Role of

Civil Engineering

In

Socio-Economic Development

Lesson Objectives

- Socio-economic overview of India
- Fundamental needs of Human Society
- Role of Civil engineering in meeting the fundamental needs of the society and enhancing the quality of life.
- Role played by civil engineering in India for the socio-economic development
- Challenges faced by civil engineering profession (In India) in the 21st century

India - *Socio-Economic Scenario*

India Occupies 2.4 % of worlds Land

but is

Home to 17 % of Worlds population

- **67.25 % population lives in Rural areas**
- **32.75 % Population lives in Urban areas**

Third largest Economy in the World

India - *Socio-Economic Scenario*

- The estimate by the United States Department for Agriculture Economic Research Service (USDA) assumes the Indian economy will expand annually at an average 7.4% to $6.84 trillion by 2030.
- India is well poised to become the third-largest economy by 2030, surpassing four developed nations Japan, Germany, Britain and France, according to projections by a US government agency.

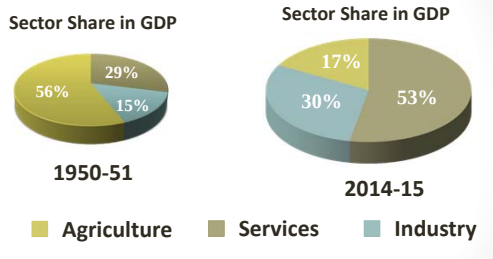
Gross Domestic Product - GDP

- The total value of goods produced and services provided in a country during one year.
- Nominal GDP estimates are commonly used to determine the economic performance of a whole country or region, and to make international comparisons.
- GDP can be determined in three ways, they are the production approach, the income approach, or the expenditure approach.
- Though GDP is usually calculated on an annual basis, it can be calculated on a quarterly basis as well

Gross Domestic Product - GDP

- The Gross Domestic Product per capita in India was last recorded as 1861.50 US dollars in 2016.
- GDP per capita in India averaged 671.68 USD from 1960 until 2016, reaching an all time high of 1861.50 USD in 2016 and a record low of 304.20 USD in 1960.
- The GDP per Capita in India is equivalent to 15 percent of the world's average.
- The **economy of India** is the **sixth-largest** in the world measured by nominal GDP and the **third-largest** by purchasing power parity (PPP).

Indian Socio –Economic Scenario



65 % people share only 15 % wealth

Gross Domestic Product - GDP

Per Capita Income comparisons

Country	Per Capita GDP in US $
U S A	53,042
UK	38,452
Japan	36,449
Korea	33,140
China	11,907
India	**6,490**
Pakistan	4,602
Ethiopia	1,320

gross domestic product at purchasing power parity per capita, the value of all final goods and services produced within a country in a given year divided by the average (or mid-year) population for the same year.

Source : world Bank, 2014

India - *Socio-Economic Scenario*

The World Bank, in 2011 based on 2005's PPPs International Comparison Program, estimated **23.6% of Indian population**, or about **276 million people**, lived below **$1.25 per day** on purchasing power parity

What is 'Quality Of Life' ?

- It is the standard of health, comfort, and happiness experienced by an individual or group.
- **Quality of life** (**QOL**) is the general well-being of individuals and societies, outlining negative and positive features of life. It observes life satisfaction, including everything from physical health, family, education, employment, wealth, religious beliefs, finance and the environment.
- Quality of life should not be confused with the concept of standard of living, which is based primarily on income.

Maslow's Pyramid of Human needs and Quality of Life

- **Maslow's hierarchy of needs** is a theory in psychology proposed by Abraham Maslow in 1943.
- Maslow used the terms "physiological", "safety", "belonging" and "love", "esteem", "self-actualization", and "self-transcendence" to describe the pattern that human motivations generally move through.

Maslow's Pyramid of Human needs and Quality of Life

What are the Fundamental Human Needs ?

- Food
- Water
- Shelter
- Sanitation
- Transport
- Security

Civil Engineering Profession

Civil Engineering serves the basic needs of Society and enhances the Quality of Life, while Creating a Sustainable World

Civil Engineers are

- **Planners, Designers, Constructors,** and **Operators** of society's **Economic and Social Engine**— they Build-environment
- Stewards of the natural environment and its resources

Civil engineering - Socio-Economic Engine

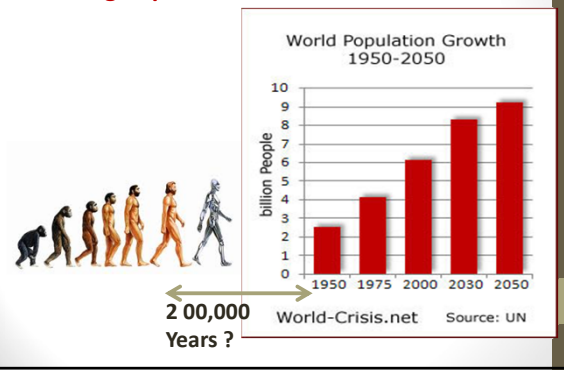
Challenges in meeting

Fundamental Human Needs

?

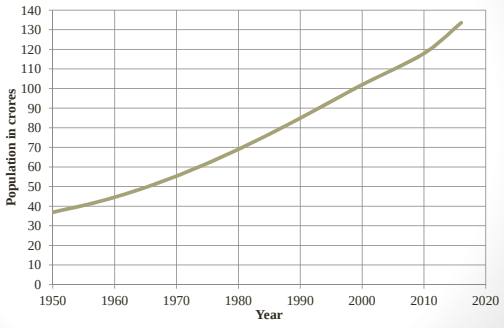
Challenges in meeting Fundamental Human Needs

Increasing Population



Challenges in meeting Fundamental Human Needs

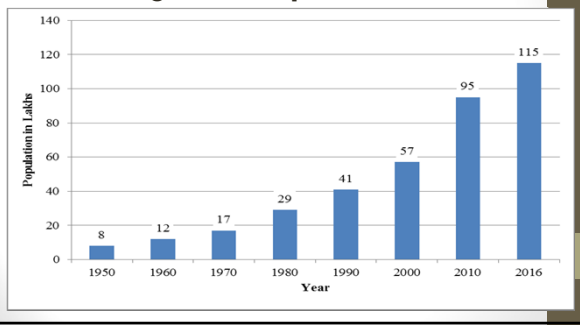
Increasing Population -India



Challenges in meeting Fundamental Human Needs

Population –Increasing Urbanization

Bangalore –Population Growth



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Irrigation
– A Game Changer

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Irrigation – A Game Changer

1950	2000
23 million hectares	90 million hectares

Temples of Modern India

-Pt. Jawaharlal Nehru

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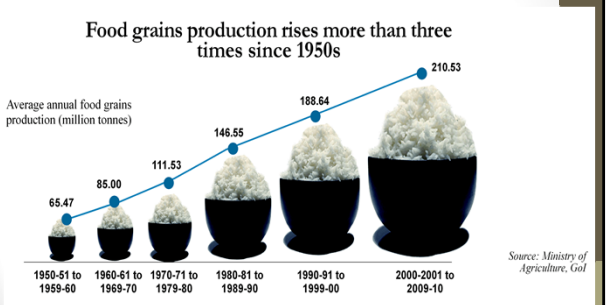
Irrigation – A Game Changer



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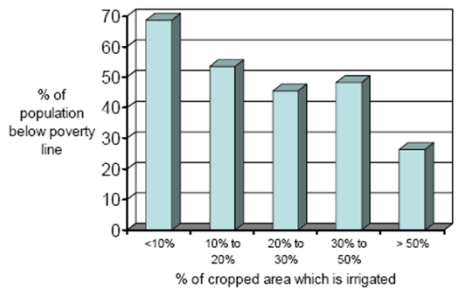
Irrigation – A Game Changer

How Irrigation Reduces Poverty In India



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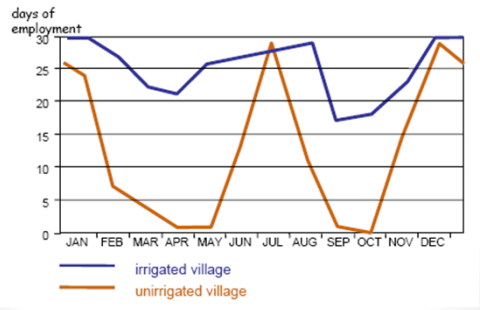
Irrigation – A Game Changer

How Irrigation Increases Employment



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Water Supply & Sanitation

Social Impact

"The greatest advances in improving human health were the development of clean drinking water and sewage systems. So, we owe our health as much to civil engineering as we do to biology."

- Lewis Thomas, Former Dean of Yale Medical School

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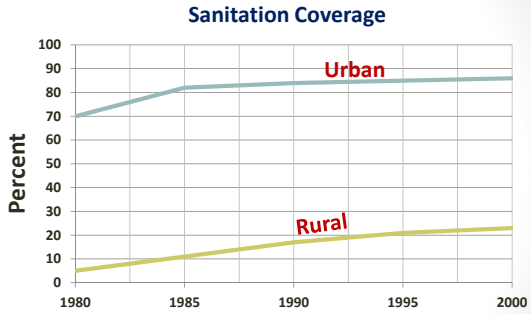
Water and Sanitation

- In India **Water** and **Sanitation** related infections account for between 70-80 per cent of the burden of disease *(Tenth Five Year Plan, 2002-07)*
- **In India, diarrhea alone causes more than** 1,600 deaths *daily—the same as if eight 200-person jumbo-jets crashed to the ground each day*.
- Annual economic losses due to the adverse effects of poor quality drinking water on human health are estimated to be Rs 122 billion *(Pachauri R K and Sridharan P V(eds).1998)*



Water Supply – a case study Hubli- Dharwad

	Component	2017
1.	Network coverage	65 %
2.	Access to piped supply	55 %
3.	Per capita production Supplied through Surface Source	191 MLD
4.	Water Supplied through Underground Source	13 MLD
5.	Hours of supply	2-3 hrs / once in 3 to 4 days
6.	Non- revenue water	35- 40 %

Sewerage – a case study Hubli- Dharwad

Hubli – Dharwad Muncipal corporation has a partial sewerage system (Under Ground Drainage System). The system developed and commissioned during early 1960s.

	Component	Service level
1.	Network coverage	50 %
2.	Access to UGD	55 %
3.	Total quantity generated	78 MLD (approx)
4.	Sewerage Treatment Facility	Yes
5	Treatment and disposal	Limited
6	Recycle and reuse	0 %

Sewerage – a case study Hubli- Dharwad

Comparison with other Municipal Corporations
(as on 2001)

Municipal corporation	UGD (Coverage)	Provision of STP
Gulbarga	**60 %**	No
Belgaum	**80 %**	No
Mysore	**80 %**	Yes
Mangalore	**80 %**	Only primary treatment
Hubli –Dharwad	**50 %**	Yes

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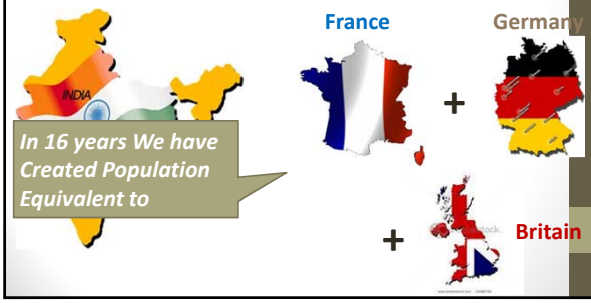
Housing

Housing INDIA

Population in 2001 -- 102 Crore

Population in 2017 -- 134 Crore



Housing

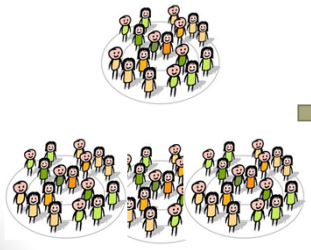
Per Capita area required (existing standards) **-10 sq. mts**

100sq. fts

- According to the *Times of India*, "a majority of Indians have per capita space equivalent to or less than a 10 feet x 10 feet room for their living, sleeping, cooking, washing and toilet needs.
- The average is **103 sq ft per person in rural areas** and **117 sq ft per person in urban areas**.

Housing

- *For 19 Crore people*



Approximately

- **40 Million Houses**
- **19000 Million Sq.ft Construction**
- **Rs. 5, 70,000 Crore investment**

Construction Industry

Indian Construction Industry

- India's construction industry employs about 31 million persons – second only to agriculture in terms of employment.
- Consumes 40-50% of the National Plan outlay
- Contributes nearly 12 per cent to the GDP

Civil

Grand Challenges of Engineering In 21st Century

Civil

Grand Challenges of Engineering In 21st Century

No Child will Cry of Hunger or Thirst

Civil

Grand Challenges of Engineering In 21st Century

Every Child will get clean air and Water for good health and well-being

Civil

Grand Challenges of Engineering In 21st Century

No women will be needed to walk around 1.0 km or climb 600 steps to fetch water

Civil

Grand Challenges of Engineering In 21st Century

No child will grow, soaking in rain or in scorching sun without a decent shelter

Civil

Grand Challenges of Engineering In 21st Century

Sustainable Future

Meeting the needs of the present while improving the ability of future generations to meet their own needs

Quality of life using Maslow's pyramid

Physiological needs

Physiological needs are the physical requirements for human survival. If these requirements are not met, the human body cannot function properly and will ultimately fail. Physiological needs are thought to be the most important; they should be met first.

Air, water, and food are metabolic requirements for survival in all animals, including humans. Clothing and shelter provide necessary protection from the elements.

Safety needs

Once a person's physiological needs are relatively satisfied, their safety needs take precedence and dominate behavior. In the absence of physical safety – due to war, natural disaster, family violence, childhood abuse, etc. – people may experience post-traumatic stress disorder or transgenerational trauma. Safety and Security needs include:

- Personal security
- Financial security
- Health and well-being
- Safety net against accidents/illness and their adverse impacts

Social belonging

After physiological and safety needs are fulfilled, the third level of human needs is interpersonal and involves feelings of belongingness. Deficiencies within this level of Maslow's hierarchy can adversely affect the individual's ability to form and maintain emotionally significant relationships, such as:

- Friendships
- Intimacy
- Family

For example, some large social groups may include clubs, co-workers, religious groups, professional organizations, sports teams, and gangs.

Some examples of small social connections include family members, intimate partners, mentors, colleagues, and confidants.

Humans need to love and be loved by others.

Many people become susceptible to loneliness, social anxiety, etc in the absence of this love or belonging element.

Esteem

All humans have a need to feel respected; this includes the need to have self-esteem and self-respect. Esteem presents the typical human desire to be accepted and valued by others. People often engage in a profession or hobby to gain recognition. These activities give the person a sense of contribution or value. Psychological imbalances such as depression can hinder the person from obtaining a higher level of self-esteem or self-respect.

Self-actualization

"What a man can be, he must be". This quotation forms the basis of the perceived need for self-actualization. This level of need refers to what a person's full potential is and the realization of that potential.

SPECIALIZATION IN CIVIL ENGINEERING

INTRODUCTION:

Civil engineers have one of the world's most important jobs: they build our quality of life. With creativity and technical skill, civil engineers plan, design, construct and operate the facilities essential to modern life, ranging from bridges and highway systems to water treatment plants and energy efficient buildings. Civil engineers are problem solvers, meeting the challenges of pollution, traffic, drinking water and energy needs, urban development and community planning.

Civil engineering being the oldest engineering discipline has the largest number of specializations. All branches of civil engineering are directly related to design, construction and maintenance of the physical and naturally built environment. Civil engineering provides the infrastructure required for all human activities.

Branches of Civil Engineering

- Structural Engineering
- Geotechnical Engineering
- Environmental Engineering
- Hydraulics and Water Resources Engineering
- Transportation Engineering
- Surveying and Geospatial Science
- Construction Engineering and Management

STRUCTURAL ENGINEERING:

- Concerned with designing structures so that they can safely withstand the loads they are subjected to, during their life time
- Structural engineers mainly work with
  - Structural material such as steel, concrete, prestressed concrete and their behaviour when subjected to loads
  - Loads that are expected to act on the structure being considered
- Deformation of structures when loads are applied on them
- Shape and size of structure and its members so that the structure is both safe and economical
- Structural engineering is based on the principles of mechanics, starting with Newton’s Laws of Motion
- Structural materials such as high performance concrete
  - Self-compacting concrete – flows under its own weight without application of external energy
  - High strength concrete (120 N/mm2)
- Structural Dynamics and Earthquake Engineering - study of vibration of structures
- Bridge engineering

GEOTECHNICAL ENGINEERING

- Geotechnical engineering is concerned with engineering behaviour of earth materials
- Concerned with
  - Design of foundations to support weight of structures and machines
  - Stability of earth slopes and embankments such as on hilly roads, dams and tanks
  - Earth retaining structures such as retaining walls
  - Tunnels, Rock slopes, underground structures

Specialization in Geotechnical Engineering

- **Foundation engineering** – Design of foundations for structures
- **Soil dynamics** – study of soils under vibration, such as during earthquakes
- **Rock mechanics** – behaviour of rocks is quite different compared to that of soil
- **Environmental geotechnical engineering** – study of transport of liquid contaminants in soil and their effect on soil properties

ENVIRONMENTAL ENGINEERING

- Environmental engineering is the application of science and engineering principles to improve the natural environment – air, water and land resources
- Concerned with
  - Treatment and supply of water for human activities
  - Treatment of industrial waste and its safe disposal
  - Control of air pollution
- Environmental engineers design systems for treatment of water, industrial wastes and polluted air
- Environmental engineers are also engaged in monitoring parameters related to environment and develop regulations to prevent mishaps.
- Environmental engineers use knowledge of chemistry, biochemistry and biology
- Design of treatment units is similar to design of systems in chemical engineering and biotechnology
- Environmental engineers use knowledge of fluid mechanics in designing pipe networks and pumping equipment

Specializations in Environmental Engineering

- **Water supply engineering –** Identification of sources of water, estimating water requirements, systems for their treatment, systems for supplying treated water to consumers
- **Sanitation engineering –** Treatment of wastewater so that it is safe for disposal into the environment
- **Air pollution and control**

- **Environmental impact assessment –** Quantify impact of human activities on natural resources to decide whether a proposed work can be undertaken
- **Environmental geotechnical engineering**

HYDRAULICS AND WATER RESOURCES ENGINEERING

- Hydraulics engineering is the study of flow of fluids, mainly water, in pipes, open channels (canals, rivers), and inside the earth
- Water resources engineering is the study of water requirement of crops and design of systems to store and supply water for irrigation
- Hydraulics is based on fluid mechanics
- Water resources engineering requires knowledge of mathematics, statistics and operations research to
  - Estimate rain fall based on past rain fall records
  - Determine optimum operations of reservoirs to supply water for crops as well as avoid floods during heavy rain fall
- Transportation engineering is the application of technology and engineering principles to the planning, functional design, operation and management of facilities for any mode of transportation
- It ensures transportation of people and goods is safe, rapid, comfortable, convenient, economical and environmentally compatible
- It includes all modes of transportation – road, rail, air and water

TRANSPORTATION ENGINEERING

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Specializations in Transportation Engineering

- **Traffic planning –** Estimation of existing and future traffic, optimal design of routes, cost of construction and cost recovery in reasonable time
- **Pavement design –** Design of pavements for roads and airport runways. Requires knowledge of some aspects of geotechnical and structural engineering
- **Railway engineering –** Design of subgrade and embankments for railway tracks
- **Airport engineering –** Design of runways, terminals

- **Port and harbor engineering –** Design, construction and operation of ports, harbors and other marine facilities for berthing of ships and handling goods
- Capacity and functional design of bridges, interchanges, grade separators

SURVEYING AND GEOSPATIAL ENGINEERING

- Surveying is the science of accurately determining three dimensional position of points and the distances and angles between them
- This can be done at different levels of sophistication
  - Using surveying instruments such as total station and theodolites
  - Using Global Positioning Systems (GPS) using signals from GPS satellites
  - Photogrammetry and remote sensing using aerial photographs
  - Geographical Information Systems (GIS) using satellite imagery

Surveying:

- Surveying requires knowledge of geometry and trigonometry
- Surveying furnishes information required for many civil engineering activities
  - Area of catchment of a river
  - Volume of water that will be stored by a dam
  - Amount of cutting and/or filling required to construct a dam, road or rail embankment
- Surveying is the first activity in any major civil engineering project

Specializations in Surveying:

- **Trigonometric surveying –** Measurement considering the spherical nature of earth's surface. Plane surveying assumes that earth's surface is plane
- **Digital Terrain Modelling (DTM) –** 3D modelling of earth's surface from survey data
- **GIS –** Not only measures distances and elevations but also recognizes features on earth's surface such as, vegetation, soil type, water bodies etc. from satellite imagery

CONSTRUCTION ENGINEERING AND MANAGEMENT

- Construction engineering and management deals with the designing, planning, construction and management of infrastructure
- It is concerned with the use of materials, labours and equipment
- It aims to increase efficiency, reduce cost and assure quality of construction
- Construction engineering is based on knowledge of construction materials, methods and technologies
- Requires knowledge of
  - Estimation of quantity of **materials** required for construction

- Estimation of **time** required to complete construction
- Estimation of **labour** required for construction
- Sequence of construction to plan each phase
- Construction equipment and methods to reduce time and cost and increase efficiency and safety