CE 1102
FUNDAMENTALS OF CIVIL ENGINEERING

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Your Lecturer:

I am a Civil Engineer/Senior Lecturer/Researcher

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ACADEMIC QUALIFICATIONS

Bachelor of Science in Engineering (Honours)- Specialization: Civil Engineering, Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Sri Lanka.

M.Sc. (Full Time Research)-Specialization: Environmental Engineering, School of Urban Development, Faculty of Built and Environmental Engineering, Queensland University of Technology (QUT), Australia.

Doctor of Philosophy - Specialization: Hydraulics Engineering, School of Civil, Mining and Environmental Engineering , Faculty of Engineering, University of Wollongong (UOW), Australia.

RECENT ACHIEVEMENTS (Selected)

- **Vice-Chancellors Award for Outstanding Contribution to Teaching and Learning (OCTAL) 2020.**
- Awarded Fellow Membership of Wollongong Academy for Tertiary Teaching & Learning Excellence (WATTLE) in recognition of contributions to the student learning experience, through teaching and learning practices 2020.
- Australian Postgraduate Awards, University of Wollongong, Australia (2015-2019).

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Speaking is easy;
Listening is difficult
Speaking is a skill;
Listening is attitude

Please work happily without sleeping!

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CE 1102 - Fundamentals of Civil Engineering

- **Scope of Civil Engineering**
- Fluid mechanics, Hydrostatics
- Hydrodynamics
- Flow classification

} **Week 1-6**

- Introduction to structural engineering
- Building construction & materials
- Highway Engineering

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RESOURCES

- **Module Descriptor**- Available in LMS
- **Lesson Plan**- Available in LMS
- **Suggested list of further readings**-Available in LMS
- **Each week Lecture notes**- Will be uploaded to LMS before the each week lecture
- **Lecture recordings for each week**- Will be uploaded to LMS after the each week lecture
- **Any other specific learning materials** will be uploaded to the LMS in each week

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Content

- Introduction to Civil Engineering
- Specializations of Civil Engineering
  - Hydraulics, Water Resource & Irrigation Engineering;
  - Structural Engineering;
  - Transportation Engineering;
  - Surveying;
  - Architecture & Town Planning;
  - Building Materials;
  - Construction Technology;
  - Environmental Engineering;
  - Geotechnical Engineering;
  - Remote Sensing & GIS.

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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

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Civil Engineering

- Oldest branch of engineering, next to Military engineering.
- 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, Mesapotamia, Indus Valley Civilizations).
- *John Smeaton* was the first self proclaimed Civil Engineer who built Eddystone Light House in 1771.

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Civil Engineering is Everywhere

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.

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Building Big!!!!

Buildings & Structures: Cities

Infrastructure: Transportation

Culture: Art: Architecture

The Future: Without Limit!

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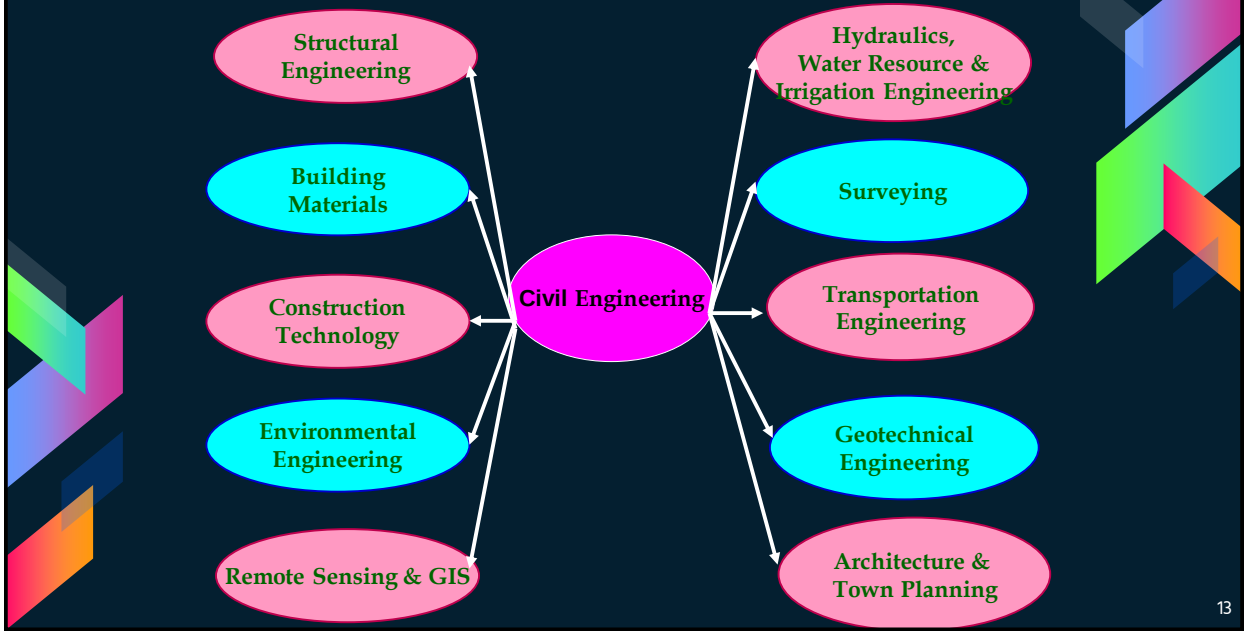
DISCIPLINES OF CIVIL ENGINERING



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Wonders of Civil Engineering

https://www.youtube.com/watch?v=Rn0pZlLlv-4
https://www.youtube.com/watch?v=cJaRjI7K-Lw
https://www.youtube.com/watch?v=XmtKwDE_5lk

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Structural Engineering

Burj, Dubai

Golden Gate Bridge, San Francisco, CA, USA

Petronas twin tower, Malasia

- 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.

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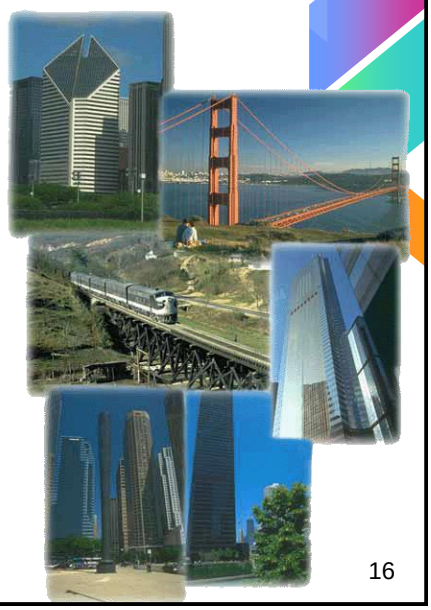
Structural Engineering

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



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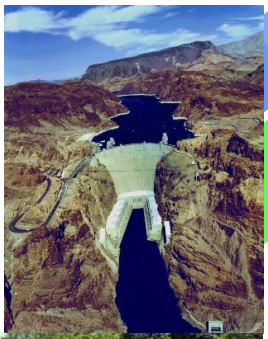
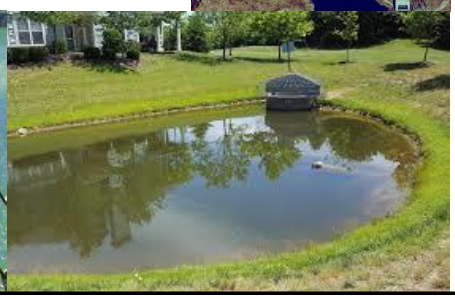
Hydraulics, Water Resource & Irrigation Engineering

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.





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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 considering the environmental sustainability.

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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

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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

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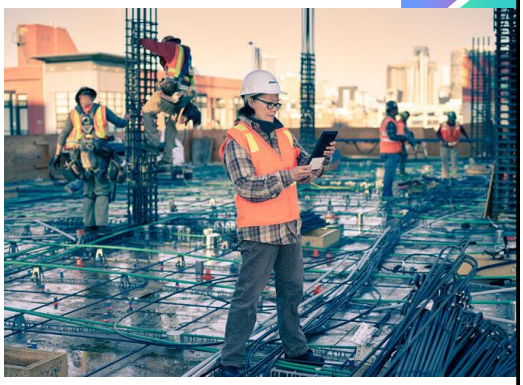
Construction Technology & Management

- 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.



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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.

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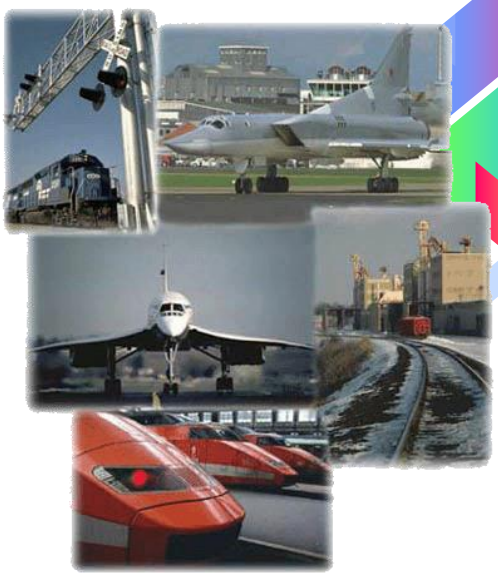
Transportation Engineering

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 up gradation of docks, harbors, airports, railway system based on requirements, population growth is a part of this discipline.



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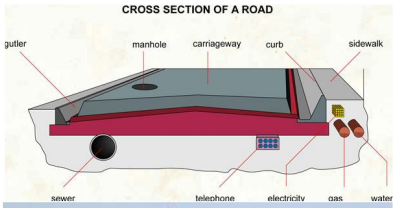

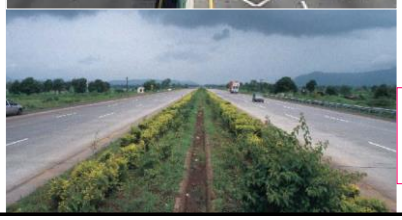

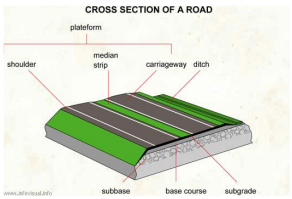

Deals with Transportation system Planning And high way material design

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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

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Environmental Engineering

Environmentalist Vs Environmental Engineer

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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

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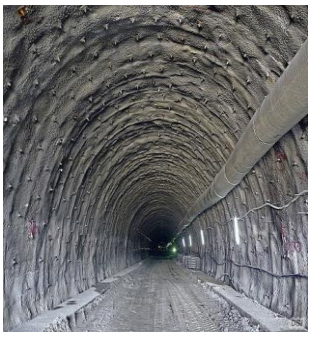
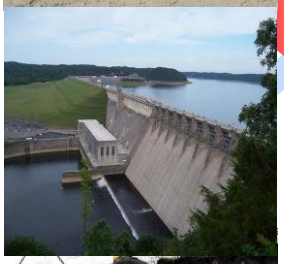
Geotechnical Engineering

To assess the quality of soil or rock to carry the structure

Proper knowledge of geotechnical eng. is necessary for safety and stability of structures





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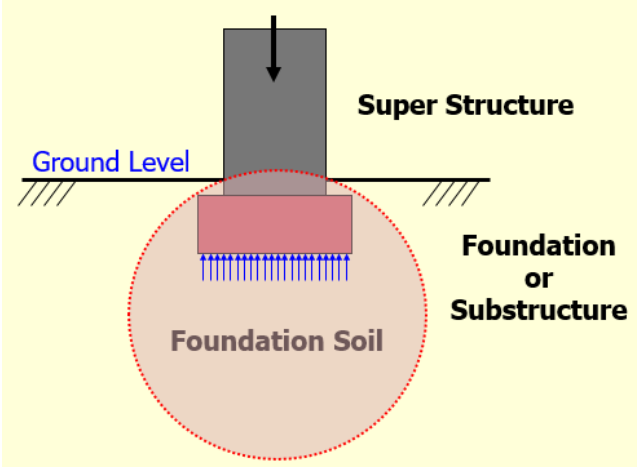
For a geotechnical engineer



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

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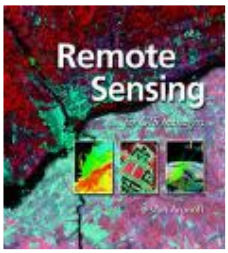
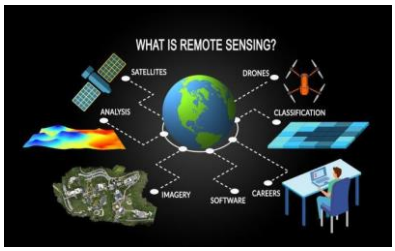
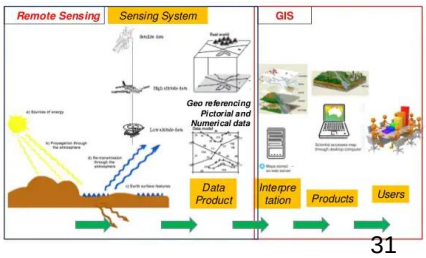
Remote Sensing & GIS

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







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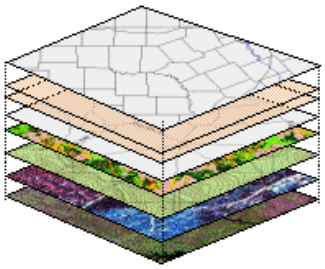

Good mapping technique helps to get required information accurately and quickly to effectively manage and monitor the available resources for optimal use.

GIS is an high tech 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.

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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

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Roads

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).

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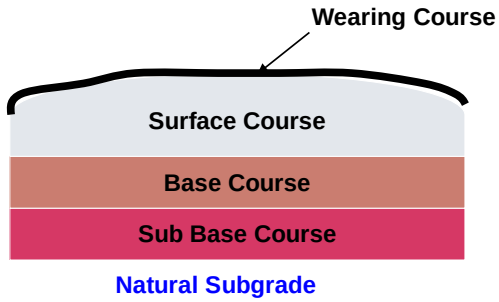
Components of Road

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



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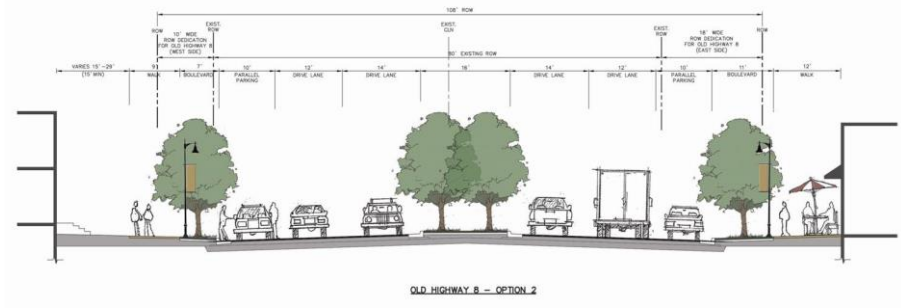

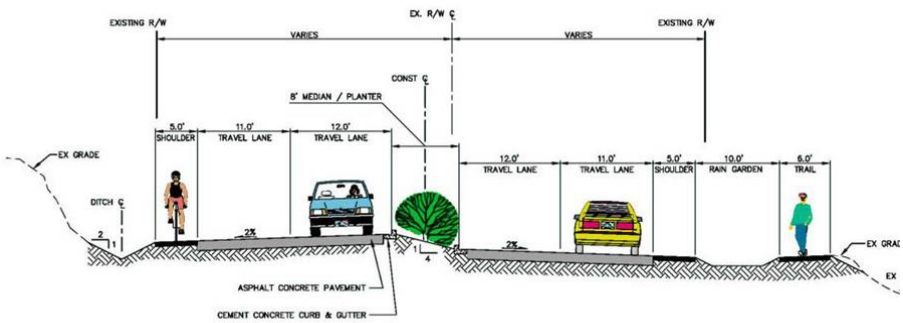

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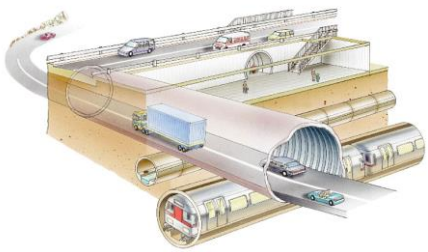

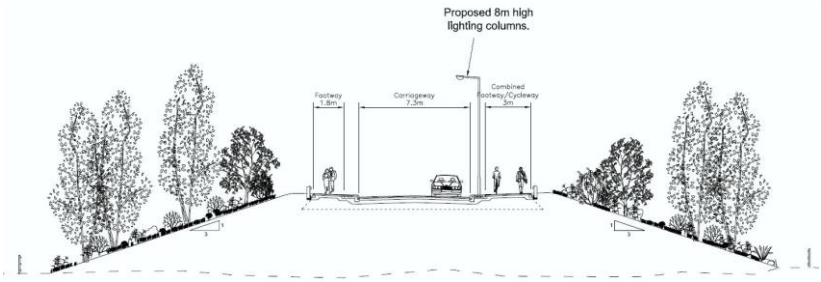
Proposed 8m high lighting columns.
Footway 1.8m
Carriageway 7.3m
Combined footway/Cycleway 3m

Plan 9

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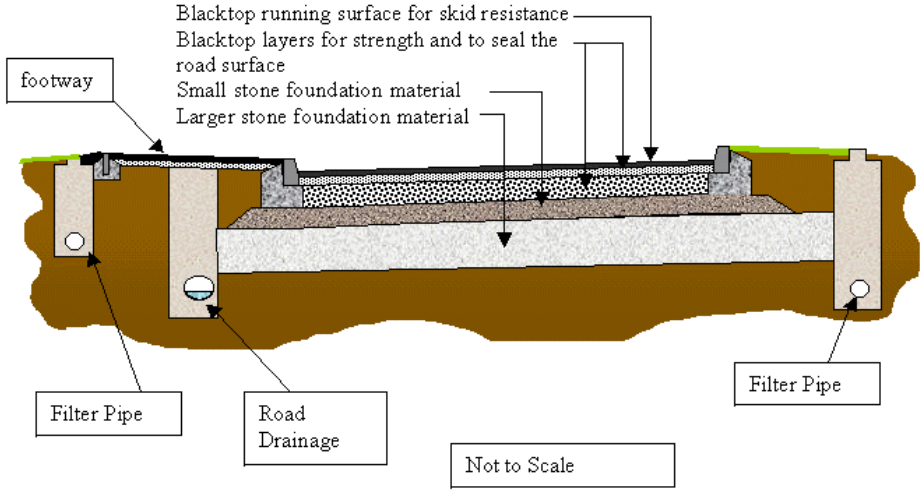
Blacktop running surface for skid resistance
Blacktop layers for strength and to seal the road surface
Small stone foundation material
Larger stone foundation material
footway
Filter Pipe
Road Drainage
Filter Pipe
Not to Scale

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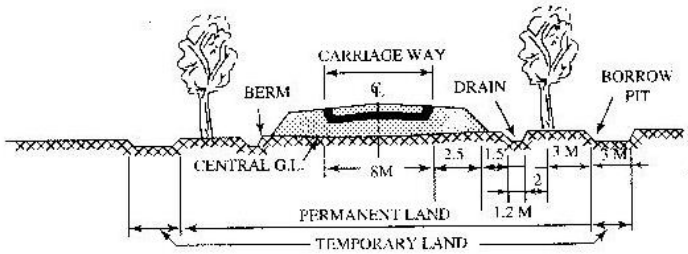
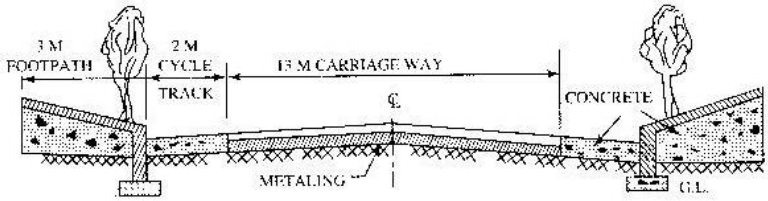


National Highway.



District Road.

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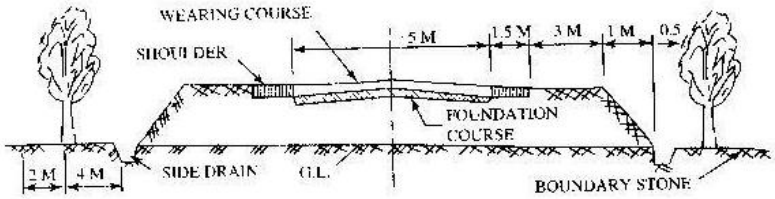
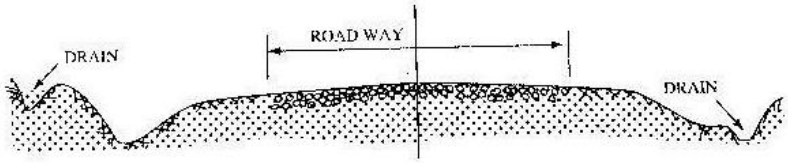


Other District Road.



Village Road.

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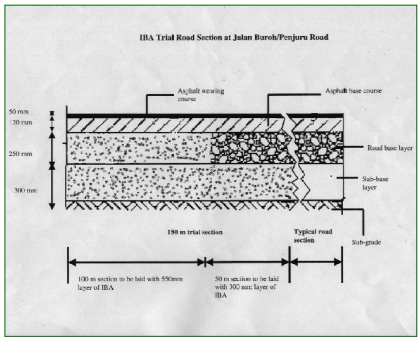

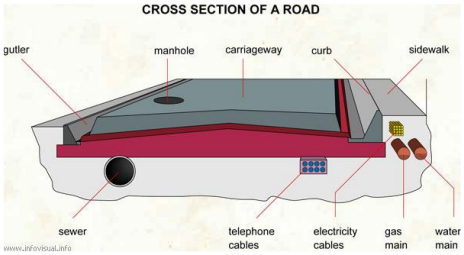

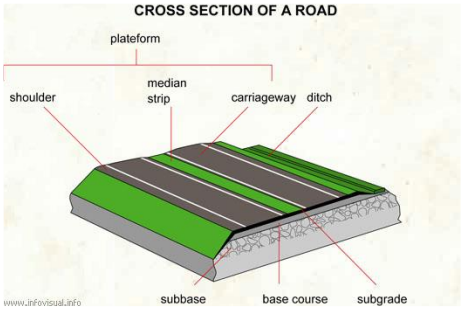

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Bridges

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.

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Namihaya Bridge, Osaka, Japan

Meiwa Bridge, Edogawa-Ku, Tokyo

2nd Mameyaki Bridge, Saitama, Japan

Tsurumi Tsubasa Bridge

Hakucho Bridge

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Classification of Bridges

Based on Action

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

Based on Material used

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

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Classification of Bridges

Based on Material used

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

Based on purpose

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

Based on type of Support

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

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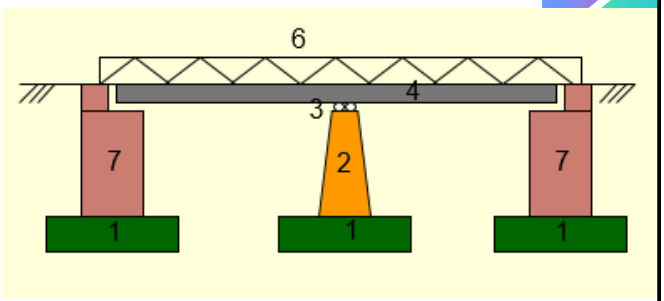
Components of Bridge

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



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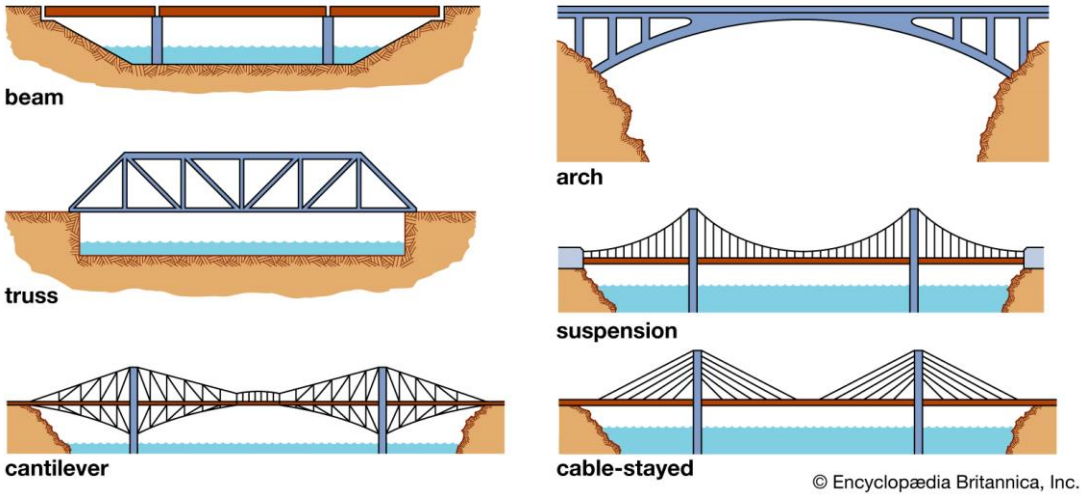
The Basic Bridge Types



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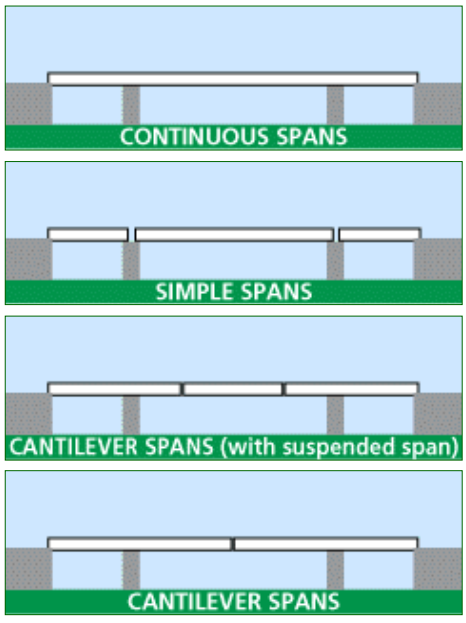
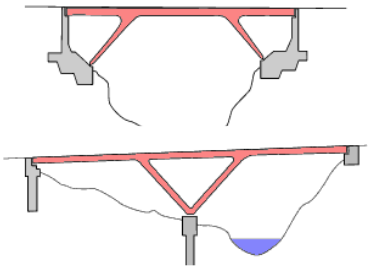
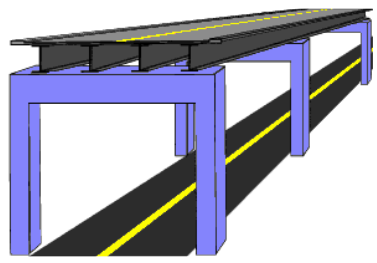




Types of supports



Beam/Girder Bridge

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Dams

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 through canals

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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

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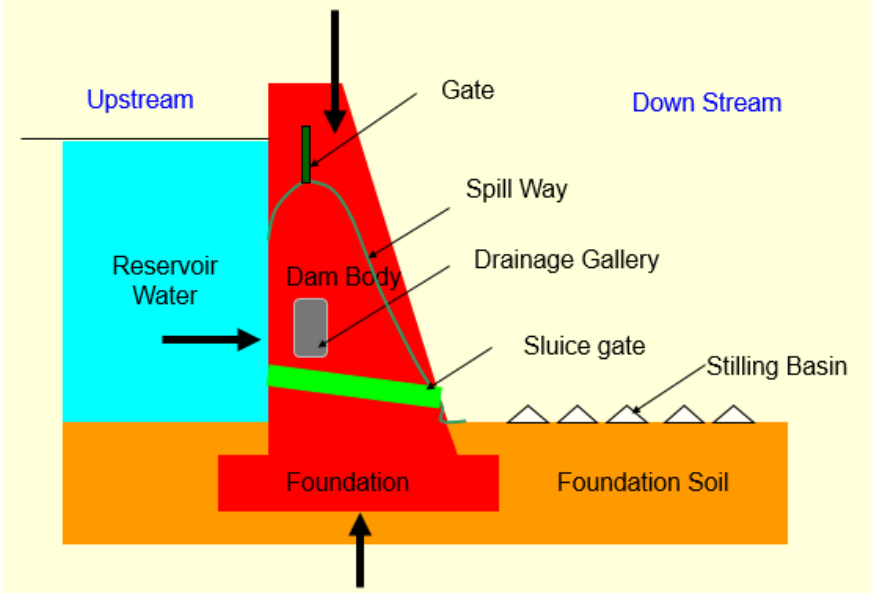
Components & Forces in Dams



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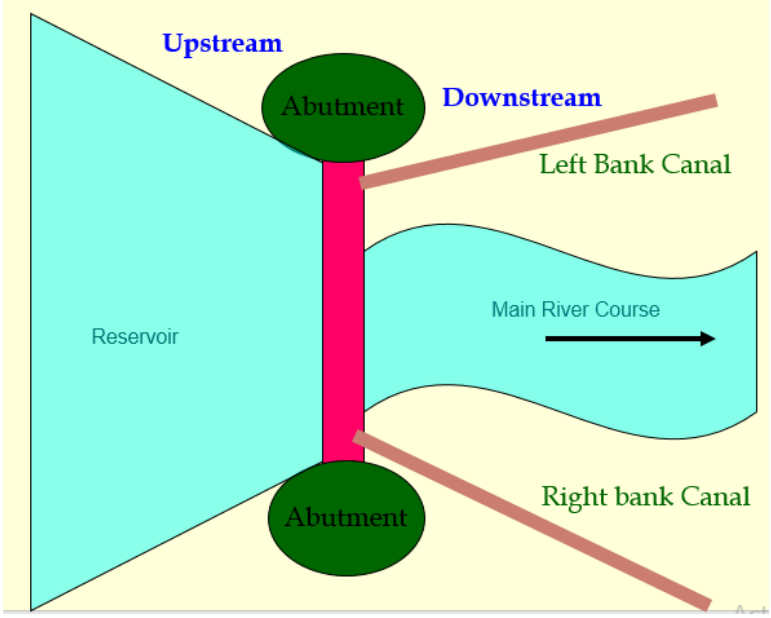
Plan of Dam



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FUNCTIONS OF DAMS

Function	Example
Power generation	Hydroelectric power 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.
Stabilize water flow / irrigation	Dams are often used to control and stabilize water *flow*, for agricultural purposes and irrigation. They can help to stabilize or restore the water *levels* 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 dykes or levees) are used to prevent ingress of water to an area that would otherwise be submerged, allowing its reclamation for human use.
Water diversion	Dams are used for the purpose of diversion.

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Classification of Dams

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

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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

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Classification based on Material of construction

Masonry Dam
Concrete Dam
Timber Dam
Steel Dam
Earth Dam
Rock fill Dam
Composite Dam

Classification based on action

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

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Gravity Dam

Timber Dam

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

Steel Dam

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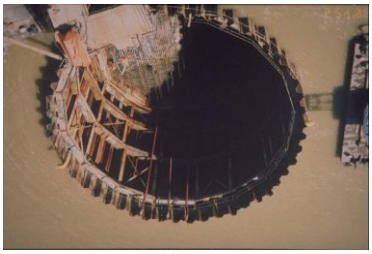
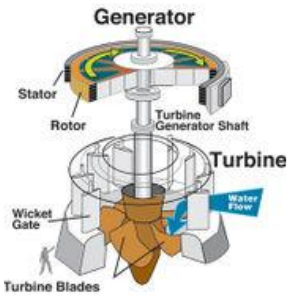


Coffer dam

Hoover Arch Dam



Power generation Plant

Spillway

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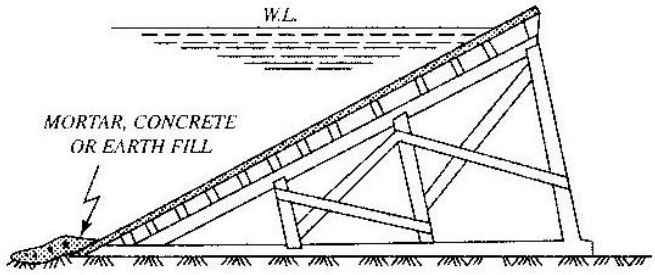
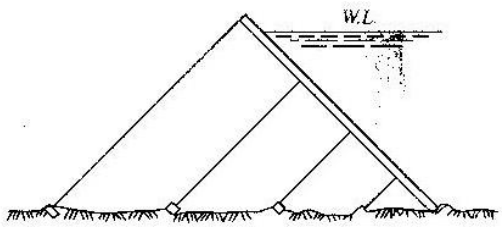


Timber Dam



Steel Dam

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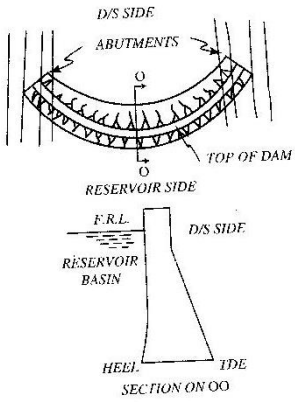
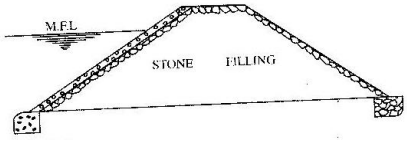
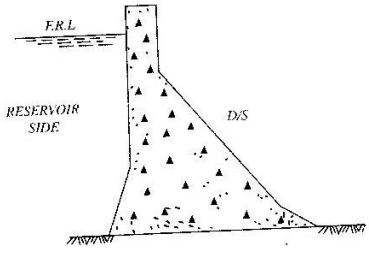


Arch Dam



Rockfill Dam



Solid Gravity Dam

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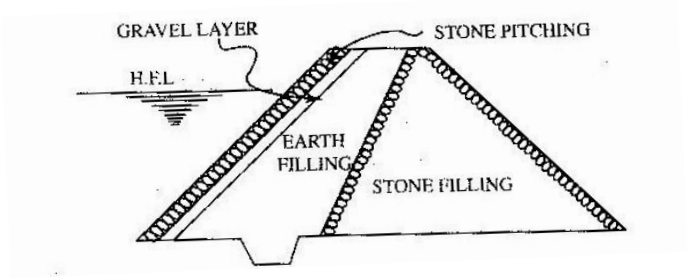
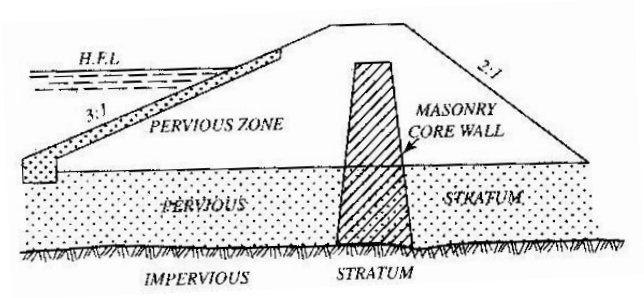


Combined Earth & Rockfill Dam



Earth Dam

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Infrastructure

•**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.

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Impact of infrastructural development of a country

- Increase in food production
- Protection from drought, food shortage, 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,, thermal, solar or wind energy
- Improved, wealth, prosperity, standard of living
- Overall growth of a nation

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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.

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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

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Port city Development

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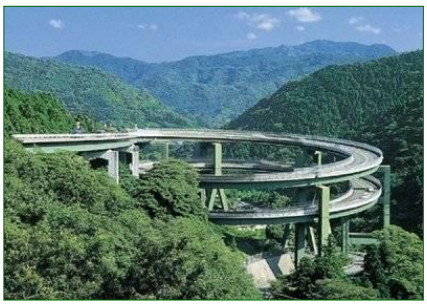

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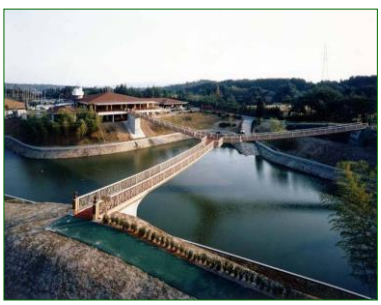

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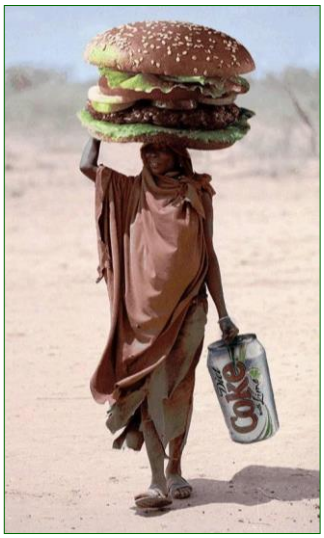

Mixture of Technological growth & raw rural strength, blend of western & traditional culture

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"You've got to get up every morning with determination if you're going to go to bed with satisfaction."

– George Lorimer

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