Public/ Private | 10-30 years | Terminals, channels Entire greenfield port |
| Build Own Operate | Public & Private | Private | Private | Indefinite | Terminals, channels |
| Divesture | Private | Private | Private | Indefinite | Entire ports complex |

Source: SSKI, September, 2005

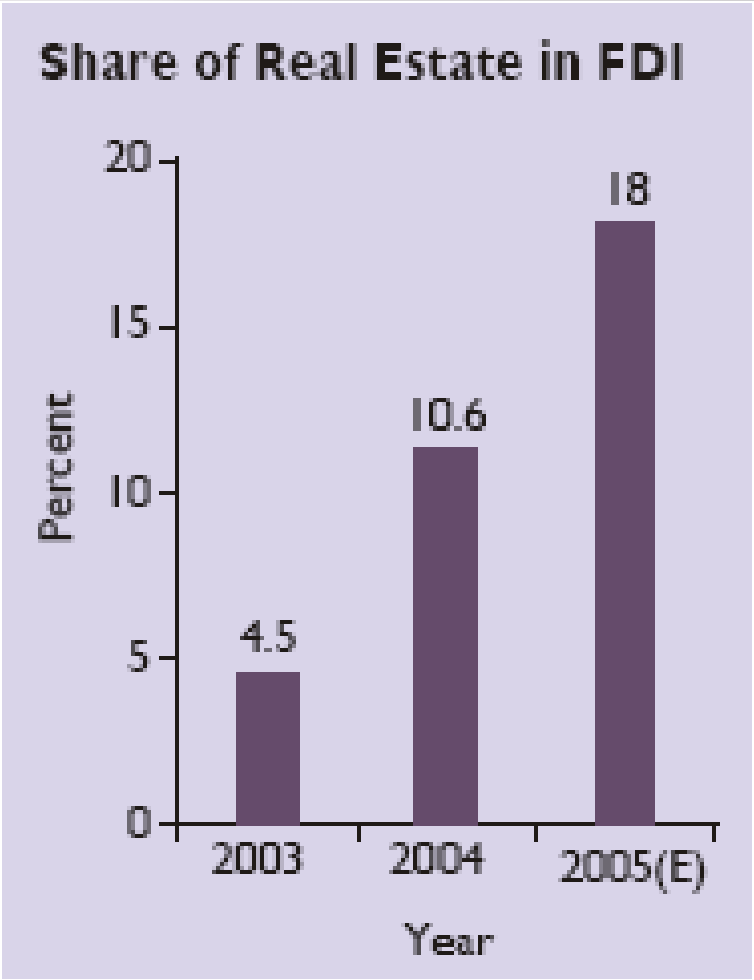
Pipeline of private port projects

| Project Name | Port Name | Capacity (m tonnes) | Project Cost (Rs. m) |
|---|------------------|------------------------|-------------------------|
| Container Terminal | JNPT | 7.2 | 9,650 |
| Liquid Cargo Berth | JNPT | 5.5 | 2,000 |
| Container Terminal at Chennai (Stage I) | Chennai | 5.6 | 9,699 |
| Multipurpose General Cargo Berths | Mormugao | 5.0 | 2,240 |
| Redevelopment of bulk terminal into container terminal | JNPT | 15.6 | 9,000 |
| Oil Jetty and related facilities | Vadinar (Kandla) | 10.0 | 2,500 |
| Construction of a berth for handling coal on BOOT basis | Mumbai | 1.5 | 2,000 |
| International Container Transshipment Terminal at Vallarpadam | Cochin | 5.0 | 21,180 |
| Construction of Jetty for POL Products/Chemicals | Ennor | 3.0 | 2,000 |

Privatised berths in India

| Port | Type of Port Facility | Private Developer/Operator |
|--------------|---|---|
| Kolkata | Multipurpose Berth | SAIL |
| Haldua Berth | Multipurpose Berth | TISCO & IQ MartradelSPL |
| Paradeep | Fertiliser Berth Multipurpose Cargo Berth (MPB - I) | Paradip Phosphate Ltd. Oswal Chemicals & Fertiliser |
| Vizag | Container terminal, bulk cargo berths | Dubai Port Authority Gammon India Ltd. |
| Ennore | Coal Jetty | TNEB |
| Chennai | Jawahar Dock 1 Jawahar Dock 5 | Ege Seramik (Malaysia) & T Arumaidurai & Co. ACT India Ltd |
| Tuticorin | Container terminals | P&O Ports, Australia and PSA SICAL Terminal Ltd |
| Mormugao | Coal & general cargo berth & waterfront (ship repair) | ABG Goa Port Ltd & Western India Group |
| Mumbai | Berth at Pir Pau | Tata Electric Company |
| JNPT | Berths for handling POL & container terminal | BPCL, IOCL, PSOCP&O Ports, Australia |
| Kandla | Virtual Jetties, Oil Jetty, Oil Jetty | Geepee Corp., Thailand IOCL, HPCLEssar Oil and IFFCO |

Foreign Direct Investment Growth in Real Estate



Airports – Ready to take off

- ▣ Upsurge in air traffic
- ▣ Upgradation of Metro city airports
- ▣ Development of new airports

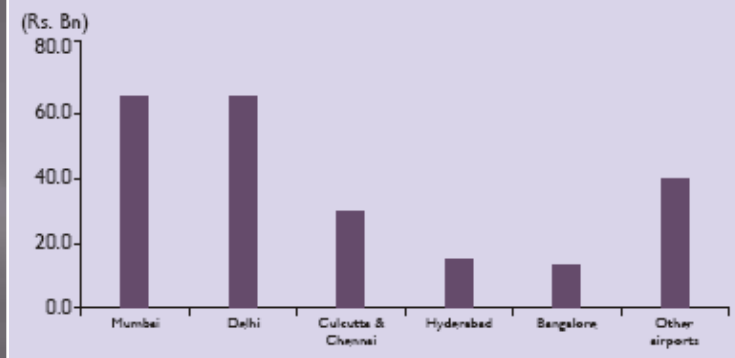


More Connections

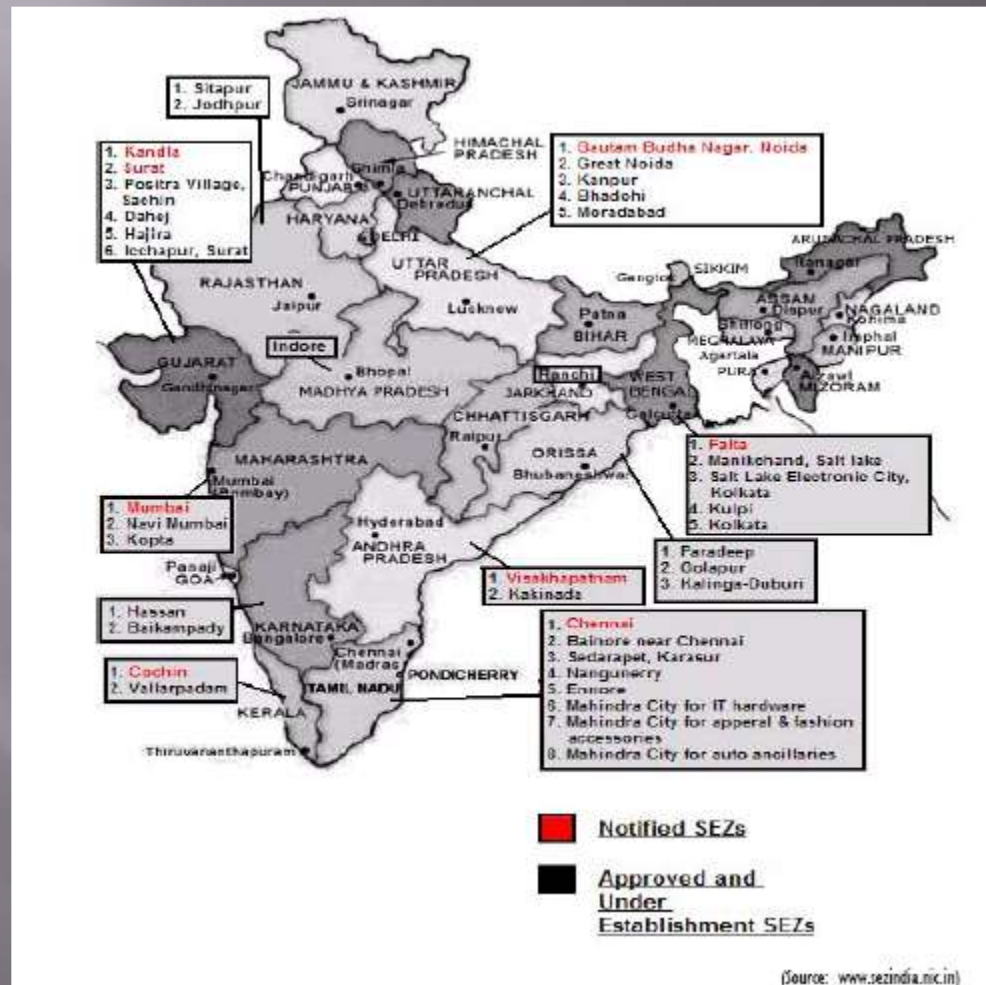
| | # of flights | # of destinations |
|-----------------|--------------|-------------------|
| Indian Airlines | 250 | 58 |
| Air Decann | 180 | 45 |
| Air Sahara | 123 | 22 |
| Spice Jet | 60 | 11 |
| Go Air | 7 | 4 |
| Jet Airways | 275 | 43 |
| Paramount Air | 18 | 4 |

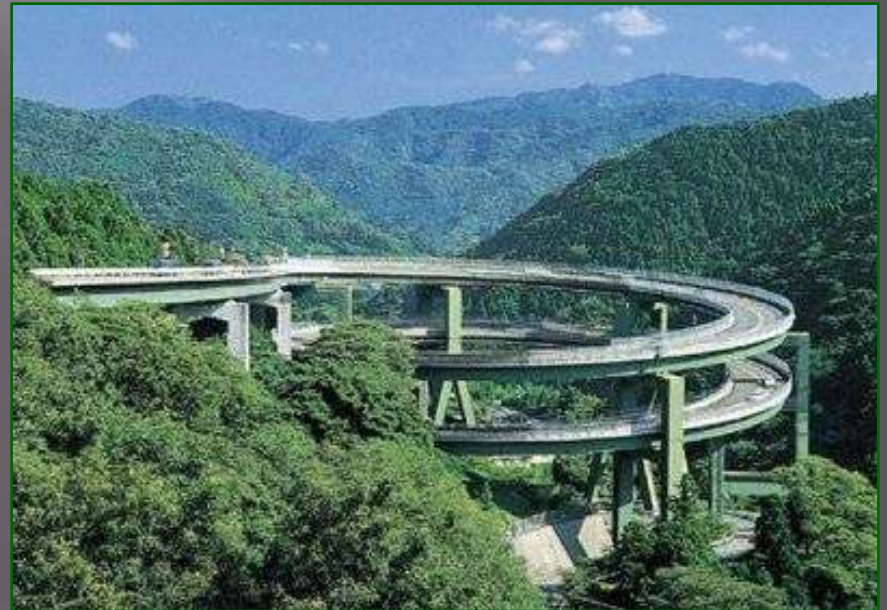
| Airport | Area for Commercial Development (Acres) | Real Estate Plans | % of Revenue Expected | Expected Investment (US\$ Million) |
|-----------|---|--|-----------------------|------------------------------------|
| Bangalore | 300 | Hotels, Office Space, malls | N.A. | 400-500 |
| Hyderabad | 600-800 | NA | N.A. | 500-600 |
| Kolkata | 300 | Golf Course, 4 hotels, convention centre | 70-80 | 750-850 |

Investments Planned in airports

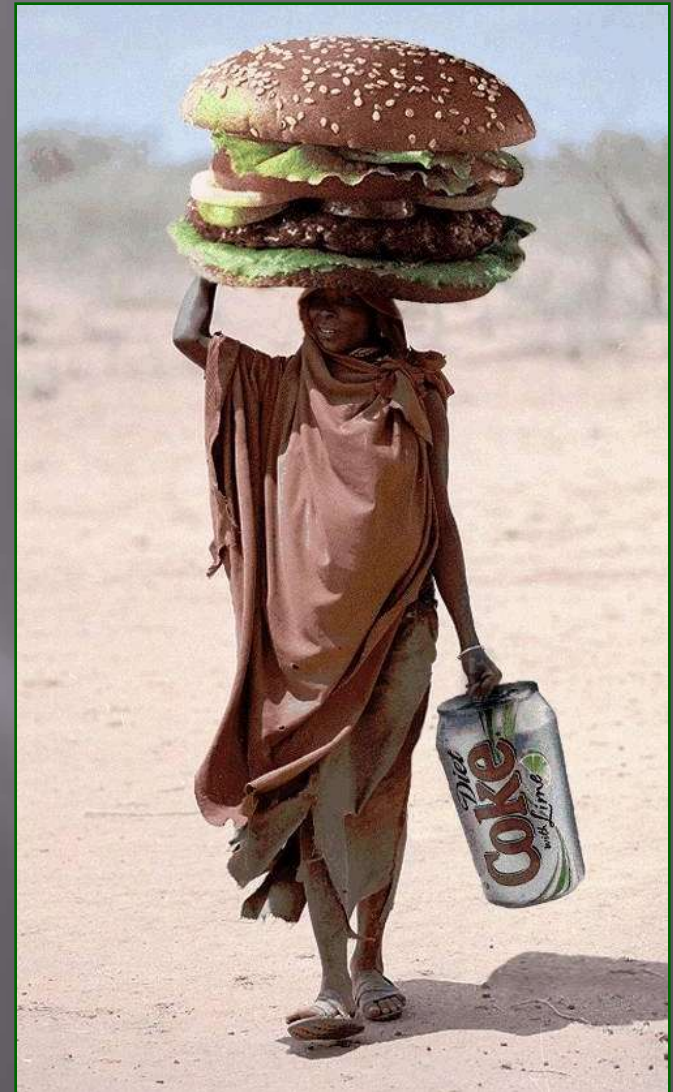


Special Economic Zones - mushrooming across India









Mixture of Technological growth & raw rural strength, blend of western & traditional culture

Assignment

1. What is Civil Engineering? What are the main functions of a civil engineer?
2. List the main disciplines of civil engineering and mention the purpose and application of each discipline.
3. What is infrastructure? How does it relate with civil engineering?
4. What is the influence of infrastructural growth on the development of a country?
5. Draw a neat sketch of road cross section and list the components of road. Mention the use of each component
6. Classify the roads according to different classification systems.
7. Draw a neat sketch of a dam and label its parts. Mention the use of each component.
8. Classify the dams according to different classification systems.
9. What are the functions of roads, bridges & dams
10. Draw a neat sketch of a bridge and label its parts. Mention the use of each component.
11. Classify the bridges according to different classification systems.

Thank You

