

Law and Banking

Management and Economy

Civil Engineering

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## कृषि विकास बैंक लि.

खुला प्रतियोगिता कार्यालय, काठमाडौं लिखित परीक्षाको पाठ्यक्रम

### पदको विवरण

पद : सिभिल इन्जीनियर  
तह : ६ (छ)

सेवा / समूह / उपसमूह : प्राविधिक, इन्जीनियरिङ, सिभिल

### परीक्षाको किसिम:

(क) : लिखित परीक्षा : २०० पूर्णाङ्क

(ख) : अन्तर्वार्ता : ३० पूर्णाङ्क

### न्यूनतम शैक्षिक योग्यता:

मान्यता प्राप्त विश्व विद्यालयबाट सिभिल इन्जीनियरिङ विषयमा स्नातक तह उत्तिर्ण गरी नेपाल इन्जीनियरिङ काउन्सिलमा दर्ता भई प्रमाणपत्र प्राप्त गरेको ।

### पाठ्यक्रमको उद्देश्य:

बैंकको सिभिल इन्जीनियर प्राविधिक, सिभिल इन्जीनियरिङ तह-६ पदका लागि निर्धारित कार्य-विवरणलाई दृष्टिगत गरी तोकिएको आवश्यक न्यूनतम योग्यता पुगेका योग्य उम्मेदवारहरु मध्येबाट बैंकको सिभिल इन्जीनियरिङ कार्य सम्पादनका लागि बैंकको कार्यक्षेत्र र कार्य प्रकृतिसँग सम्बन्धित निर्माण, मर्मत सम्भार तथा अन्य बैंकिङ कारोबार संचालन जस्ता सान्दर्भिक विषयमा उम्मेदवारहरुको सैद्धान्तिक र व्यावहारिक ज्ञानको परीक्षण गर्नु प्रस्तुत पाठ्यक्रमको उद्देश्य रहेको छ ।

### लिखित परीक्षाको संरचना:

सि.नं.	पत्र	विषय	खण्ड	प्रश्न प्रकृति	प्रश्न संख्या	अंक	अंकभार	पूर्णाङ्क	उत्तीर्णाङ्क	समय
१	प्रथम पत्र	कानून, बैंकिङ, व्यवस्थापन तथा आर्थिक सम्बन्धी	क	छोटो उत्तर	४	५	२०	१००	४०	३ घण्टा
				लामो उत्तर	३	१०	३०			
			ख	छोटो उत्तर	४	५	२०	१००	४०	३ घण्टा
				लामो उत्तर	३	१०	३०			
२	द्वितीय पत्र	सेवा सम्बन्धी	क	छोटो उत्तर	४	५	२०	१००	४०	३ घण्टा
				लामो उत्तर	३	१०	३०			
			ख	छोटो उत्तर	४	५	२०	१००	४०	३ घण्टा
				लामो उत्तर	३	१०	३०			

### द्रष्टव्य:

- (१) लिखित परीक्षाको प्रश्न पत्र नेपाली वा अंग्रेजी दुवै भाषामा सोधिने छ । सबै प्रश्नको उत्तर अनिवार्य छ । लिखित परीक्षामा परीक्षार्थीले नेपाली र अंग्रेजी भाषामध्ये कुनै एक वा दुवै माध्यममा उत्तर दिन सक्नेछन् ।
- (२) पाठ्यक्रममा भएका यथासम्भव सबै पाठ्यांशका ईकाईहरु समावेस हुनेगरी प्रश्न सोधिने छ ।
- (३) यस पाठ्यक्रमका विषयवस्तुमा जेसुकै लेखिएको भएतापि यस पाठ्यक्रममा परेका ऐन, नियम तथा नीतिहरु परीक्षाको मितिभन्दा तीन महिना अगाडि संशोधन भई कायम रहेकालाई यस पाठ्यक्रममा समावेस भएको सम्भन्नु पर्छ ।
- (४) लिखित परीक्षामा प्रत्येक पत्रको उत्तीर्णाङ्क न्यूनतम चालीस प्रतिशत अंक रहेको र लिखित परीक्षामा सफल भई योग्यताक्रममा छनौट भएका उम्मेदवारहरु मात्र अन्तर्वार्ता परीक्षामा सम्मिलित हुन पाउने छन् ।
- (५) विषयगत प्रश्नहरुका हकमा एउटा लामो प्रश्न वा एउटै प्रश्नका दुई वा दुईभन्दा बढी भाग (Two or More parts of a single question) वा एउटा प्रश्न अन्तर्गत दुई वा बढी टिप्पणीहरु (Short notes) सोधन सकिनेछ ।

पाठ्यक्रमको स्वीकृति तथा लागु मिति : २०७७/५/१२

## प्रथम-पत्र : कानून तथा बैंकिङ सम्बन्धी

खण्ड - क : कानून तथा बैंकिङ सम्बन्धी				छोटो उत्तर	४ प्रश्न X ५ अंक = २०
पाठ्यक्रमको इकाई विभाजन				लामो उत्तर	३ प्रश्न X १० अंक = ३०
बुँदा नं. :	१	२	३	४	
प्रश्न संख्या :	२	२	२	१	

- (१) ऐन, नियम: नेपाल राष्ट्र बैंक ऐन, २०५८, बैंक तथा वित्तीय संस्था सम्बन्धी ऐन २०७३, बैंकिङ कसूर तथा सजाय ऐन, २०६४, सम्पति शुद्धीकरण (मनी लाउण्डरिङ) निवारण ऐन, २०६४, कम्पनी ऐन २०६३, विद्युतिय (इलेक्ट्रोनिक) कारोबार ऐन, २०६३ तथा नेपाल राष्ट्र बैंकबाट जारी एकिकृत निर्देशन सम्बन्धी जानकारी ।
- (२) बैंकिङ प्रणाली: अवधारणा, विकासक्रम, बैंकका प्रकार तथा कार्यहरु, नेपालको आर्थिक विकासमा बैंकिङ क्षेत्रको महत्व, वर्तमान अवस्था, केन्द्रीय बैंकको स्थापना, भूमिका, काम, कर्तव्य र अधिकार, नेपालमा बैंकिङ क्षेत्रको वर्गीकरण तथा बैंक तथा वित्तीय संस्थाहरूको काम, कर्तव्य र अधिकार, बैंकिङ क्षेत्रको सम्भावना, अवसर तथा चुनौतिहरु, बैंकिङ व्यवसायमा जोखिम र न्यूनीकरणका उपायहरु ।
- (३) बैंकिङ सेवाहरु: निक्षेप सेवा, कर्जा सेवा, विप्रेषण, प्रतीतपत्र, बैंक जमानत कारोबारको अवधारणा, महत्व र प्रकार, कोष र गैह कोषमा आधारित कारोबारहरु, कर्जा चक्र, कर्जाको वर्गीकरण, Branchless Banking, Any Branch Banking System (ABBS), Mobile Banking, Internet Banking, SWIFT, Debit Card, Credit Card, ATM, PoS, QR code, Online account, Good for Payment Cheque, Manager's Cheque, Locker, Financial Literacy, Digital Literacy, Kisan Credit Card/Apps, Opportunities and Challenges of Digital Banking in Nepal र बैंकिङ शब्दावली (Banking Terminology) ।
- (४) कृषि विकास बैंक लि.: बैंकको स्थापना, विकासक्रम, कार्यप्रकृति, दूरदृष्टि, ध्येय, उद्देश्य, संगठनात्मक संरचना, कारोबारको अवस्था, वासलातको आकार, विद्यमान सबल एवं दुर्बल पक्ष तथा अवसर र चुनौतिहरु, कृषि विकास बैंक लि. कर्मचारी सेवा विनियमावली, २०६२, बैंक तथा वित्तीय संस्थामा कार्यरत कर्मचारीले पालना गर्नुपर्ने आचरण तथा अनुशासन ।

खण्ड - ख :				छोटो उत्तर	४ प्रश्न X ५ अंक = २०
व्यवस्थापन तथा आर्थिक सम्बन्धी				लामो उत्तर	३ प्रश्न X १० अंक = ३०
पाठ्यक्रमको इकाई विभाजन					
बुँदा नं. :	१	२	३	४	५
प्रश्न संख्या :	१	१	१	१	१

- (१) **Management:** Organization concept, Structure, objectives & principles, Communication System, Organization change & development, Organization cultural, Organization governance, Management concept, Principles, Types & Functions, Key management process, Current issues of management, Management Information System and its components, Time Management, Crisis Management, Conflict Management, Change Management, Knowledge Management, Record Management, Stress Management

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- (2) **Human Resource Management:** Concept, function and importance of HRM, HR Planning, Recruitment & selection, Training & development, Job description, Job specification & Job analysis, Motivation, Reward & Punishment, Performance appraisal, Career Planning, Employee ethics, Human Resource Information System, Moral values, Retirement & Socialization, Industrial Relation & Collective Bargaining.
- (3) **Economics:** Characteristics of Nepalese economy, GDP, National Income, Per capita Income, Interest Rate, Inflation, Investment, Saving, Government Securities, Balance of Payment, Money market, Capital market.
- (4) **Strategic & Risk Management:** Strategic planning framework, Strategy formulation process and methods, SWOT analysis, Risk Management Concept, Identification, Types, Measurement, Cyber securities, IT risk management techniques and strategies, Contingency planning and management.
- (5) **Project Management:** Concept, Project identification, formulation, appraisal, implementation, monitoring, evaluation and control.
- (6) **Fiscal & Monetary policy:** Concept, feature, objectives and instruments of monetary policy & fiscal policy.
- (7) **Information Technology:** Computer System (Input Device, Output Device), Operating System, Application software, MS office system, Internet, Intranet, Extranet and e-mail system, Database management system, Hardware, Networking, Backup, Related threats. Need of core banking system (CBS) in banking business, Importance & related risks of CBS in banking institution.

### द्वितीय पत्र : (सेवा सम्बन्धी)

खण्ड - क : सेवा सम्बन्धी		छोटो उत्तर	४ प्रश्न X ५ अंक = २०	
		लामो उत्तर	३ प्रश्न X १० अंक = ३०	
पाठ्यक्रमको इकाई विभाजन				
बुँदा नं. :	१	२	३	४
प्रश्न संख्या :	१	१	२	१
			५	६
			१	१

1. **Engineering Survey:** Concept and basic principles of surveying.
- 1.1 Linear measurements: techniques; chain, tape, ranging rods and arrows; representation of measurement and common scales; sources of errors; effect of slope and slope correction; correction for chain and tape measurements; Abney level and clinometers
  - 1.2 Compass and plane table surveying: bearings; types of compass; problems and sources of errors of compass survey; principles and methods of plane tabling
  - 1.3 Leveling and contouring: Principle of leveling; temporary and permanent adjustment of level; bench marks; booking methods and their reductions; longitudinal and cross sectioning; reciprocal leveling; trigonometric leveling; contour interval and characteristics of contours; methods of contouring

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- 1.4 Theodolite traversing: need of traverse and its significance; computation of coordinates; adjustment of closed traverse; closing errors

- 1.5 Uses of Total Station and Electronic Distance Measuring Instruments

## **2. Drawing Techniques:**

- 2.1 Drawing sheet composition and its essential components
- 2.2 Suitable scales, site plans, preliminary drawings, working drawings etc
- 2.3 Theory of projection drawing: perspective, orthographic and axonometric projection; first and third angle projection
- 2.4 Drafting tools and equipments
- 2.5 Drafting conventions and symbols
- 2.6 Topographic, electrical, plumbing and structural drawings
- 2.7 Techniques of free hand drawing

## **3. Structure Analysis and Design:**

- 3.1 Stresses and strains; theory of torsion and flexure; moment of inertia
- 3.2 Analysis of beams and frames: Bending moment, shear force and deflection of beams and frames: determinate structure - Energy methods; three hinged systems, indeterminate structures- slope deflection method and moment distribution method; use of influence line diagrams for simple beams, unit load method
- 3.3 Reinforced concrete structures: Difference between working stress and limit state philosophy, analysis of RC beams and slabs in bending, shear, deflection, bond and end anchorage, Design of axially loaded columns; isolated and combined footings, introduction to pre-stressed concrete
- 3.4 Steel and timber structures: Standard and built-up sections: Design of riveted, bolted and welded connections, design of simple elements such as ties, struts, axially loaded and eccentric columns, column bases, Design principles on timber beams and columns

## **4. Estimating and Costing, Valuation and Specification:**

- 4.1 Types of estimates and their specific uses
- 4.2 Methods of calculating quantities
- 4.3 Key components of estimating norms and rate analysis
- 4.4 Preparation of bill of quantities
- 4.5 Purpose, types and importance of specification
- 4.6 Purpose, principles and methods of valuation

## **5. Transportation & Construction:**

- 5.1 Transportation system and its classification.
- 5.2 Road transport and road construction in Nepal.
- 5.3 Classification of roads in Nepal (NRS and IRC)
- 5.4 General principles of road network planning.
- 5.5 Feasibility study of road projects.
- 5.6 Alignment, engineering survey and its stages.
- 5.7 Geometric design of roads: map study, element of cross-section and highway alignment, design of horizontal curve, super elevation, transition curve, vertical curves, right of way.
- 5.8 Drainage consideration in roads: Introduction and design of culverts and minor bridges, cross drainage structures, subsurface drainage system

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- 5.9 Special consideration in Hill roads design: Problems associated with hill roads construction, Route location, hairpin bends and special structures.
- 5.10 Bioengineering practices along hill side.
- 5.11 Activities and techniques in road construction in rural roads.
- 5.12 Maintenance, repair and rehabilitation of roads.
- 5.13 Basic knowledge on design, construction and maintenance of suspended and suspension bridge in Nepal.
- 5.14 Low-cost road construction.

## **6. Energy System:**

- 6.1 Hydrological study, planning and design of hydropower projects.
- 6.2 Head works, dams, spillways, surge tanks, stilling basin etc.
- 6.3 River diversion works.
- 6.4 Biogas- Introduction.
- 6.5 Alternative energy systems in Nepal.

खण्ड - ख :सेवा सम्बन्धी		छोटो उत्तर	४ प्रश्न X ५ अंक = २०		
		लामो उत्तर	३ प्रश्न X १० अंक = ३०		
पाठ्यक्रमको इकाई विभाजन					
बुँदा नं. :	१	२	३	४	५
प्रश्न संख्या :	१	१	२	१	१

## **1. Housing, building and urban planning:**

- 1.1 Present status and practices of building construction in Nepal
- 1.2 Specific considerations in design and construction of buildings in Nepal
- 1.3 Indigenous technology in building design and construction
- 1.4 Local and Modern building construction material in Nepal
- 1.5 Community buildings: School and hospital buildings and their design considerations
- 1.6 Urban planning needs and challenges in Nepal.

## **2. Technology, Environment and civil society:**

- 2.1 Technological development in Nepal.
- 2.2 Promotion of local technology and its adaptation
- 2.3 Environmental Impact Assessment, Initial Environmental Examination, Global-warming phenomena.
- 2.4 Types of sources of pollution: point / non-point (for air and water)
- 2.5 Social mobilization in local infrastructure development and utilization in Nepal.
- 2.6 Participatory approach in planning, implementation, maintenance and operation of local infrastructure

## **3. Construction Materials:**

- 3.1 Properties of building materials: physical, chemical, constituents, thermal etc.
- 3.2 Stones-characteristics and requirements of stones as a building material
- 3.3 Ceramic materials: ceramic tiles, Mosaic Tile, brick types and testing etc.
- 3.4 Cementing materials: types and properties of lime and cement; cement mortar tests
- 3.5 Metals: Steel; types and properties; Alloys
- 3.6 Timber and wood: timber trees in Nepal, types and properties of wood

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3.7 Miscellaneous materials: Asphaltic materials (Asphalt, Bitumen and Tar); paints and varnishes; polymers

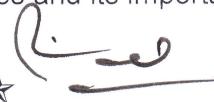
#### **4. Building Construction Technology:**

- 4.1 Foundations: i) Subsoil exploration ii) Types and suitability of different foundation: shallow, deep, iii) Shoring and dewatering iv) Design of simple brick or stone masonry foundations
- 4.2 Walls: i) Types of wall & their functions ii) Choosing wall thickness, Height to length relation iii) Use of scaffolding
- 4.3 Damp Proofing: i) Sources of Dampness ii) Remedial measures to pre-went Dampness
- 4.4 Concrete Technology i) Constituents of cement concrete ii) Grading of aggregates iii) Concrete mixes iv) water cement ratio v) Factors affection strength of concrete vi) Form work vii) Curing

#### **5. Construction Management:**

- 5.1 Construction scheduling and planning:
  - i) Network techniques (CPM, PERT) ii) Bar chart iii) Gantt Chart
- 5.2 Contractual procedure and management:
  - i) Types of contract ii) Tender and tender notice iii) Preparation of bidding document
  - iv) Contract prequalification/Post qualification v) Evaluation of tenders and selection of contractor vi) General Condition of contract vii) e-bidding viii) Single envelope & double envelope system.

#### **6. Professional Practices:** Ethics and professionalism, Code of conduct and guidelines for professional engineering practices, Nepal Engineering Council Act, 2055 and regulations, 2056, Relation with clients, contractor and fellow professionals, Public procurement practices for works, goods and services and its importance.

   
★ ★ ★ ★ ★



# **Law and Banking**

# **Law, Acts**

## **Nepal Rastra Bank Act, 2058)**

- formulated first time in 2012BS
- bank was established under this act in Baishakh 1, 2013BS
- act 2012 with major objective of establishing Central Bank and replace indian currency
- was amended in 2058 with some major changes

### **Objectives:**

1. To establish Nepal Rastra Bank
2. To manage and operate Nepal Rastra Bank
3. To formulate necessary monetary policy and foreign exchange policy
4. To maintain relationship with government
5. To maintain stability of the price
6. To consolidate Balance of Payment (BoP)
7. To develop effective and efficient payment system
8. To regulate other bank and financial institutions such as **issue license, Issue directives, inspection, supervision and monitoring**
9. To increase public trust in the banking
10. To increase public involvement in the banking service
11. To assign role of the central bank such as
  - a. Issuing bank notes and coins
  - b. Act as bank of the bank as lender of last resort
  - c. Act as financial advisor/agent of the government of Nepal etc.

### **Objectives of Nepal Rastra Bank**

1. To formulate necessary monetary policy and foreign exchange policy

2. To maintain and promote financial stability and liquidity required in banking and financial sectors
3. To develop efficient and effective payment system

*The objective of Nepal Rastra Bank is to maintain economic stability, sustainable economic development, the balance of payment (BoP) increases public trust and increase public access in the banking system.*

### **Function of Nepal Rastra Bank**

1. To issue bank notes and coins
2. To formulate necessary monetary policy and foreign exchange policy and implement them
3. To determine the FOREX rate
4. To manage the FOREX reserve
5. Issue license to BFIs
6. Act as lender of the last resort
7. Act as agent/banker/financial for government of Nepal
8. Develop and promote efficient and effective payment system
9. Perform other activities to meet the objective of NRB

### **Prohibited Function of Nepal Rastra Bank**

1. Not to accept deposit from the general public
2. Not to provide credit to general public
3. Not to make any type of financial gift
4. Not to purchase any share capital of other commercial bank and public organizations
5. Not to operate any types of business
6. Not to acquire any movable and immovable properties

### **Facilities Provided by Nepal Rastra Bank Act 2058**

1. Exemption in the tax, fees, charges in any types of capital transaction, house, land carried out by NRB
2. No need to pay the registration fee for registration activities while providing loans or refinancing
3. No requirement of revenue stamps on any of the documents relating to bank •  
Exemption in all types fees, charges, customs, duty on the import export of

- Exemption in all types fees, charges, customs, duty on the import export of bank notes, coins, golds, silvers, chemicals, papers, metal and other required materials used for printing the bank notes and minting coins.

#### **Formation of NRB Board**

Designation	Who?	Number
Chairperson	Governor	1
Member	Secretary of Ministry of Finance	1
Member	Deputy Governors	2
Director	Appointed by Government of Nepal from amongst the person renowned in the field of Economic, Monetary, Banking, Finance and Commercial Law	3
Total		7

There shall be Board of Directors in the bank consisting of the following members-

- 1 Board, 7 Members (4 internal + 3 External ) chaired by the Governor
- Appointed by the Government of Nepal
- 5 years of tenure
- Board members can be appointed any numbers of time
- Oath by Cheif Justice
- After retirement, board members can not work in other B&FIs at least for three years
- Member can give resign to Government of Nepal

#### **Functions/Duties/Rights/Power of Board**

- To frame monetary and foreign exchange policies
- To take necessary decisions with regard to denominations of the banknotes, coins, the figures, size, metal, materials for printing notes, and other materials. Also, frame appropriate policies with regard to their issue.

- To frame necessary policies for causing the supervision and inspection of B&FIs.
- To frame the applicable policies for other B&FIs.
- To frame policies with regards to the appointment, promotion, transfer, dismissal, remuneration, pension, provident fund, leave, code of conduct and other terms and conditions relating to the services of the employees of the bank.
- To approve the necessary policy for the issue of license to commercial banks and financial institutions.
- To approve the limit of the loan to be provided to the Government of Nepal by the bank.
- To fix the amount, limit, terms and conditions about providing loan to the B&FIs.
- To make a decision with regards to the bank's membership to international organizations.
- To frame the policy for investment and mobilizations of the Bank's financial resources.

### **Appointment of the Governor**

1. Government of Nepal, the council of Minister shall appoint the Governor as per the recommendation from recommendation committee. Recommendation committee consists of three members chaired by the Minister of Finance, and the other two members ex-governor and renowned person in baking and financial sector.
2. The committee recommends at least three candidates renowned in the field of **economic, monetary, banking, finance, commerce, management commercial law** and from among the **deputy governor**.
3. 5 years of tenure.
4. Governor once appointed can be appointed for another one tenure,
5. Governor takes oath from the chief justice.
6. Governor can give resignation to the Government of Nepal.
7. Governor cannot work in other B&FIs after the retirement or after resignation.
8. Government of Nepal, the council of Minister shall remove the governor, deputy governor, or other directors. To remove Governor, three members committee should be formed. The committee led by ex-chief justice and inspect the work of Governor for one month. If the committee finds the disqualification of the Governor then government of Nepal, the council of Minister can remove Governor.

### **Functions/Duties/Power of Governer**

- Implement decisions made by the board.
- Operate and manage the bank.

- Systematize the functions to be carried out by the bank.
- Represent the Nepal Rastra Bank in the international platform.
- Implement and cause to implement the policies relating to monetary and foreign exchange matters.
- Fix the interest rate related policies of other B&FIs.
- Formulate the policy related to the liquidity of the other B&FIs.
- Formulate the terms and conditions of the gold and other precious metal related transactions.
- To fix the fees and commission of B&FIs.
- To take the decision about operating and expanding the branches of the B&FIs.
- To make the necessary arrangement for the development & operation of the information system of other banks.
- To formulate the policy relating the revocation of the license provided to commercial banks.
- To take decisions on any other subject matter to the power delegated by the BOD.

### **Appointment of Deputy Governor**

- There shall be two deputy governors.
- Government of Nepal, the council of Minister shall appoint deputy governors on the recommendation of Governor.
- While making the recommendation for application of Deputy Governor, recommend double the number of the post falling vacant from among the special class officers of the banks on the basis of their performance and capability.
- 5 years of tenure.
- No provision for reappointing.
- Take oath from Governor.
- After retirement, deputy governor cannot work in other B&FIs at least for three years

### **Provisions relating to the Audit Committee**

1 audit committee, 3 members chaired by Director, 1 member from the chief of the internal audit department, and 1 member from among the senior officer.

### **Functions/Duties/Power of Audit Committee**

- Submit audit report to the NRB board.

- The audit committee can recommend for the preparation of budget and audit procedure, support to prepare a periodic balance sheet and other documents.
- Supervise the implementation of the NRB policies of measures.
- Audit managerial and performance appraisal of the NRB entity.
- Frame bylaws relating to audit under the provision of prevailing law.

### **Financial Management of NRB**

1. **Capital of the bank:** The capital of the bank shall be 5 billion rupees (5 Arab Rupiya).
2. **Accounting System used to calculate income and expenditure of NRB:** The bank shall prepare an account of its profit and loss as per Nepal Accounting Standard and bank shall use International Accounting standard (IAS) as per the requirement.
3. **Allocation of Income:** The bank shall allocate the net income as follows
  - a. Monetary Liability Fund: 5%
  - b. Financial Stability Fund: 5%
  - c. General Reserve Fund: Min 10% and max to cover capital expenditure
  - d. Revaluation Fund: All income from revaluation of foreign exchange
  - e. Government Reserve Fund: Rest of the income
4. **Allotment of Expenditure:** The bank shall allocate the net loss as follows
  - a. All the general expenditure of general operation shall be debited from the General Reserve Fund (GRF).
  - b. All the capital debited from the General Reserve Fund (GRF).
  - c. Re-valuation loss shall be debited from the Revaluation Fund(RF)
5. **Budget:** Prepared by NRB and approved by NRB Board and sent to the Government of Nepal

### **Relationship between NRB and Nepal Government**

1. Work as bank of the government.
2. Work as the financial advisor and agent of the government.
3. Provide consultation regarding the reform of financial laws.
4. Provide consultation regarding foreign debt of the government.
5. Represent Nepal government in the international platforms.
6. Issue currencies for the Government of Nepal.

7. Work as the policy formulator for the government of Nepal.
8. Work as system builder for the payment system, settlement & clearing houses and credit creation.

#### **Conditions to declare problematic B&FIs by NRB**

- Act against the interest of depositor, shareholder, and promoters.
- Act of not fulfilling the financial liabilities.
- If B&FIs are going toward insolvency
- If B&FIs submit the fake document and acknowledge later. (while getting a license)
- If B&FIs are unable to maintain the capital structure and capital fund.
- If B&FIs initiate the process of volunteer liquidation undue delay.
- If B&FIs carry out the businesses which are restricted by NRB.
- Unable to pay the due amount.

#### **Action taken by NRB to Problematic B&FIs**

- Can issue an order to issue new shares.
- NRB can suspend the right of voting for the shareholder.
- Stop the dividend payment to any other amount to the shareholder.
- Determine the limitation to the bonus, salary, compensation and other expenses.
- Can maintain efficient arrangement to liquidity management/corporate governance.
- Can limit the transaction of B&FIs.
- Prohibit for doing specific business.
- Can issue an order to remove director/manager/staff.
- Can suspend the BOD.
- Can issue an order to delist from the stock market.

#### **What is to be improved?**

1. Financial infrastructure should be developed and maintained.
2. Focus on internal banking control.
3. Spread financial literacy.
4. Properly monitor and implement Anti Money Laundering Act.
5. Develop implement banking software.
6. Minimize banking related offense.
7. Secure the online transaction as the security challenges is getting riskier.
7. Manage employees properly.

## **Bank and Financial Institution Act, 2073 -BAFIA(2017)**

### **Financial System of Nepal**

Following are the entities of the financial system of Nepal.

1. Bank and financial institutions – Regulated by NRB
2. Insurance companies – Regulated by Beema Samiti
3. Capital Market – Regulated by SEBON
4. Mutual Funds – Regulated by SEBON
5. Cooperatives – Regulated by Sahakari Bhibag
6. Contractual funds (Saving institution) – Regulated by Government of Nepal. For example
  - Nagarik Lagani Kosh – Citizen Investment Fund
  - Karmachari Sanchaya Kosh – Employee Provident Fund
  - Samajik Surakchya Kosh – Social Security Fund

### **Objectives if Bank and Financial Institution Act (BAFIA)**

1. To promote public trust towards B&FIs.
2. To provide quality & reliable banking service.
3. To protect the right and interest of depositors and investors.
4. To protect from banking hazards/ and protect from banking risks.
5. To promote the national economy by using/adopting economic liberalization.
6. To make legal provision relating to incorporation, management, operation and winding up of B&FIs.

### **Feature of BAFIA**

NOTE- Write features on basis of provision.

1. BAFIA is an umbrella banking law.
2. It is integrated banking law/regulating law.
3. BAFIA focused on financial good governance.
4. Focused on maintaining financial stability.
5. Compliance with Money Laundering Prevention Act.
6. Allow to buyback shares.
7. Provision to incorporate B&FIs only as a public company.

8. Use of economic liberalization.
9. Promotion of transparency and protection of deposits.
10. It classifies B&FIs into 5 types and 4 classes.
11. Two types of winding up provisions are outlined – such as Voluntary and Compulsory
12. Prohibited functions of B&FIs are clearly mentioned.

### **Major Provisions of BAFIA**

- 1. It has a provision of incorporation of Banks and Financial Institutions.**
  - Before the incorporation of the Banks and Financial Institution, it is necessary to get prior approval from Nepal Rastra Bank.
  - Bank can be incorporated only as a public company.
  - To get prior approval from NRB, it is required to submit related documents along with the application: Memorandum of Association(MOA), Article of Association(AOA), Feasibility study, Details of promoters
  - NRB shall provide approval within 120 days from the date of application received
  - NRB can refuse to provide prior approval in the following conditions: accused in criminal offenses, same name, against provision or law
  - Incorporation of B&FIs with a joint venture or foreign investment need to get prior approval from NRB
  - To expand branches, need to get prior approval from NRB.
  - Incorporation od B&FIs is based on company act.
- 2. It has provision relating to the capital (Share, Stock) formation/ Share Transaction**
  - All the B&FIs must submit their prospectus to NRB before issuing share capital.
  - Must a lot their capital as per the following structure: 30% public, 51% promoters, 0.5 employee
  - To make a share transaction, they must assign capital/share manager and notice it within 7 days of an agreement
  - Lock up period for converting promotor share into the public is defined as 10 years.
  - Lock up period for the transaction of promotor share is defined as 5 years and to make a transaction of promotor share who holds more than 2% share capital of B&FIsmust ger prior approval from NRB.

- B&FIs can buy back their share if they fulfil the conditions which are outlined by law.

**3. It has provision relating to the formation of BOD**

- BOD can be of 5-7 members
- Members can be elected maximum 2 times
- Independent members cannot be repeated
- Only one member from a single family can be in BOD
- BOD member cannot involve in other BFIs.

**4. It defines the qualification of BOD.**

- For general director – at least masters degree in related field or Bachelors + 3 years work experience of 5 years of work experience in a related field.
- Independent director – Masters degree for A and class Bank, a bachelor for C class and as per the NRB for D class.

**5. Provision relating to rights, obligation, the responsibility of BOD**

**6. Provision relating to the appointment of CEO, his/her functions, rights and duties.**

- BOD can appoint CEO
- CEO can be elected two times
- If no qualification of BOD, Masters degree as per the law, then CA or Bachelor with 10 years of experience can be CEO.

**7. Provision relating to the punishment of BFI's who operate without getting a license.**

**8. Provision relating to license for banking operation**

- For incorporation of BFIs, prior approval from NRB is needed.
- Without getting a license, a bank cannot be incorporated
- To get bank license, required documents and application must be submitted.
- Documents include AOA, MOA
- NRB provides approval notice within 120 days or refusal notice within 90 days

**9. Provision relating to the capital and capital fund**

- BFIs must maintain the capital fund and Capital Adequacy Ratio as per the direction of NRB

- Must maintain a general reserve fund
  - Must maintain a foreign exchange reserve fund
  - Must maintain liquidity fund as per the direction of NRB
  - Dividend announcement and distribution as per the direction of NRB
  - NRB approval needed an increase and decrease of capital
10. Provision relating to the functions and prohibited functions as per their class
11. Compliance with Money laundering prevention act 2064
12. Provision relating to loan advancement, loan inspection, and loan recovery
13. Provision relating to the accounting, auditing, record management of the BFIs
14. Provision relating to the merger, acquisition of BFIs
15. Provision relating to the voluntary and compulsory winding up of BFIs
16. Provision relating to the punishment by NRB to other BFIs in the case of violation of the rules and regulation
17. Provision relating to the banking offense and punishment
18. Provision relating to the incorporation and operation of an infrastructure development bank
19. Provision relating to the rights of the depositors
20. Provision relating to the protection of depositors, transparency in the deposits, etc.

**Conditions B&FIs can buy back their share:**

1. If AOA contains the provision of share buyback.
2. Is SGM make a resolution to buyback share capital.
3. If the share capital is listed in the stock market.
4. Can buyback only from profit.
5. Only up to the amount of the 20% of general reserve funds.
6. Need to get approval from NRB.

# **Banking Offence and Punishment Act, 2064 – BOPA**

## **Banking offence**

- Unauthorised activities that make losses to banking system
- also known as **banking fraud** (financially motivated non-violent crime)
- many instances it is called white-collar crime

Banking offence activities:

1. Misuse of authority
2. Misuse of credit
3. Unauthorized withdrawal and payment
4. Abuse of electronic means
5. Wrong valuation
6. Violation of banking norms and rules
7. Alteration of B&FIs account or making fraud, forgery in account
8. Misuse of banking means, property and resources
9. Unauthorized act against the interest and right of depositors and shareholders
10. Not to repay interest, principles and charges

Categories

1. Act of Internal Fraud
2. External Risk Factors

## **Objectives**

- To clearly define the act of banking offence in the banking system.
- To promote the trust of the general public in the overall banking and financial system of the country.
- Protect and promote the rights and interest of depositors and shareholders.
- Provide quality and reliable banking through healthy and sound banking.
- Minimize risk relating to the banking and finance sector.
- Make necessary legal provisions relating to the punishment on banking offences.

Banking offence full activities based on BOP Act 2064 & amendment 2073:

1. In sec., 2 more clarity is added as a definition of B&FIs closers person, Banking System, Dhukuti Karobar etc.

2. New amendment widens the scope of BOP Act by covering Dhukuti. Securities. Insurance, Financial intermediary, Cooperatives, B&FIs, Commodity market etc.

#### **Banking offences as per BOP Act 2064**

1. Not to open an account of demand cash payment in unauthorized manner
  - a. Opening or knowingly allow opening an account with false documents
  - b. Opening or knowingly allow opening an account in the name of a fictitious person or an organization.
  - c. Draw cheque to obtain or knowingly make the payment from a account where he/she has an apparent knowledge that the account does not have sufficient balance.
2. Not to make unauthorized withdrawals or payment
3. Not to obtain make payment by way of abuse or unauthorized use of electronic means
4. Not to avail or provide loans in an unauthorized manner
5. Not to misuse credit
6. Not to misuse banking resources, means and assets
7. Not to make a loss by making an alteration in the account or ledger or by committing forgery or fraud
8. Not to make any activities with fraudulent to B&FIs and cooperatives
9. Not to derive a false valuation
10. Not to carry out and cause to carry out irregular economic of financial transaction
11. Not to carry out Dhukuti Transaction
12. Not to carry out an illegal economic and financial transaction
13. Not to stop credit facility in the way to loss working project of the borrower

#### **Major provisions punishments**

1. **Opening an account of demand cash payment in an unauthorized manner:** Recover the claim amount, fine as per claim amount and imprisonment up to 3 months.
2. **Not to stop credit facility in the way to loss working project of the borrower:** Recover the claim amount, fine as per claim amount depending upon the offence committed.
3. **If anyone commits any offence specified under the section 5,6 or clause (d), (e), (f), (g), or (h) of section 7 or section 8,9,10,12 or section 14,**

he/she will be punished with the fine and imprisonment as stipulated on the basis of claimed amount and depending upon the degree of offence committed.

4. If anyone commits any offence specified under clause (a), (b), (c) of section 7 or section 13 he/she shall be punished with the fine equivalent to claiming amount and imprisonment up to 4 years.
5. If claim amount is not clear – 10 lakhs fine and 2 years imprisonment
6. Section 12(a), 14(a), and 14(b) – up to 50 lakhs 1-3 years, 50 lakhs to 5 crores 3-5 years, 5 crores to 50 crores 5-7 years and above 50 crores 7-9 years imprisonment.
7. For assistant, half the punishment of main convicted
8. If anyone involved only in an attempt of banking offence he/she will also be punished.

## **Money Laundering Act, 2064**

- Money laundering is the process of concealing the source of illicit property.
- It is the act of decorating the illegal property with the veil and legitimate sources.
- It is the act of converting or changing the source and nature of the black (illegally earned proceeds) into the clean or white property.
- It is a serious financial crime. It is also known as white-collar crime.

### **Features of Money Laundering**

1. **Organized crime** – There are multiple parties involved in money laundering. A single person can not commit money laundering.
2. **It may cross border crime** – involvement of two more countries
3. **Essence/presence of illicit property** – there must be black money
4. It is **white collar crime**
5. **It is predicated offense** – occurs after other crime committed
6. **Present of illicit property** – There must be illegal property.
7. **Follows money laundering cycle**
  - a. **Placement** – Placement is the process of scattering illicit money in different places as much as possible. This is usually done in those areas where there is no need for revealing income sources.
  - b. **Layering** – Layering is the process of creating multiple transactions so as to cover up the illicit property.

- c. **Integration** – Integration is the process of mixing up illicit money with a legal/white/clean property.

#### **Offense:**

- **Money Laundering offense**

1. Acts of converting, transferring property by any mean knowing that it is proceeds of crime.
2. Acts of concealing or changing the nature, source, position, ownership of property knowing that it is proceeds of crime.
3. Acts of acquiring, using, or processing illicit property knowing that is proceeds of crime.
4. Conspire, abet, assist, facilitation and association to money laundering.

- **Terrorist Financing Offence**

1. Acts of providing or collecting funds by knowing, willful, illegally, directly or indirectly with the intention of use in terrorist financing.
2. Acts os support or attempt to support terrorist activity.
3. Conspire, abet, assist, facilitation to support any resources or participate as an accomplice to commit terrorist activity of financing.

#### **Punishment Provisions of Money Laundering & Terrorist Financing:**

##### **For natural person**

1. For money laundering offense – fine 2 times the amount of crime and 2-10 years of imprisonment.
2. For terrorist financing offense – fine 3 times and 3-20 years of imprisonment.
3. If the claim amount is not clear – fine up to 1 crore and 3-20 years of imprisonment.
4. For accomplice – half the punishment of main convicted.
5. For higher authority or reporting unit, a civil servant- 10% more punishment.
6. Confiscation of all the crime amount of money laundering and terrorist financing.

##### **For Artificial Person (Organization)**

1. Fine 5 times the amount fine for a natural person and restriction of public procurement for a specific period of time.
2. Restriction to produce and purchase for a specific period of time.
3. Recovery of all the losses.
4. Cancellation of license.

5. De-registration of company

#### **Major Provisions of Money Laundering Prevention Act:**

1. **Reporting unit and reporting procedure** – Reporting units are those institutions which are assigned to report their financial transactions. It includes – all the financial and non-financial firms, professional and businesses. (e.g. B&FIs, Casinos, Real Estate)
2. It defines money laundering and terrorist financing offenses.
3. Restriction to open account of a fictitious person (imaginary person).
4. Restriction to make anonymous transactions.
5. **Restriction to operate shell Banking.** (Shell banking – carrying out banking operation by registering in registrar office but without physical existence)
6. **Provision of customer due diligence (CDD)** – All the B&FIs and other firms who carry out the financial transaction must use Know Your Customer (KYC) to maintain customer due diligence (CDD).
7. **Monitoring and record keeping of cross border corresponding baking.** (Corresponding Baking – correspond ko aadharma euta deshko bank le arko deshko bank lai transaction garaune)
8. Institutional provision for the prevention of Money Laundering and Terrorist Financing. (DLMI, FIU)
9. Provision of seizing confiscation of suspicious property and visa/travel documents of a suspicious person while investigation.
10. Provision of punishment of ML and TF offense as per natural person and legal person.
11. Free/open time limitation for ML and TF case to case the file.
12. Provision of rewarding to information providers as 10 lakhs or 10% of the crime amount whichever is less.
13. Provision relating punishment of to false FIR providers as up to 10,000 fines.
14. Provision to prepare “National Risk Assessment Report” periodically.
15. Provision of reporting of suspicious transaction to FIU promptly by report unit

#### **Major Achievements after formation of MLP Act 2064:**

1. Reporting unit.
2. Max. use of KYC for CDD.
3. Need to disclose the source of income properly.
4. Restriction to operate shell banking.

5. Establishment and operation of FIU (Financial Information Unit).
6. Establishment od DMLI (Department of Money Laundering Investigation).
7. Support to control capital flight.
8. Compliance with other laws.
9. Support to promote financial good governance.
10. Support to control ML and TF.

#### **Weakness of MLP Act 2064**

1. Lack of specialization in investigation
2. The dilemma in functional jurisdiction
3. Complex provision
4. Open border
5. Maximum use of Indian currency
6. Problem in compliance with other legal provisions
7. Political and crime nexus provision

## **Company act, 2063**

#### **Company:**

Company is an organization of firm incorporated under the provision of company law. Incorporation means the process of registering the firm, organization, institution under the provision of law. A company is also known as a legal or artificial person.

#### **Features of the company**

- Company is incorporated association
- Company has limited liabilities
- Perpetual succession (It lasts for long life until the liquidation and BOD keep changing)
- Legal capacity to sue and to be sued
- Contractual capacity
- Common seal
- It has its own signature
- Ownership is divided into a unit of shares and share capital
- Management by representative

- Permanent existence
- Registered office
- Must have MOA, AOA
- Driven by formalities (Operate formally)
- Shares are transferable

### **Objectives of Company Act 2064**

- To create dynamism into the economic development of the nation by promoting investment in industries, trade, and business.
- To promote the use of economic liberalization.
- To make legal provision relating to incorporation, operation, management, and administration of the company much simpler, easier and more transparent.

### **Major Provisions of the Company Act**

- It has the provision of the company incorporation in which various types of companies can be incorporated under its provision such as private, public, profit not distributing, investment, subsidiary, etc. (Laxmi capital is a subsidiary company of Laxmi Bank).
- It has the provision to promote corporate good governance.
- It defines the management tools of the company such as AOA, MOA, and BOD.
- It creates the features of a legal person.
- All the company must use suffix as Pvt. Ltd. or Ltd as per their nature.
- Few types of companies should be incorporated only as a public company such as B &FIs, Insurance, Stock Market, Mutual Fund, Retirement funds, Telecommunication service providers which has capital more than 5 crores.
- It has provision relating to the conversion of private company into public and vice versa.
- Provision of Office of Company Registrar (OCR) can provide service from branch office and outlets.
- It has the provision relating to share, capital, and debenture of companies.
- It has the provision of Board of Director (BOD) formation, Types of director and their rights and liabilities and also BOD meeting procedures.
- It has the provision of general meeting its types and agendas of the company.
- It has the provision of account record keeping and auditing.
- Provision of company winding up as per the voluntary, compulsory and with deregistration process.

- It has special provision of de-registration
- If the company are defunct they need to submit/providing 0.5% (as a fee) of their capital should be submitted to OCR for deregistration from the time of the last amendment.
- It has provision relating to the protection of shareholders.
- It has provision relating to private, holding, subsidiary and foreign company.
- It has provision relating to control the use of ultra vires by BOD. (Company should not go beyond the AOA & MOA)
- It has provision relating to a proceeding of lawsuits and punishment.
- Provision of the substantial shareholder.
- Hold more than 1% if capital is 25 Crore
- Hold more than 5% if capital is more than 25 Crore
- Compulsory provision of company secretary for a company which has more than 1 crore capital
- It is in compliance with the Money Laundering Prevention Act.
- It has the provision of merger and acquisition of the company.
- Development committee can be converted into the public company if the government gives permission.

### **Types of General Meeting**

#### **1. First Annual General Meeting (FAGM)**

- Chairperson or director shall call the Annual General Meeting.
- AGM should be conducted within 6 months after the end of the fiscal year.
- It can be extended up to three months with the approval of OCR.
- If a company can not conduct AGM within the predefined time, OCR schedule the time.
- If the company still do not call for AGM, the stakeholders can file a case in court for calling up AGM.

#### **2. Annual General Meeting (AGM)**

- Chairperson or director shall call the Annual General Meeting.
- AGM should be conducted within 6 months after the end of the fiscal year.
- It can be extended up to three months with the approval of OCR.
- If a company can not conduct AGM within the predefined time, OCR schedule the time.

- If the company still do not call for AGM, the stakeholders can file a case in court for calling up AGM.

### **Process of calling AGM**

- AGM notice should be published before 21 days of the AGM date mentioning the date/time, venue and agendas.
- AGM notice should be published at least two times in the national level newspaper.
- If any changes occur, notice should be published before 7 days of the AGM date.
- AGM will be hosted by the secretary, chaired by president and minute must be approved by all the members.
- This minutes' copy should be submitted to OCR within 30 days from the date of approval.

### **(Same process in case of banks)**

### **3. Special/Extraordinary General Meeting (SGM).**

- Call by Board of Director, chairperson.
- Three parties can call SGM with a written request – Auditor, Shareholders (at least 10% of share capital with minimum 3 shareholders), Shareholders (at least 25% of shareholders).
- After the written request from the above three parties, the director or president must call a Special General Meeting within 30 days.

### **Process of calling SGM**

- SGM notice should be published before 15 days of the SGM date mentioning the date/time, venue and agendas.
- AGM notice should be published at least two times in the national level newspaper.
- If any changes occur, notice should be published before 7 days of the SGM date.
- SGM will be hosted by the secretary, chaired by president and minute must be approved by all the members.
- This minutes' copy should be submitted to OCR within 30 days from the date of approval.

### **Agendas of SGM**

- Increase/decrease capital
- Share buyback
- Bonus share

- About Merger/acquisition
- Company name change etc

**All the members of the BOD must attend the meeting physically. If not possible physically, use of video conference to use voting right.**

## **Electronic transaction law, 2063**

### **Electronic Transaction**

- transactions of electronic records data by using any types of electronic means.
- contains electric records and valid digital medium.
- the exchange of all types of records which are in the form of electronic.

### **Objectives of Transaction Act 2063**

- To make legal provision for authentication and regulation of electronic data.
- To make a reliable date generation, communication, and transmission.
- To make a secured and authentic means of electronic communication.
- To regulate all the relating matters of electronic transactions.

### **Scopes of Electronic Transaction Act 2063**

- Creation and use of digital signature
- Control cyber/computer-related crimes.
- Protection of intellectual property.
- Protection of confidentiality.
- Regulations of an electronic transaction by establishing regulating bodies – such as
  - Office of Certificate Control (OCC)
  - Certificate Agencies (CA)
  - Subscribers

### **Major provisions of the Electronic Transaction Act 2063**

- It has the provision relating to electronic records and digital signature.
- It has the provision relating to dispatch, receive an acknowledgment of electronic records.
- It has the provision of few regulating bodies and their functions, rights, and duties such as –

- Office of Certificate Control (OCC)
  - Certification Agencies (CA)
  - Subscriber
- It has the provision relating the use of digital signature and certificate.
- It has the provision relating to government use of the digital signature.
- It has a provision relating to the computer network and network services providers.
- It has the provision relating to computer-related crimes and punishments.
- Provision of IT tribunal is defined as the first jurisdictional and appellate jurisdiction. IT tribunal
  - First Jurisdictional
  - Appellate Jurisdictional
- It defines a few documents which this act is not applicable for
  - All the negotiable instrument defined by the “Negotiable Instrument Act 2034”
  - All the documents related to the ownership of properties (dhanipurja, laalpurja ect).
  - Any documents which are used as a primary document in the court process

### **Major computer related crimes and punishments**

- Pirate/ Destroy/Alter computer source code
- Unauthorized access in the computer system
- Damage to computer and computer system0
- Up to 3 years of imprisonment, or up to 2 lakh fine or both
- Distribution of electronic materials in electronic form – Not to publish the prohibited materials which are prohibited by prevailing laws, the materials which may create jeopardy in social harmony, spread hate and jealousy, materials which may create harassment to women trafficking, pornography materials
- Up to 5 years imprisonment or up to 1 lakh or both
- Disclose of Confidentiality
- Deform false statement by parties at the time of the electronic transaction
- Up to 2 years imprisonment or 1 lakh fine of both
- Display and submit false license for electronic means
- Only display 1 lakh fine

- Display+submit and perform = 2 years imprisonment or 1 lakh fine or both
- Non-submission of prescribed statements
- Up to 50,000 fine
- Computer fraud
- Compensate claim amount
- Fine up to 1 lakh and 2 years of imprisonment or both
- Computer fraud
- For abetment fine up to 50,000 and up to 6 months imprisonment
- For accomplice
- Half of the main convicted

### **Cyber crime:**

Cyber crime is a crime committed by using cyber means/computer technology. Cyber crime is also known as computer-related crime. All the illegal activities committed by using or with the application as computer technology such as

- Damage to computer and computer system.
- Acts to gain illegal access into the system.
- Use as weapons to commit other crimes.
- Acts against the provision of cyberlaw.

Some examples of cyber/computer crimes are

- Creating fake documents
- Blackmailing/social media abuse
- Distribution of pornography materials
- Misuse of electronic cards
- Piracy of intellectual properties
- Spreading computer viruses/malware

## **Unified Directives from Nepal Rastra Bank**

Directives Archives - Nepal Rastra Bank

Nepal Rastra Bank (NRB) is the Central Bank of Nepal and regulatory body of commercial bank and financial institutions. One of the NRB's objectives as set out in NRB Act, 2002 is to maintain financial stability. In order to achieve this objective, NRB has issued

23 directives to Banks and Financial Institutions. Out this, directives no. 2, 3 and 12 are related to credit management, single obligor limit and blacklisting requirement. These directives are most important for credit department and revisions/amendments in these directives are made annually. The personnel working in credit department needs to be well known with the intrinsic spirit of each and every paragraphs of the updated directives. In depth knowledge of these directives shall make daily working easy, effective and help to avoid the loss that arises from non-compliance of these directives.

# **Banking System**

## **Concept**

A bank is a financial institution and a financial intermediary that accepts deposits and channels those deposits into lending activities, either directly by loaning or indirectly through capital markets.

A bank may be defined as an institution that accepts deposits, makes loans, pays checks and provides financial services. A bank is a financial intermediary for the safeguarding, transferring, exchanging, or lending of money. A primary role of banks is connecting those with funds, such as investors and depositors, to those seeking funds, such as individuals or businesses needing loans. A bank is a connection between customers that have capital deficits and customers with capital surpluses.

Banks distribute the medium of exchange. Banking is a business. Banks sell their services to earn money, and they must market and manage those services in a competitive field. Banks are financial intermediaries that safeguard, transfer, exchange, and lend money and like other businesses that must earn a profit to survive. Understanding this fundamental idea helps you to understand how banking systems work and helps you understand many modern trends in banking and finance.

## **Development**

- Traditional forms of banking traced during the civilization of Greek, Rome and Mesopotamia.
- Historical records from Greece, Rome, Egypt, and Babylon suggest that temples loaned money in addition to keeping it safe.
- The term ‘Bank’ is derived from the latin word ‘Bancus’ which refers to bench which banker would keep money and records. or ‘Banka’ of Italian which means bank.
- As a public enterprise, banking made its first appearance in Italy in 1157A.D. when the bank of Venice was established.
- The most famous Italian bank, the Medic Bank was established in 1397.
- Nepal Bank Limited- First bank of Nepal: was established in 2013BS as joint venture between government and private sector.

- Nepal Rastra Bank as central bank: Under Nepal Rastra Bank act 2012, the central bank was established in Nepal in 2013BS.
- ADBL: A cooperative bank was established in year 2020 under the cooperative act, 2019. Later in Magh 7, 2024, the cooperative bank was converted into Agricultural Development bank Limited. It was formed to induce the development of agriculture sector in Nepal.

### **Banking development in Nepal:**

- **Ancient time:** Historical documents show there were some basic operations in practice in ancient days. During the period of 8<sup>th</sup> century Gunakamadev reconstructed Kantipur. “Nepal Sambat” was introduced by Shankhadhar Shankhwa, a merchant of Kantipur after paying debt.
- **Lichhivi Era:** Nepal has proven history of money and coins from the period of Lichhivi as “monnank” the coin issued by king Mandev.
- **Malla Era:** There were some evidence of existence of professional money lenders and bankers during Malla regime in 11<sup>th</sup> century. It was further believed money-lending business, particularly for financing foreign trade with Tibet became quite popular during the reign of mallas.
- **Banking as Merchant banking in 14<sup>th</sup> century:** There were “Tanka Dhari” merchant who used to do lending business during the end of 14<sup>th</sup> century.
- **Shah Resign:** Prithivi Narayan Shah established “Kausi Toshi Khana” as banking agency.

## **Types of banks and their functions**

The banks and financial institutions in Nepal can be categorized into different types. Following are the major categories of banks in Nepal.

1. **On the basis of paid up capital**
  - a. Commercial bank – 800 Crore (8 Arba)
  - b. Development bank – 250 Crore (2.5. Arba)
  - c. Finance company – 80 Crore
  - d. Microfinance – 10 Crore
2. **On the basis of ownership**
  - a. Government bank (Fully or partially)
    - Rastriya Banijya Bank – 100% government ownership

- Agriculture Development Bank – 51% Government, 49% Public
  - Nepal Bank – 51% Government, 49% Public
  - b. Private bank (non-governmental)
3. **On the basis of work nature/function/purpose**
- a. Central bank
  - b. Commercial bank
  - c. Development bank
  - d. Infrastructure bank

## **Importance of bank for development of Nepal**

1. Financial Literacy
2. Financial Access
3. Economy promotion
4. Financial Transparency
5. Facilitate Entrepreneurship
6. Facilitates Government Transactions
7. Coping with Global Trend

## **Current State of Banks**

The table below shows the number of BFIs and their branches.

Banks/BFI Class	No. of BFIs	No. Of Branches
Commercial Banks(A)	27	4856
Development Banks(B)	17	1065
Finance( C )	17	248
Microfinance (D)	67	5046
Infrastructure Development Bank	1	
<b>Total</b>	<b>129</b>	11,215

Current Status of Banking in Nepal [Updated] | Investopaper

## **Establishment of Central Bank and Introduction**

The Nepal Rastra Bank (NRB) was established April 26, 1956 A.D. (Nepali Date: Baisakh 14, 2013 B.S.) under the Nepal Rastra Bank Act, 1955, to discharge the central banking responsibilities including guiding the development of the embryonic domestic financial sector.

As of now, the NRB is functioning under the new Nepal Rastra Bank Act, 2002. functions of NRB are to formulate required monetary and foreign exchange policies so as to maintain the stability in market prices, to issue currency notes, to regulate and supervise the banking and financial sector, to develop efficient payment and banking systems among others. The NRB is also the economic advisor to the government of Nepal. As the central bank of Nepal, it is the monetary, supervisory and regulatory body of all the commercial banks, development banks, finance companies and micro-finances institutions. The central office is located in Baluwatar, Kathmandu and it has eight provincial offices, located at Biratnagar, Janakpur, Birgunj, Pokhara, Siddharthanagar, Nepalganj, Surkhet and Dhangadhi.

NRB formulates and implements monetary policy. Nepal Rastra Bank also oversees foreign exchange rates and the country's foreign exchange reserves. The NRB is one of the principal owners of the Nepal Stock Exchange.

## **Work, Duty, Rights**

As per Nepal Rastra Bank Act, 2058.

## **Classification of banks in Nepal and works BMIs, their responsibilities and rights**

<b>Basis/class</b>	<b>A(Commercial)</b>	<b>B(Development)</b>	<b>C(Finance companies)</b>	<b>D (Microfinance Institutions)</b>
Capital	8 Arab	2.5, 1.2 and 0.5 arab	800 and 400 Million	10 and 2 crore is in practice
Transaction Nature	commercial	Development	Consumer	Low class
Work area	National	Provisional	National/state level	Rural sector focused
Term	Short	Long	Mid	Short/ small credit
Upgradation	-	A class	A and B class	-

According to function and nature of bank, in Nepal banks are classified in following types:-

1. **Central Bank:** The Nepal Rastra Bank (NRB) was established in Baisakh 14, 2013 B.S. (April 26, 1956 A.D.) as a central bank of Nepal to supervises the banks and financial institutions (licensed by the NRB) in Nepal and guides monetary policy. Nepal Rastra Bank was established in 1956 under the Nepal Rastra Bank Act, 1955, to discharge the central banking responsibilities including guiding the development of the embryonic domestic financial sector. Since inception, there has been a significant growth in both the number and the activities of the domestic financial institutions.
2. **Commercial Bank (Class A):** A Commercial bank is a type of Bank / Financial Institution that provides services such as accepting deposits, making business loans, and offering basic investment products. Commercial bank can also refer to a bank, or a division of a large bank, which more specifically deals with deposit and loan services provided corporations or large/middle-sized business – as opposed to individual members of the public/small business – Retail banking, or Merchant banks. At present there are 29 Commercial Bank in Nepal.
3. **Development Bank (Class B):** The bank which is established for the development of different sectors like industrial, agricultural, infrastructural etc by imitating the modern system and methodology through financial, technical and administrative assistance is known as development bank. Development banks in Nepal are playing vital roles for the development of economy status of Nepal. Nepal has many nationalized and private banking. There are 70 development banks in Nepal.
4. **Finance Companies (Class C):** The history of financial institutions is not very old. When banking sector started carrying out current activities of finance company, large number of finance companies was established and they expanded at a rapid pace in the developed countries, UK and USA in 1960. In the context of Nepal, there were few insurance companies and Karmachari Sanchaya Kosh working as non-banking financial institution before enactment of Finance Company Act, 2042. Need of Finance Company Act was felt because unauthorized sector was collecting savings from the common public in the name of Upahar and Dhukuti programmes. People showed great interest and enthusiasm in these programmes but they were cheated by most of the organizers of these programmes. Considering peoples' interest in such programmes, benefit of mobilizing such savings in productive sector, banking sectors' inability to carry out capital market activities and to meet consumers' need for credit, government felt the need of finance companies and introduced Finance Company Act, 2042. However, no finance company set up till 2049 because the act came into being only in 2049 with some amendments. At Present there are 44 Finance companies in Nepal.
5. **Micro Credit Development Bank (Class D):** Nepal is a land locked developing country. Many people (38%) of Nepal are under poverty region. Most of the poor

people lives in rural ares and have little opportunity. Micro finance (Micro Credit Development Bank) could help poor people who do not have any collateral, but a willingness to work and a desire to do some business activities from which He/She will acquire employment as well as income. At present there are 41 Micro Credit Development Bank in Nepal.

## **Scope, Opportunities and challenges**

### **Scope, Opportunities**

1. Increasing investment potential
2. Rural banking
3. Technology
4. Robust demand
5. Hopeful rural sector
6. decreasing number of banks: due to merging
7. Emerging concept of public private parternership
8. Emerging Nation

### **Problems/Challenges of the Banking Sector**

1. Weak corporate governance
2. Lack of adequate and skilled manpower
3. Difficulty in rural access
4. Cyberthreat
5. Lack of maintenance and improvement of equipment

## **Risk in banking and how to manage them**

### **Risk**

#### **Why risk?**

Risk is an uncertain future outcome that tends to make loss or injury in an organization. It is an element of investment. The possibility of variation of actual return from the expected return is a risk. Risk cannot be avoided but can be managed.

- All the investments are exposed to risk.
- No risk no return.

- Lower the risk, lower the return.
- Higher the risk, higher the return.

There are **three types of investor-**

1. Risk seeker – who wants to take risk
2. Risk neutral – neutral
3. Risk Averter – Fear of taking risk

### **Major Risks in Banks (cause - management)**

1. **Credit Risk:** when client cant pay principle or interest
  - When Customer Fails to Pay Interest and Principle on Time
  - Compliance with exposures
  - Compliance with SOL
  - Internal Control System
  - Collateral Monitoring
  - Cash Flow Analysis
  - Loan Loss Provision
  - Performance Monitoring
  - Stress Testing
  - Credit Approval Process and Authority
2. **Operational Risk:** problem in own process, people and system
  - Internal System, Process and People
  - Internal Control System
  - Compliance and Reporting
  - Timely Reconciliation
  - System Audit
  - Insurance
  - Regular MIS
  - Corporate Governance
3. **Liquidity Risk:**
  - bank cannot complete its responsibilites to client

- when bank cannot provide loan to client
  - When Bank Unable to Meet Financial Obligation
- Assets Liabilities Management
- Risk Exposure Analysis
- Contingent Liquidity
- Stress Testing
- Maintaining CD Ratio

#### **4. Legal Risk/Regulatory Risk**

- when employee do not receive or understand legal issues
- arises in business conduct, accounting, taxation, documentation, etc.
  - Due to Lack of Legal Knowledge
- Make Aware of Legal Aspects, Rules & Regulations

#### **5. Interest Rate Risk:** bad changes in market

#### **6. Foreign Exchange Risk:** change in rate of foreign currencies

#### **7. Market Risk:** arises due to the change in foreign exchange risk, equity risk, commodity price, and interest rate.

#### **8. Concentration Risk:**

- do not provide same type of loan to same business in same area
- follow lending principles when giving credit

#### **Risk as introduced in unified directives:**

1. Liquidity Risk
2. Interest Rate Risk
3. Foreign Exchange Risk
4. Credit Risk
5. Operational Risk

# **Banking Services**

## **Deposit Service**

Bank deposits consist of money placed into banking institutions for safekeeping. These deposits are made to deposit accounts such as saving accounts, checking accounts, and money market accounts. The account holder has the rights to withdraw deposited funds, as set forth in the terms and conditions governing the account agreement.

Deposit collection is the primary function of the commercial bank. Bank simply cannot function without deposits from savers in the economy. Bank make profit from the peoples' deposit by lending it. On the other hand people will also benefitted by:

- Earning interest
- Meeting contingencies
- Avoiding risk of theft

## **Credit Service**

A banks' major operations are to accept deposits and to grant loans. If lending principles are strictly followed, it would increase the profitability and a healthy turnover. Such lending, in turn, assists in the transformation of rural environment, promote rapid expansion of industrial process and thereby build nation's economy strong.

The loan portfolio is critical to the profitability of the most financial institutions. If serve of lending is carried out skillfully, the institution creates wealth for its shareholders and for society in general. If bank collect back its loan efficiently, it further enhances the bank's confidence and ability to know the customer. Lending principle is not only related to the safety of the fund. It also concerns about the using of fund in productive sectors as per NRB directives.

## **Remittance**

A remittance is a payment of money that is transferred to another party. Broadly speaking, any payment of an invoice or a bill can be called a remittance. However, the

term is most often used nowadays to describe a sum of money sent by someone working abroad to his or her family back home.

The term is derived from the word remit, which means to send back.

## **Letter of Credit**

A letter of credit, or “credit letter,” is a letter from a bank guaranteeing that a buyer’s payment to a seller will be received on time and for the correct amount. In the event that the buyer is unable to make a payment on the purchase, the bank will be required to cover the full or remaining amount of the purchase. It may be offered as a facility.

Due to the nature of international dealings, including factors such as distance, differing laws in each country, and difficulty in knowing each party personally, the use of letters of credit has become a very important aspect of international trade.

## **Bank Guarantee**

### **Concept**

A bank guarantee is a type of financial backstop offered by a lending institution. The bank guarantee means that the lender will ensure that the liabilities of a debtor will be met. In other words, if the debtor fails to settle a debt, the bank will cover it. A bank guarantee enables the customer (or debtor) to acquire goods, buy equipment, or draw down a loan.

### **Importance**

- It allows one to defer payment for goods or services procured on the basis of the security provided by the bank guarantee
- All the money is not tied up in one project but can be spread around
- There is the cash available to explore and expand business
- Assessment of business
- Risk Reduction
- Adds to creditworthiness
- Confidence of Performance

## **Types**

There are two key types of bank guarantees—a financial bank guarantee and a performance guarantee. Financial bank guarantees are for debts owed, while performance-based guarantees are for obligations laid out in a contract, such as particular tasks.

1. **Financial Guarantee:** beneficiary will meet the financial obligations
2. **Advance Payment Guarantee:** advance amount will be returned
3. **Bid Bond Guarantee:** bidder would undertake the contract he has bid for
4. **Foreign Bank Guarantee:** for foreign beneficiary
5. **Deferred Payment Guarantee:** payment for later like instalments

## **Funded and Non-Funded Based Business**

When the bank provides credit facility with funds (real cash), it is called funded; while unfunded are like guarantees and documentary credits (where bank does not give any cash but take risk of the companies and charge commission).

### **Funded Banking Business:**

Funded facilities are those funding facilities in which funds of the bank are directly involved. The examples of funded facilities can be, a Bank overdraft, Overnight lending facility, Cash Finance, Running Finance, Financing against Defence saving certificates or other marketable securities, Project Financing, etc. Amount of money is actually disbursed in fund facility and mark up charged against this facility.

### **Free based Business(Non-Funded Business)**

Bank earn their income in two parts. One type of income is generated by undertaking risk i.e. by lending their deposits. This is called interest income and forms the major portions of any bank's earnings. However, banks can also generate earnings from other sources wherein they do not have to lend money or collect interest. Such sources are called fee based banking services and form an important part of any banks profit and loss statement. Some examples are credit cards, debit cards, smart cards, ATM, safe lockers, Letter of Credit, Account Related Fees, etc. Fee based financial services are specialized field to earn a substantial income in form of fees.

## Credit Cycle

A credit cycle describes the phases of access to credit by borrowers. Credit cycles first go through periods in which funds are relatively easy to borrow; these periods are characterized by lower interest rates, lowered lending requirements, and an increase in the amount of available credit, which stimulates a general expansion of economic activity. These periods are followed by a contraction in the availability of funds.

During the contraction period of the credit cycle, interest rates climb and lending rules become more strict, meaning that less credit is available for business loans, home loans, and other personal loans. The contraction period continues until risks are reduced for the lending institutions, at which point the cycle troughs out and then begins again with renewed credit.

## Loan Classification

The bank loan can be classified into two types according to the overdue of the credit period.

1. Performing Loan
  1. Pass Loan : no overdue or up to 1 month
  2. Watchlist : 1-3 months
2. Non-performing Loan
  1. Sub-standard: 3-6months
  2. Doubtful: 6-12months
  3. Loss: more than 1 year

## Branchless Banking

Branchless banking is the provision of financial services outside traditional bank branches, often via agents, and transmitting transaction data via information and communication technologies. These usually include card-reading POS terminals and cell phones.

Examples of branchless banking technologies available in Nepal are internet, automated teller machines (ATMs), debit cards, mobile phones, etc.

Benefits of branchless banking:

- service provided at doorstep/village

- permits use of wide range of agents outside bank increasing number of services points
- Hassle free transaction
- reduces cost of transaction
- familiarity with dealing with their own person
- saving time
- hygiene (so relevant at pandemic times)
- Accessibility 24/7/365

## **Any Branch Banking System(ABBS)**

Any Branch Banking System(ABBS) is a facility for our customers to operate their account from any of our networked branches. The ABBS is made available for easy, flexible, and prompt service to the customer.

Facilities available under ABBS Service:

1. Cash Withdrawl
2. Cash Deposit
3. Fund Transfers
4. Stop Payment Facility at Remote locations

## **Mobile Banking**

Mobile banking is the act of making financial transactions on a mobile device (cell phone, tablet, etc.). This activity can be as simple as a bank sending fraud or usage activity to a client's cell phone or as complex as a client paying bills or sending money abroad. Advantages to mobile banking include the ability to bank anywhere and at any time. Disadvantages include security concerns and a limited range of capabilities when compared to banking in person or on a computer.

## **Internet Banking**

Online banking allows a user to conduct financial transactions via the Internet. Online banking is also known as Internet banking or web banking.

Online banking offers customers almost every service traditionally available through a local branch including deposits, transfers, and online bill payments. Virtually every

banking institution has some form of online banking, available both on desktop versions and through mobile apps.

## **SWIFT**

Need to transfer money overseas? Today, it is easy to walk into a bank and transfer money anywhere around the globe, but how does this happen? Behind most international money and security transfers is the Society for Worldwide Interbank Financial Telecommunications (SWIFT) system. SWIFT is a vast messaging network banks and other financial institutions use to quickly, accurately, and securely send and receive information, such as money transfer instructions.

More than 11,000 global SWIFT member institutions sent an average of 42 million messages per day through the network in 2021, marking an increase of 11.4% over 2020.

## **Debit Card**

A debit card is a payment card that deducts money directly from a consumer's checking account when it is used. Also called "check cards" or "bank cards," they can be used to buy goods or services; or to get cash from an automated teller machine or a merchant who'll let you add an extra amount onto a purchase.

## **Credit Card**

A credit card is a type of payment card in which charges are made against a line of credit instead of the account holder's cash deposits. When someone uses a credit card to make a purchase, that person's account accrues a balance that must be paid off each month. Although failure to pay off the credit card on time could result in interest charges and late fees, credit cards can also help users build a positive credit history.

## **ATM**

An ATM, which stands for automated teller machine, is a specialized computer that makes it convenient to manage a bank account holder's funds. It allows a person to check account balances, withdraw or deposit money, print a statement of account activities or transactions, and even purchase stamps.

## **PoS**

The full form of POS is *Point of sale*. POS refers to any place where transaction can happen., whether it's for a product or service. It is also called point of purchase(POP). POS is the time and place where a retail transaction is completed. Directly, POS is payment method method by swiping the credit card or debit card while purchase in retail stores.

Alternative: PoS in crypto, proof of stake

## **QR Code**

A quick response (QR) code is a type of barcode that can be read easily by a digital device and which stores information as a series of pixels in a square-shaped grid. QR codes are frequently used to track information about products in a supply chain and often used in marketing and advertising campaigns.

QR codes are considered an advancement from older, uni-dimensional barcodes, and were approved as an international standard in 2000 by the International Organization for Standardization (ISO).

## **Online Account**

Online Account means the Bank account from which you will be conducting transactions using a Service.

## **Good for Payment Cheque**

Good-for-payment cheques, which are otherwise called certified cheques, are guaranteed or endorsed cheques that will never bounce because their payment has been guaranteed by the concerned drawee bank. Such a cheque is endorsed at the request of the account-holder only after ensuring that the account has sufficient balance and the drawer of the cheque is genuine. The signature or signatures of the account-holder or account-holders (in the case of joint accounts) is also verified before certifying the cheque. The amount of the cheque is blocked so that the cheque will not bounce due to insufficient balance. After completion of all the procedures, the cheque is handed over to the payee or beneficiary. As such, a good-for-payment cheque is guaranteed for payment. Hence the name. The drawee bank has full liability for the cheque. The intention behind a good-for-payment cheque is that the payee or beneficiary gets the payment without fail As per the latest NRB directive, the signatures of two officials and the stamp of the bank or financial institution (BFI) are required to issue good for payment cheques.

## **Manager's Cheque**

A manager's cheque is a secure cheque that the bank issues to purchasers. Payment for the cheque can be done via cash or funds from a bank account, this guarantees acceptance of the cheque by the receiving party.

Paying with a manager's cheque is preferable to paying with large sums of cash for both convenience and safety. The recipient of the cheque knows that the cheque is good for the amount written and does not waste time or money on a cheque backed with insufficient funds.

## **Locker**

A safe deposit box (or safety deposit box) is an individually secured container—usually a metal box—that stays in the safe or vault of a federally insured bank or credit union. Safe deposit boxes are used to keep valuables, important documents, and sentimental keepsakes protected. Customers rely on the security of the building and vault to safeguard their contents.

## **Financial Literacy**

Financial literacy is the ability to understand and effectively use various financial skills, including personal financial management, budgeting, and investing. Financial literacy is the foundation of your relationship with money, and it is a lifelong journey of learning. The earlier you start, the better off you will be because education is the key to success when it comes to money.

## **Digital Literacy**

Digital literacy refers to an individual's ability to find, evaluate, and communicate information through typing and other media on various digital platforms. It is evaluated by an individual's grammar, composition, typing skills and ability to produce text, images, audio and designs using technology.

Digital literacy means having the skills you need to live, learn, and work in a society where communication and access to information is increasingly through digital technologies like internet platforms, social media, and mobile devices.

## **Kisan Credit Card/Apps**

<https://kisan.adbl.gov.np/>

## **Kisan Credit Card**

Kisan Credit Card, provides a medium through which our farmers can make purchases of agriculture goods and tools such as farming equipment, fertilisers and pesticides. It also provides access to the farmers' finances such as making transactions and with drawing cash without having to visit a bank branch. Along with giving kisan access to credit for different transactions, Kisan Card also acts as an identity card, which will be useful for payment verification.

The initial step of obtaining Kisan Card comprises of visiting a bank branch, filling out the required information and accessing whether one meets the prerequisites to obtain a Kisan Card. This depends on their past transactions and history with the bank.

ADBL's Kisan Card has the feature of QR codes to make the transaction more digitized, quick and error-free.

## **Kisan App**

The app itself serves as a platform to optimise farming processes. This is mainly done through kisan being able to communicate and transact with krishi merchants, as well as withdraw money and make payments to cashpoint agents.

An overview of the key features available on this app include payment, transfer of payment, utility payment, scan to pay, FAQs as well as knowledge centre for information regarding farming, prices in the market, and other information such as success stories, and information related to the Krishi Merchants and Kisan CashPoint Agents.

# **Opportunities and Challenges of Digital Banking in Nepal**

## **Digital banking challenges**

Digital banking challenges refer to factors that are preventing digital banking from stabilizing and becoming a universal banking method for everybody. And they include:

1. Security
2. Fully digitized bank, brick, and mortar or both
3. An evolution from ancient banking systems
4. The non-financial institution already filling the space
5. Internal barriers
6. To buy or build the banking system

## Opportunities available for banks in digital banking

1. More output more profits
2. More customers with time
3. Mobile banking
4. More loans, more interests
5. Fastened services
6. Better market predictions

## Banking Terminology

1. **Routing number:** A nine-digit number that identifies your financial institution. Larger banks may have multiple routing numbers that are based on the geographic location where the account was opened
2. **Certificate of deposit:** Commonly known as a CD, an account into which you deposit a sum of money and agree to keep it there for a specified length of time. The account typically pays higher interest rates than standard savings and checking accounts.
3. **APY:** Annual percentage yield. The amount of interest you gain from keeping money in an account in a year, including compound interest.
4. **APR:** Annual percentage rate. The amount of interest you gain from keeping money in an account in a year, not including compound interest. In the context of a loan, the APR represents the cost of borrowing money.
5. **Compound interest:** Interest that applies to the original deposit as well as any newly earned interest.
6. **Savings account:** Typically, an interest-bearing account used to hold money for short- or long-term goals or emergencies. You can add to this account at any time, but certain types of withdrawals may be limited to six per month.
7. **Returned item fee:** A bounced-check fee charged to the person trying to deposit the check. It can be charged if there are insufficient funds in the check writer's account or if the account is closed.
8. **Overdraft fee:** A fee incurred when your checking account doesn't have enough funds to cover a payment that is requested. The financial institution will pay what your account lacks, after which your account may have a negative balance.
9. **Checking account:** An account at a financial institution into which you can deposit money and from which you can write checks for purchases. Most people use checking accounts to receive their wages and pay their bills.

# **Agriculture Development Bank Limited**

## **Establishment of bank**

With the main objective of providing institutional credit for enhancing the production and productivity of the agricultural sector in the country, the Agricultural Development Bank, Nepal was established in 1968 under the ADBN Act 1967, as successor to the cooperative Bank. The Land Reform Savings Corporation was merged with ADBN in 1973. Subsequent amendments to the Act empowered the bank to extend credit to small farmers under group liability and expand the scope of financing to promote cottage industries. The amendments also permitted the bank to engage in commercial banking activities for the mobilization of domestic resources.

## **Development**

The bank worked as a premier rural credit institution since its establishment, contributing substantial agricultural credit supply in the country. Rural finance has been the principal operational area of ADBN in the past. However, the bank is also involved in commercial banking operations since 1984, to provide commercial banking services.

The enactment of Banks and Financial Institutions Act (BAFIA) took all the banks and financial institutions (BFIs) under its umbrella and abolished all the acts related to the BFIs including the ADBN Act, 1967. Since then, the bank has been working as a public limited company registered under the Companies Act, 2006 and is licensed as “A class financial institution” by Nepal Rastra Bank from 2006.

Having glorious history of more than 53 years, the bank is one of the leading commercial banks of the country. With its investment in agriculture, industry, trade, commerce and households, the bank has above 1.2 million happily satisfied customers.

it is spread all over the 7 provinces & 77 districts of the nation with its 278 offices. While providing comprehensive services with complete banking solution, the bank has main motto of promoting rural agriculture, productive and deprived sectors. The bank is committed to provide best banking services through its widespread network and help the government from its part, to achieve the aim of:

## **Nature of Functions**

### **Function and Functions**

#### **1. Accepting Deposit**

1. **Current Account:** non-interest bearing account, as demand deposits
2. **Saving Account:** as per unified directives of NPB, in name of individuals, partnership, ...
3. **Fixed Account:** cannot be withdrawn until some amount is reached
4. **Call Account:** for valued customers

#### **2. Providing Loan**

1. Retail Loan
2. Corporative Loan
3. Transfer of money
4. Remittance
5. Foreign Exchange
6. Other Services: letter of credit, mobile banking, ...

### **Programs**

1. Training and Financial Support Program]
2. Programs with Government Grants
3. Micro Cottage and Small Industries Credit Program
4. Youth and Small Entrepreneurs Self-Employment Program

## **Vision, Mission, Objective**

### **Vision**

To be a Mass-based Complete Bank serving from Urban to Rural.

### **Mission**

To deliver comprehensive banking solution strengthening its extensive network.

### **Objective**

- To provide quality banking services

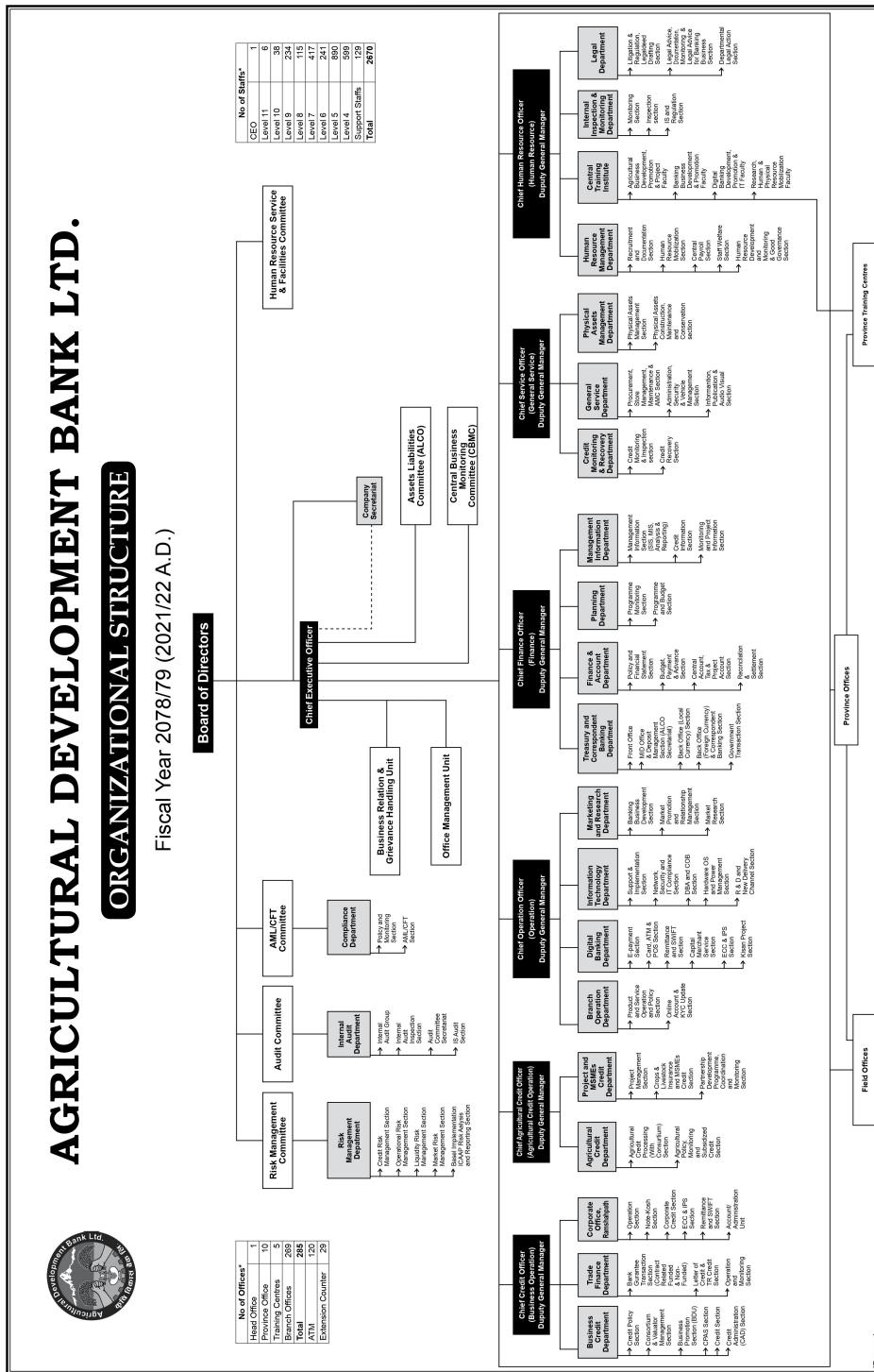
- To adopt market driven strategy
- To obtain sustained and competitive return on investment.

**Corporate Conduct:**

In achieving its corporate objective in pursuit of its corporate mission and vision, ADBL will:

- comply with all relevant legislation, codes of conduct and standards of good corporate citizenship in Nepal while maintaining full autonomy in the management of its operations;
- conduct its operations in an open and transparent manner;
- put local resources to work for local development, serving the rural community and its aspirations;
- provide a full and balanced range of financial products and services that satisfies the needs of the rural population of Nepal, on a profitable and sustainable basis;
- strive consistently to provide improved products and services to its clients at reasonable cost, using modern banking, information and communication technology in the most appropriate form to its clients needs;
- be vigorous in building reputation for professionalism, competitive pricing, reliability and quality of service and innovation;
- operate in accordance with best banking practice, acting with financial prudence and keeping in mind the need to balance profitability with asset preservation and liquidity and to safeguard depositor's funds;
- work together with its employees to develop their capabilities to contribute to achievement of the bank's objectives, promoting excellence, rewarding achievement and providing them the opportunity to share in the bank's success;
- develop mutually acceptable relationship with government in the pursuit of improvement in living standards in rural areas, while respecting best financial practices;
- ensure that its activities contribute to the environmental stability and overall improvement of living standards in Nepal; and
- judge the bank's success against the measures that include profitability, portfolio quality in terms of minimal arrears and non-performing loans, portfolio worth, total deposits, geographic outreach and public image.

# Organizational structure



## **Current Situation of Transaction**

[https://www.adbl.gov.np/documents/245/Annual\\_Report\\_\\_ADBL\\_15th\\_2078\\_compressed\\_P2OUORh.pdf](https://www.adbl.gov.np/documents/245/Annual_Report__ADBL_15th_2078_compressed_P2OUORh.pdf)  
/todo: summary...

## **Size of Transactions**

- Authorized capital: - **NRs. 25,000,000,000/-**
- Authorized Equity Share Capital): - **NRs. 16,000,000,000/-**
- Authorized Preference Capital: - **NRs. 9,000,000,000/-**
- Issued & Paid-up capita: - **NRs. 18,620,627,763/-**

(From general issued share capital **NRs.13,187,915,763/-** (51% of Nepal Government and 49% of general public) & From non-cumulative irredeemable preference share capital **NRs.5,432,712,000/-** (100% of Nepal Government)

Both equity and preference shares are of **NRs. 100** each

## **Strength and Weakness, Opportunities and Threats**

SWOT Analysis of ADBL (Agricultural Development Bank Limited) - Share Gyan

### **Strength**

1. Government owned capital bank
2. Huge capital structure
3. Mass-based branch network
4. Use of modern core banking solution (CBS)
5. Large number of employee
6. Huge transaction volume
7. Ownership and trust of customer

### **Weakness**

1. Poor managerial sovereignty
2. Lengthy and complex internal work procedure
3. Complexity in act, rules and other legal provision

4. Weak work environment
5. Lack of work efficiency and employee motivation

## **Opportunities**

1. Market expansion and financial access
2. Expansion of transaction through government transaction
3. Efficient and effective service delivery through young and energetic human resources
4. Increasing use of IT in the field of banking service delivery
5. Expansion of market with modern banking facilities
6. International market expansion due to amendment in banking law
7. Achieving leading role in agriculture development sector
8. Providing lending opportunity in rapid physical infrastructural development

## **Threats**

1. High competition in the market due to implementation of IT
2. Automation in the banking service system
3. Challenges of capacity development empowering employees in bureaucratic structure
4. Challenge of cost cutting in branch expansion
5. Market expansion because of limited market and large number of players
6. Achieving continuous profit in competitive environment
7. Challenge to promote Internal control and corporate governance in the bank

## **ADBL Employees Bylaws, 2062**

### **Employee Ethics/Employee's Code of Conduct and Discipline Who are Working in Financial Institutions**

According to Employee Service Rules, 2062 of ADBL, major ethics and code of conducts are:

1. Employees are not allowed to, if that hinders banking activities, accept any type of donation and gift and do not let their family to accept gift and donation without prior approval from concerned authority.

2. Employee should not accept any type of economic subscription and contribution
3. Employees are restricted to have following business
  - To transact directly or indirectly with any type of financial customer
  - Full time job elsewhere except bank
  - To act as custodian of property of bank customers
4. No employee can conduct any type of business, no one can have any type of government and non-governmental job, and they are even not allowed to become a partner of any type of partnership deeds without consent of the bank.
5. Employees should submit property statement within the three months of completion of probation period(Parishyan Kaal) and submit time to time as required by bank.
6. Employee shall carry ‘Ramana Patra’ for transfer and promotion. Similarly, they should accept ‘Farak Patra’ while leaving the job.
7. Employees are not allowed to disclose any type of internal information to outsiders without consent of head of bank or without compelled by any act and legislation of the kingdom of Nepal.
8. Job holding employees must follow the office time schedule prescribed by the bank. They should inform the bank beforehand for the leave.
9. Employees are restricted to participate in active politics.
10. Employees are not allowed for any type of marriage and cause to marriages against prevailing law of Nepal. (Like child, multiple,...)
11. Discipline, Obedience and laborious related:
  - Employees should follow order of superior
  - Courteousness and respect must be offered to their seniors.
  - Employees must go to render the services with willingness to any places of the kingdom of Nepal if required.
  - Employees should follow operating rules, regulations, act, memorandum, directives etc. issued by the bank in time and time.

# **Management and Economy**

# Management

## Organization Concept

Organization is the foundation upon which the whole structure of management is erected. Organization is associated with developing an outline where the overall work is divided into manageable components in order to facilitate the achievement of objectives or goals. Thus, organization is the structure or mechanism that enables living things to work together.

In a static sense, **an organization is a structure or machinery manned by group of individuals who are working together towards a common goal.**

The term organization has been used in four different senses;

1. **Organization as Framework of Relationships:** Organization refers to the structure and interactions among various job positions which are created to realize certain objectives.
2. **Organization as a process:** Organization is viewed as a dynamic process and a managerial activity which is vital for planning the utilization of company's resources.
3. **Organization as a System:** Organization is also viewed as a system. System concepts recognize that organizations are made up of components, each of which has exclusive properties, abilities and reciprocated associations. The constituent elements of a system are linked together in such complex ways that actions taken by one individual have far reaching effects on others.
4. **Organization as a Group of Persons:** Organization is very often viewed as a group of persons contributing their efforts towards certain goals.

**“Organization is a system of cooperative activities of two or more persons.”** – Chester Barnard

### Nature of organization:

- Common goal
- Division of labour
- Authority structure
- Group
- Communication
- Coordination
- Environment
- Rules and regulation

# **Structure**

An organizational structure is a system that outlines how certain activities are directed in order to achieve the goals of an organization. These activities can include rules, roles, and responsibilities.

It also determines how information flows between levels within the company. For example, in a **centralized structure**, decisions flow from the top down, while in a **decentralized structure**, decision-making power is distributed among various levels of the organization.

## **Centralized Structure:**

- Traditional
- Central leadership
- Military is famous for its highly centralized structure
- Clear responsibilities for each role

## **Types of Organizational Structures(Order based on commonness)**

### **1. Functional Structure:**

- common organizational structures are implemented in the real world
- bureaucratic organizational structure
- breaks up a company based on the specialization of its workforce
- E.g. Dividing the firm into departments consisting of marketing, sales, and operations

### **2. Divisional or Multidivisional Structure:**

- Break based on the products, projects, or subsidiaries they operate
- E.g. Johnson & Johnson; with thousands of products and lines of business, the company structures itself so each business unit operates as its own company with its own president.

### **3. Flatarchy Structure**

- New system used by startups
- As the name alludes, it flattens the hierarchy and chain of command and gives its employees a lot of autonomy
- have a high speed of implementation

### **4. Matrix Structure**

- confusing and least used
- matrixes employees across different superiors, divisions, or departments
- E.g. employee may have duties in both sales and customer service

## **Objectives**

To achieve the following objectives a company sets up an organization:

### **1. To Administer Economy in Production**

- aims at a reduction on cost of production, distribution or operation
- result: cheaper availability of goods to the ultimate consumer
- if price not reduced; quality improves (worker get more wages, society benefited)
- return on investment goes up leading to larger savings

### **2. To Serve the Society**

- aim of organization: service to society, service of enterprise it is part of
- gains from service: recognition, strength, stimulus; goodwill
- need of society: goods at proper time, standard quality, cheaper rate and regularly

### **3. To Economize the Use of Available Resources**

- if one resource is abundance and other scarce; use of both should be economized to guard against future non-availability of resources

### **4. To Establish Healthy Relations between Labour and Capital**

- Human relations and behavioral sciences form the basis of any organizational structure
- capital labour harmonious relations helps in attaining the objectives of the enterprise quickly and honestly

## **Principles**

For timely and systematic completion of work it is must for every organization to adopt some techniques or principles. Thus these principles would be the deciding factor for the success or failure of an organization.

### **1. Principle of Objective:** Enterprises should set certain central objectives and its every elements should be geared to the central objectives

**2. Principle of Specialization:**

- Precise division of work facilitates specialization.
- Division of work among the employees should be based on their knowledge, skills, abilities, capabilities and interests.
- Would lead to specialization which would in turn lead to efficiency, quality and elimination of wastage of resources.

**3. The Scalar Principle:**

- It is sometimes referred to as the chain command
- There must be clear lines of authority running from the top to bottom of the organization and linking all the individuals in the organization

**4. The Principle of Authority:** It is the tool by which the manager can create an environment where an individual can perform with greater efficiency.

**5. The Principle of Span of Control:**

- This principle states that there is a limit to the number of subordinates that report to one superior.
- Supervision of too many people can lead to trouble and confusion; no spare time to supervise each
- It is easy to supervise a large number of subordinates involved in routine jobs and working in the same room, whereas it is difficult to supervise highly diverse and specialized personnel scattered widely.

**6. The Principle of Unity of Command:** avoid dual reporting

**7. The Principle of Definition:** Each individual in the organization should be made aware about his/her responsibilities, duties, authorities and relations with the other job positions in the organization structure.

**8. Principle of Unity of Direction:** Major objectives should be split into functional activities and there should be one objective and one plan for each group of people.

**9. The Principle of parity of Authority and Responsibility:** The responsibility for execution of work must be accompanied by the authority to control and direct the means of doing the work.

**10. The Principle of Supremacy of Organizational Objectives:**

- The organizational goals and objectives should be given wide publicity within the organization.
- one should give higher priority to organization's objectives in comparison to personal motives.

## **Communication System**

Communication systems are the various processes, both formal and informal, by which information is passed between the managers and employees within a business, or between the business itself and outsiders.

**There are of two types:**

### **1. Internal communication system**

- communications within the organization
- e.g. Modern Intranets, Employee Apps, Chat Services, Email and Newsletter Software, Podcasting Tool, Video Tools, Digital Signage Software, Collaboration Tools, Digital Company Newspapers

### **2. External communication system**

- communication with the external factors affecting the business
- e.g. Content of website and blogging, Conferences and live consorts, Email and newsletters, Social media, Press releases

## **Organization Change**

Organizational change is the alteration of work environment in the organization. It is continuous process that changes whole or some part of organization directly or indirectly.

**Causes:**

1. **Government policies:** e.g. when computerization came into existence government banks make their employee change from manual process to computerized so organization has to go for a change.
2. **Competition:** if one company is going for innovation other has to go for it. e.g. in case of Coke and Pepsi if one goes for new advertisement another will also go for same and bring change in their advertisement policies.
3. **Technology:** Change in storage methods, use of new technologies, etc.
4. **Change in customer requirement:** Product as per customer demand
5. **Change in managerial personnel:** New manager will bring his own new ideas

## **Organization Development**

It is a dynamic technique.

Every organization wants to compete and to survive in long run so development plays vital role.

### **Benefits of organizational development:**

- Gives more emphasis on human resources rather than any other physical resources.
- Helps in development of human resources by initiating change.
- Provides opportunities and challenge for the human beings to use their abilities.
- Helps to achieve organizational effectiveness.

## **Organization Cultural**

Organizational culture is the collection of values, expectations, and practices that guide and inform the actions of all team members. It is collection of traits that make your company what it is. It exemplifies positive traits that lead to improved performance.

### **Importance of culture:**

- Organizational culture affects all aspects of your business, from punctuality and tone to contract terms and employee benefits
- When workplace culture aligns with your employees, they're more likely to feel more comfortable, supported, and valued.
- Companies that prioritize culture can weather difficult times and changes business environment and come out stronger.
- Culture is a key advantage when it comes to attracting talent and outperforming the competition

### **Qualities of great organizational culture:**

- |               |                        |
|---------------|------------------------|
| • Trust       | • Integrity            |
| • Performance | • Innovation           |
| • Resilience  |                        |
| • Teamwork    | • Psychological safety |

## **Organization governance**

ISO 26000, defines organizational governance as "a system by which an organization makes and implements decisions in pursuit of its objectives."

It includes the management processes designed to deliver on performance objectives while considering stakeholder interests.

Major characteristics of good governance (United Nations Economic and Social Commission (UNESC)):

- participatory
- consensus-oriented
- accountable
- transparent
- responsive
- effective and efficient
- equitable and inclusive
- follows the rule of law

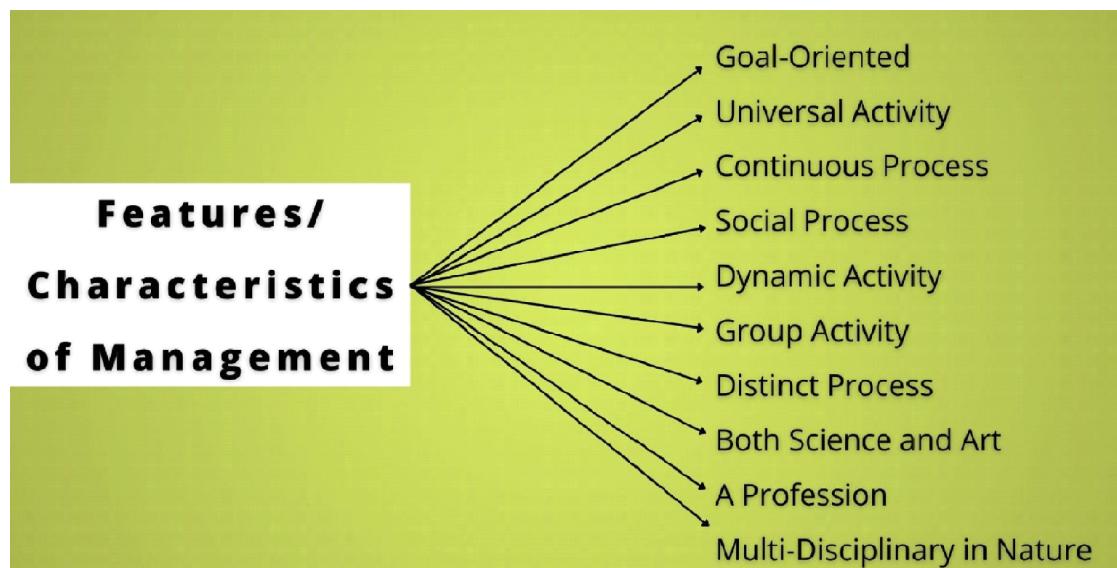
## Management

Management is the process of getting things done through others with the help of some basic activities like planning, organizing, directing, coordinating, and controlling to achieve the desired goals and objectives.

It is basis for every organization as organization cannot run for long time if all devices are not suitably managed.

In other words, management is the act of harmonizing the 5Ms men, money, materials, machines, and methods towards the achievement of desired goals and objectives.

### Features/Characteristics of Management:



#### 1. Goal Oriented

- management is instrument or system that contributes to the efficient use of human and other resources to achieve predetermined objectives
- main objective: maximize productivity with optimum use of human effort

## **2. Universal Activity**

- it's necessary where there is human activity
- necessary for all types of organizations
- process may be different but principle remains same

## **3. Continuous Process**

- continuous up to existence and functioning of organization
- manager should manage each and every activity

## **4. Social Process**

- management achieves its objectives by, with and through people
- it ought to fulfill the necessities of employees

## **5. Dynamic Activity**

- a management system of today may not be applicable or effective tomorrow
- should modify its styles according to time and situation

## **6. Group Activity**

- it signifies team, class, or section of people associated with multiple managerial duties
- it is essential if there is a group of people involved in performing any activity to achieve common goals
- defines authority, responsibility, and procedures to perform specific work

## **7. Distinct Process**

- it is process involving various types of functions
- every function of management is connected with other
- it has clear process to achieve predefined goal
- no trial and error

## **8. Both Science and Art**

- it is science because it is based on some basic principles of universal application
- it is art because skill and ability are required for performing managerial functions

## **9. A Profession**

- profession involves a specific type of work, followed by special knowledge and education

- management of huge organizations is entrusted to hand of professionals having specific skills and knowledge

## 10. Multi-Disciplinary in Nature

- Principles and techniques are borrowed from psychology, sociology, economics, and mathematics.

## Principles

Principles of management are the basic rules and philosophy that every manager has to know and apply their concept in organizational success.

Henry Fayol's principles, which are universally accepted are as follows:

1. **Division of Work:** Employee should have a specific task to do so that he/she can give the best productivity
2. **Authority and Responsibility:** Employees should have sufficient authority to fulfill responsibility
3. **Discipline:** Core value of success. Being disciplined in own self and with the organizational culture.
4. **Unity of Command:** Employee should have provision to get orders from single manager at a time.
5. **Unity of Direction:** All members should have same goal and only directed by single boss.
6. **Subordination of Individual Interest To General Interest:** focus on group interest than single for long term achievement.
7. **Remuneration:** all should be paid reasonable and fair rewards.
8. **Centralization and Decentralization:** both concept should be implemented when needed
9. **Scalar Chain:** line of authority bottom-up or top-to-bottom, unchanged
10. **Order:** instruments should be ordered in proper forms either materials or people
11. **Equity:** every employee have right to be equally treated and respected
12. **Stability of Tenure of Personnel:** the manager should make believe his employees that their job is secure.
13. **Initiative:** let employees take their own initiative
14. **Espirit De Corps:** At core of this principle, “Union is Strength” and “Team Spirit”

## Types

A management style is a way in which a manager works to fulfill their goals.

There are three broad categories of management styles: **Autocratic**, **democratic** and **laissez-faire**.

### 1. Autocratic management styles

It follows top-down approach, with one-way communication from bosses to employees.

- i. **Authoritative:** Managers dictate exactly what they require their subordinates to do and punish those who do not comply
- ii. **Persuasive:** Managers use their persuasive skills to convince employees that unilateral decisions that manager implements are good for team, department and organization.
- iii. **Paternalistic:** Manager acts with best interests of their subordinates at heart.

### 2. Democratic management styles

In this style, managers encourage employees to give input during the decision-making process, but are ultimately responsible for the final decision.

- i. **Consultative:** managers ask for the opinions and thoughts of their team, consulting the viewpoints of every member of their team.
- ii. **Participative:** managers and staff are all active members of the decision process.
- iii. **Collaborative:** management creates an open forum for ideas to be discussed extensively before making decisions based on majority rule.
- iv. **Transformational:** Managers focus their efforts on pushing their staff to ever greater accomplishments through encouragement, pushing them past their comfort zones regularly, and consistently motivating their teams to raise their bar for achievements.
- v. **Coaching:** managers see themselves as the coach and their employees as the valued members of their team.

### 3. Laissez-faire

management takes a hands-off approach to leadership.

- i. **Delegative:** the manager is only present to assign tasks
- ii. **Visionary:** managers lead through inspiring their staff.

## **Functions**

Basic functions include planning, organizing, staffing, directing, and controlling which are basically directed to the achievement of desired objectives.

### **Planning:**

- deciding now as to what to do in the future to achieve the set of goals
- manager task is to make most effective plan so that its objectives can be achieved in easiest and most cost-efficient way.

### **Organizing:**

- 5M should be organized in proper form to manage
- if employee is capable to do well and has no authority, he should be given

### **Staffing:**

- giving person a job that best his/her skills, knowledge, experience and competencies

### **Directing:**

- manager's task is to guide them, and instruct them so that they can devote their effort to realization of desired goals

### **Controlling:**

- During the implementation period, different factors such as organizational resources, structure, market condition, competition, and emerging situations affect the achievement of that objective.
- Controlling means overseeing the actual performance, finding if it has met the standard (expected) and if not taking corrective action to again seek to achieve desired goals and objectives.

## **Key management process**

Management process is a process of setting goals, planning and/or controlling the organising and leading the execution of any type of activity, such as:

- a project (project management process) or
- a process (process management process, sometimes referred to as the process performance measurement and management system).

An organization's senior management is responsible for carrying out its management process. However, this is not always the case for all management processes, for example,

sometimes it is the responsibility of the project manager to carry out a project management process.

#### **Steps:**

1. **Planning:** it determines the objectives, evaluate the different alternatives and choose the best from them.
2. **Organizing:** define the group's functions, establish relationships and defining authority and responsibility
3. **Staffing:** recruitment or placement and selection or training takes place for the development of members in the firm
4. **Directing:** is to give the Direction to the employees.
5. **Controlling:** Controlling involves ensuring that performance does not deviate from standards.
6. **Coordination:** it ensures that different departments and groups work in sync.

## **Current issues of management**

#### **Some challenges are:**

- **Globalization:** it occurs when organization extends its activities to other parts of the world, actively participates in other markets, and competes against organization located in other countries.
- **Ethics and Social responsibility:** Complexity of ethics, environmental issues
- **Workforce diversity:** people in organization are becoming more heterogeneous demographically
- **Empowerment:** Decision making is pushed down to operating level, workers are given freedom to make choice about schedule, procedures, and solving work related problems.
- **Technology:** recognize and anticipate technological changes, which result in modification in products and services, the way they are produced and marketed.
- **Building a Competitive Advantage:** reduce resource used in production, increase quality, bringing new products faster, responsiveness
- **Development of the environment:** take care of environmental issues
- **Quality and productivity:** quality supports to maximize productivity and minimizes per unit cost of output.
- **Innovation and change:** handle innovation of new knowledge and expectations of stakeholders

- **Knowledge management:** employees are primary source of knowledge. their ideas should be accumulated to prepare plan and policies.
- **Multicultural effects:** maintain coordination among them

## **Management information system and its components**

MIS is a system that takes data as input, processes it to generate information that can help the management of an organization in decision-making and strategic planning.

**The MIS has various components, which are as follows:**

**1. Executives:**

Executives are the people who utilize MIS. These people are computer professionals who operate MIS for data processing to achieve organizational goals like planning and decision-making.

**2. Hardware:**

The hardware components of MIS include various input and output devices that helps in feeding data as well as displaying the information when required. The input devices include the keyboard, scanners and mouse. The output devices may be the monitor, printer, network devices, and so on.

**3. Software:**

Computer programs which are designed to do a specific task. For e.g. MS Office, Banking Software's, Railway's applications etc. different kinds of software available to process the data/information in an organization such as ERP (enterprise resource planning) and CRM (customer relationship management).

**4. Organizational Procedures:**

- Procedures are sets of rules or guidelines that an organization establishes for the use of a computer-based information system.
- The procedures may vary from one organization to another. It may also vary from one department to another as per the requirement.
- The production department requires information regarding the raw material or quantity of goods to be produced. So, the production department sets its procedures in such a way that the MIS system helps in retrieving the information required by the department.
- The sales department requires information regarding the quantity of goods sold and the other expenses that occurred during the sales of the product. Therefore, the sales department sets the procedures in such a way that they get only that information which is required from the MIS.

## **Time management**

### **What is Time Management?**

- Time Management refers to managing time effectively so that the right time is allocated to the right activity.
- Effective time management allows individuals to assign specific time slots to activities as per their importance.
- Time Management refers to making the best use of time as time is always limited.

### **Benefits of good time management are as follows:**

- Greater productivity and efficiency.
- Less stress.
- A better professional reputation.
- Increased chances of advancement.
- More opportunities to achieve your life and career goals.

### **Time management includes:**

- Effective Planning
- Setting goals and objectives
- Setting deadlines
- Delegation of responsibilities
- Prioritizing activities as per their importance
- Spending the right time on the right activity

## **Crisis management**

A sudden and unexpected event leading to major unrest amongst the individuals at the workplace is called as organization crisis. Crisis management is the application of strategies designed to help an organization deal with a sudden and significant negative event. Crises almost invariably require that decisions be made quickly to limit damage to the organization.

### **Points to keep in mind during crisis**

- Don't panic or spread rumors around. Be patient.
- At the time of crisis the management should be in regular touch with the employees, external clients, stake holders as well as media.
- Avoid being too rigid. One should adapt well to changes and new situations.

## **Conflict Management**

Conflict management is the process by which disputes are resolved, where negative results are minimized and positive results are prioritized. An absolutely essential aspect of being a good leader is understanding how to manage conflicts.

### **The 5 conflict management styles:**

1. **Accommodating:** putting other parties needs before one's own
2. **Avoiding:** reduce conflict by ignoring it, removing the conflicted parties, or evading it in some manner.
3. **Compromising:** find the middle ground by asking both parties to concede some aspects of their desires so that a solution can be agreed upon.
4. **Competing:** reject compromise and involves not giving in to others viewpoints or wants.
5. **Collaboration:** Each party's needs and wants are considered, and a win-win solution is found so that everyone leaves satisfied.

## **Change Management**

Change management is defined as the methods and manners in which a company describes and implements change within both its internal and external processes. This includes preparing and supporting employees, establishing the necessary steps for change, and monitoring pre- and post-change activities to ensure successful implementation.

### **How to implement change management:**

1. Define the change.
2. Select the change management team.
3. Identify management sponsorship and secure commitment.
4. Develop implementation plan including metrics.
5. Implement the change—in stages, if possible.
6. Collect and analyze data.
7. Quantify gaps and understand resistance.
8. Modify the plan as needed and loop back to the implementation step.

# **Knowledge Management**

Knowledge management is the conscious process of defining, structuring, retaining, and sharing the knowledge and experience of employees within an organization.

As organizations evolve, expand into new areas, and define their approach to business, they develop significant institutional knowledge. This information is invaluable to the company. Imparting it to new or less experienced staff is vital for maintaining successful operations.

**Knowledge management can be separated into three main areas:**

1. Accumulating knowledge
2. Storing knowledge
3. Sharing knowledge

**Knowledge management methods:**

1. **Tutoring & training, communities of practice, and Q&A:** all involve transferring information directly from the knowledge holder to other employees.
2. **Documentations, guides, guidelines, FAQ, and tutorials:** Written communications are great for storing and transferring knowledge.
3. **Forums, intranets, and collaboration environments:** These online resources spark conversation and bring many knowledge holders into the same place.
4. **Learning and development environments:** Creating an environment where learning is considered an asset will continuously drive employees to educate themselves.
5. **Case studies:** These in-depth studies into particular areas serve as complete guides to a subject.
6. **Webinars:** These online seminars can be beneficial in widely disseminating ideas throughout teams, branches, or the entire company.

**Benefits of Effective Knowledge Management**

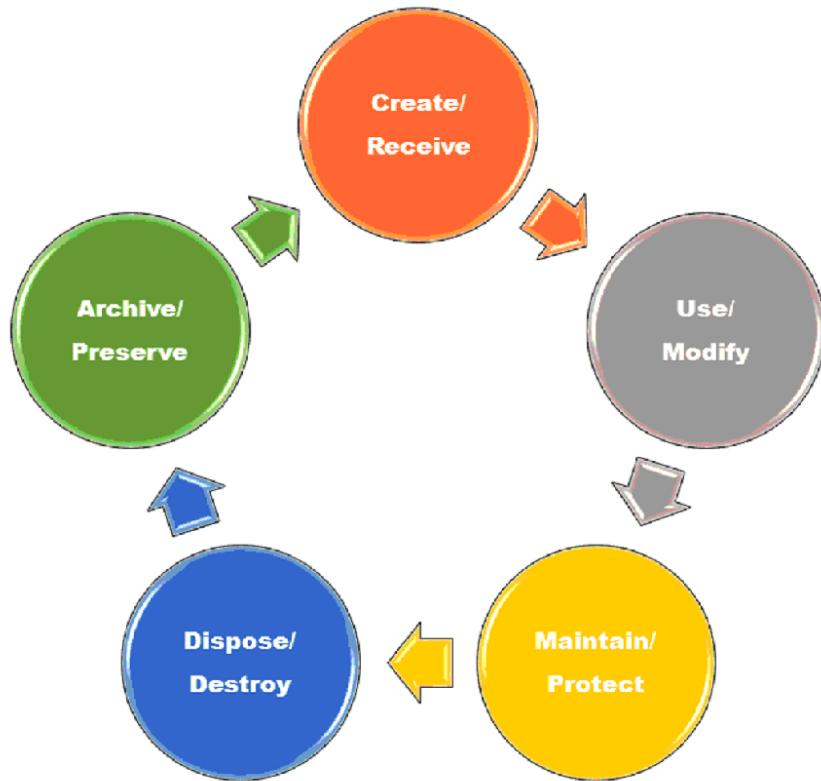
# Benefits of Effective Knowledge Management



## Record Management

Records management (RM), also known as records and information management (RIM), is an organizational function responsible for the creation and maintenance of a system to deal with records throughout a company's lifecycle. RM includes everything from the creation of a record to its disposal. Essentially, it comprises anything that is part of a business transaction.

### Record management Lifecycle



## Stress Management

Stress management is defined as the tools, strategies, or techniques that reduce stress and reduce the negative impacts stress has on your mental or physical well-being.

**Why Managing Stress:** when we are stressed too much, we can start to feel wired. Then after time, we start to feel exhausted. But now in our modern world, we have this kind of ongoing chronic stress that wears us down over time. This can be devastating for our mental and physical health.

### Ways to Manage Stress:

1. **Stress Management Activities:** Sleep, Diet, Exercise
2. **Stress Management Skills:** Try meditation, Find opportunities to be kind to others, Shift your mindset
3. **Stress Management Techniques:** Progressive muscle relaxation, Breathing exercises, Cold water dunk
4. **Eating For Stress Management:** Cut down on sugar, Eat high-quality protein, Eat high-quality fats

5. **Stress Management Strategies:** Ditch the caffeine, Take adaptogen herbs, Take theanine

#### **Stress Management For Work:**

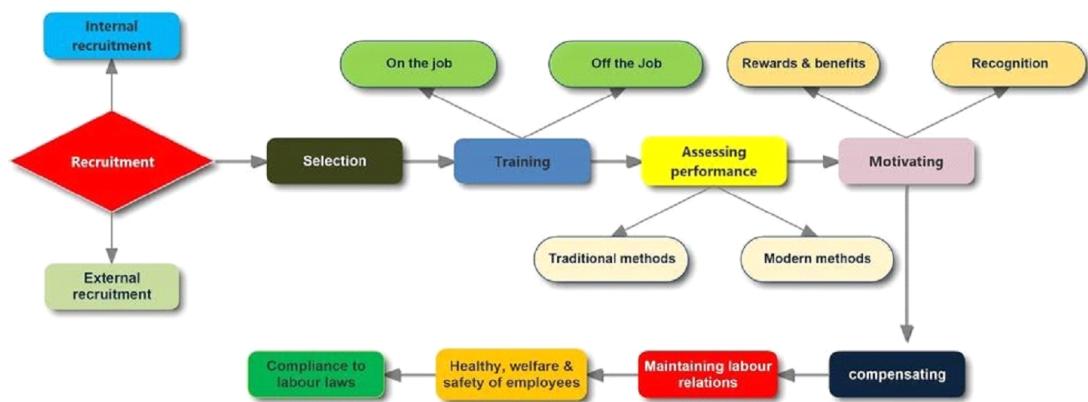
- Interpersonal communication
- Negotiating boundaries
- Positive social interactions

# **Human Resource Management**

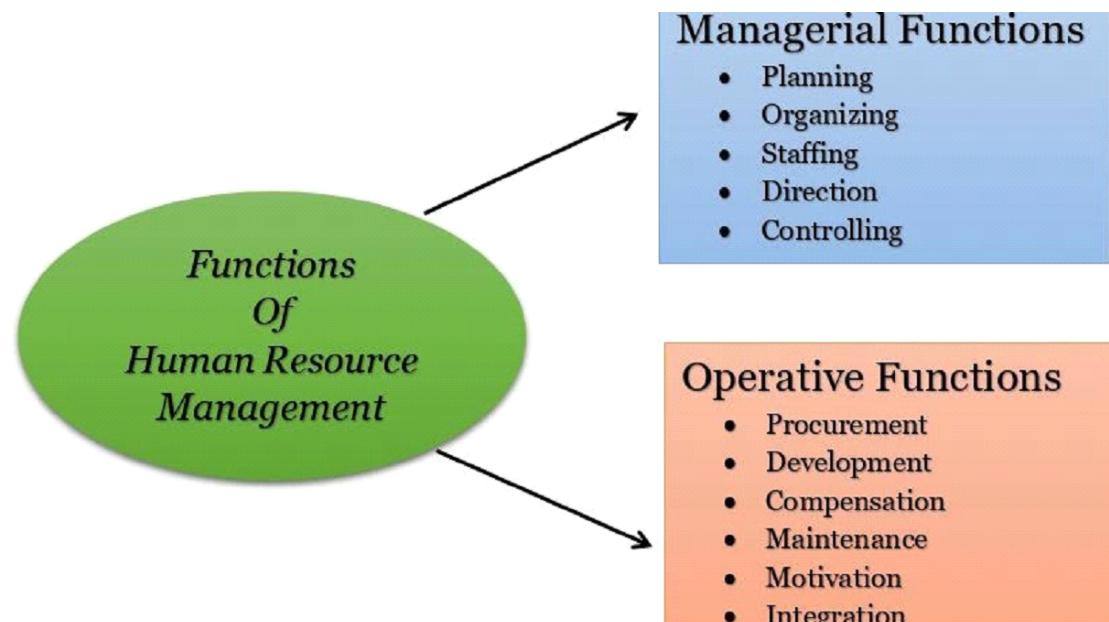
## **Concept**

- is the strategic approach to the effective and efficient management of people in a company or organization such that they help their business gain a competitive advantage.
- designed to maximize employee performance in service of an employer's strategic objectives
- responsible for overseeing employee-benefits design, employee recruitment, training and development, performance appraisal, and reward management, such as managing pay and employee-benefits systems
- overall purpose of human resources (HR) is to ensure that the organization is able to achieve success through people
- **Human Resource Management is the process of recruiting, selecting, inducting employees, providing orientation, imparting training and development, appraising the performance of employees, deciding compensation and providing benefits, motivating employees, maintaining proper relations with employees and their trade unions, ensuring employees safety, welfare and healthy measures in compliance with labour laws of the land and finally following the Orders / Judgements of the concern High Court and Supreme Court, if any.**

## HRM Process



## Function and importance of HRM



5 basic (Managerial) function of Human Resource Management:

### 1. Planning

- Establishing goals and objectives to be achieved
- Developing rules and procedures
- Determining plans and forecasting techniques

- HR outsourcing

## 2. Organizing

- Giving each member a specific tasks
- Establishing departments and divisions
- Delegating authority to the members
- Establishing channels of authority and communication
- Creating a system to coordinate the works of the members

## 3. Staffing

- Determining the type of people to be hired
- Compensating the employees
- Setting performance standards, measuring and evaluating the employees
- Counselling the employees
- Recruiting prospective employees and selecting the best ones

## 4. Direction

- Getting work done through subordinates
- Ensuring effective two-way communication for the exchange of information with the subordinates
- Motivating subordinates to strive for better performance
- Maintaining the group morale

## 5. Controlling: decide what should or shouldn't be done

## **Operative function of Human Resource Management**

### 1. Procurement

- Job analysis
- Job design
- Recruitment and selection
- Induction & Orientation

### 2. Development

- Career planning & Career development
- Executive development

- Employee training and development
- Overall development of organisation

### **3. Compensation**

- Performance evaluation
- Wages or salary administration
- Employee rewards, perks and benefits

### **4. Maintenance & Motivation**

- Employee well-being
- Worker's participation
- Motivating Employees
- Job rotation
- Maintaining HR records

### **5. Integration**

- Industrial relations
- Employee discipline
- Grievance redressed
- Dispute settlement
- Collective bargaining
- Being spokesman of employees and organization
- Resolving conflicts among employees

#### **Importance of HR management:**

1. To maintain quality of work life
2. To increase productivity and profit
3. To produce employees who are easily adaptable to change
4. To match demand and supply of human resource
5. To retain employees and motivate them to accomplish company's goal
6. To recognize merit and contribution of employee
7. To create feeling of belongingness and team spirit in the employee
8. To sustain business in the market
9. To resolve conflicts
10. To develop corporate image

## HR Planning

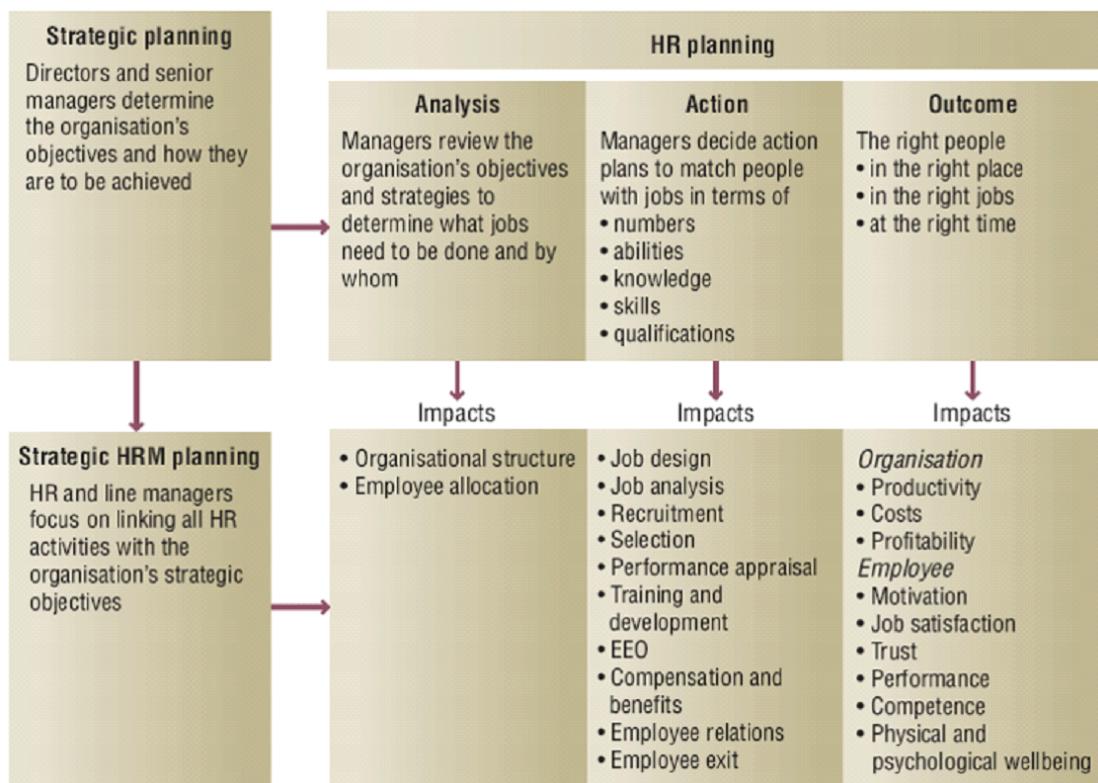
**Human resource planning (HRP)** may be defined as strategy for acquisition, utilization, improvement and preservation of the human resources of an enterprise. The objective is to place right personnel for the right work and optimum utilization of the existing human resources. HRP exists as a part of the planning process of business.

The major activities of Human resource planning include:

1. Placement of employee in the job where he exactly fit
2. forecasting (future requirements),
3. inventorying (present strength),
4. anticipating (comparison of present and future requirements) and
5. planning (necessary programme to meet future requirements).



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### Problems in HRP Process

The main problems in the process of HRP are as follows:

- Inaccuracy:** Human Resource Planning is entirely dependent on the HR forecasting and supply, which cannot be a cent per cent accurate process.
- Employee resistance:** Employees and their unions feel that by Human Resource Planning, their workload increases so they resist the process.
- Uncertainties:** Labour absenteeism, labour turnover, seasonal employment, technological changes and market fluctuations are the uncertainties which Human Resource Planning process might have to face.
- Inefficient information system:** In Indian industries, HRIS is not much strong. In the absence of reliable data it is not possible to develop effective Human Resource Planning.
- Time and expense:** Human Resource Planning is time consuming and expensive exercise, so industries avoid.

## **Recruitment & Selection**

- Selection is followed by recruitment process, Recruitment is the process of attracting qualified candidates for a job role and Selection is the process of identifying and selecting the right candidate for that job.
- Recruitment refers to the process of finding possible candidates for a job or function, undertaken by recruiters
- The selection process is series of steps used to decide which recruits should be hired

## **Training & development**

- a) Training and Development is a structured program with different methods designed by professionals in particular job.
- b) most common and continuous task in any organisation for updating skills and knowledge of employees in accordance with changing environment
- c) Optimization of cost with available resources; by improving efficiency and productivity of employees
- d) **Training** is the process of improving and polishing the required Skills to an employee in order to make him/her skilled and perfectionist in the job which he / she does. **Development** of employees is way of learning by way of observations to develop knowledge

### **Objectives:**

- **Individual Objectives:** help employees in achieving their personal goals, which in turn, enhances the individual contribution to an organization.
- **Organizational Objectives:** assist the organization with its primary objective by bringing individual effectiveness
- **Functional Objectives:** maintain the department's contribution at a level suitable to the organization's needs.
- **Societal Objectives:** ensure that an organization is ethically and socially responsible to the needs and challenges of the society

Training and development encompasses three main activities:

- **Training:** This activity is both focused upon, and evaluated against, the job that an individual currently holds.
- **Education:** This activity focuses upon the jobs that an individual may potentially hold in the future, and is evaluated against those jobs.

- **Development:** This activity focuses upon the activities that the organization employing the individual, or that the individual is part of, may partake in the future, and is almost impossible to evaluate.

## Job description

Job Description is a broad and written statement of a specific job in the organization, based on the findings of a the job analysis.

Description generally includes duties, purpose, responsibilities, scope, and working conditions of a job along with the title of the job, and the name or designation of the person to whom the employee will reports.

To create compelling job descriptions:

1. Consult Project Manager about the Opening
2. Define the Job Title Properly
3. List the Necessary Hard/Soft Skills
4. Be Flexible in Terms of Experience
5. Provide Candidates with Competitive Job Benefits
6. Avoid Spelling & Formatting Errors



## Job Specification Job analysis

### Job Specification

- John specification is a statement in which we explain the qualities required by people applying for the job.

- Components: **Experience; Education; Required Skills, Knowledge and Characteristics**

### **Job analysis**

Job analysis is a systematic process of collecting the information on

- nature of a job
- qualities and qualifications required to a job,
- physical and mental capabilities to require to a job
- duties and responsibilities, physical and mental effort required to perform a job
- necessary skills required to perform a job
- working conditions and environment for a job
- in order to describe job description and job specification, for recruitment and selection of employee, improve job satisfaction, employee safety and to build up employee motivation etc.

### **Job**

A group of homogeneous tasks related by similarly of functions. When performed by an employee in an exchange for pay, a job consists of duties, responsibilities, and tasks (performance elements) that are

1. defined and specific, and
2. can be accomplished, quantified, measured, and rated. From a wider perspective, a job is synonymous with a role and includes the physical and social aspects of a work environment. Often, individuals identify themselves with their job or role (foreman, supervisor, engineer, etc.) and derive motivation from its uniqueness or usefulness.

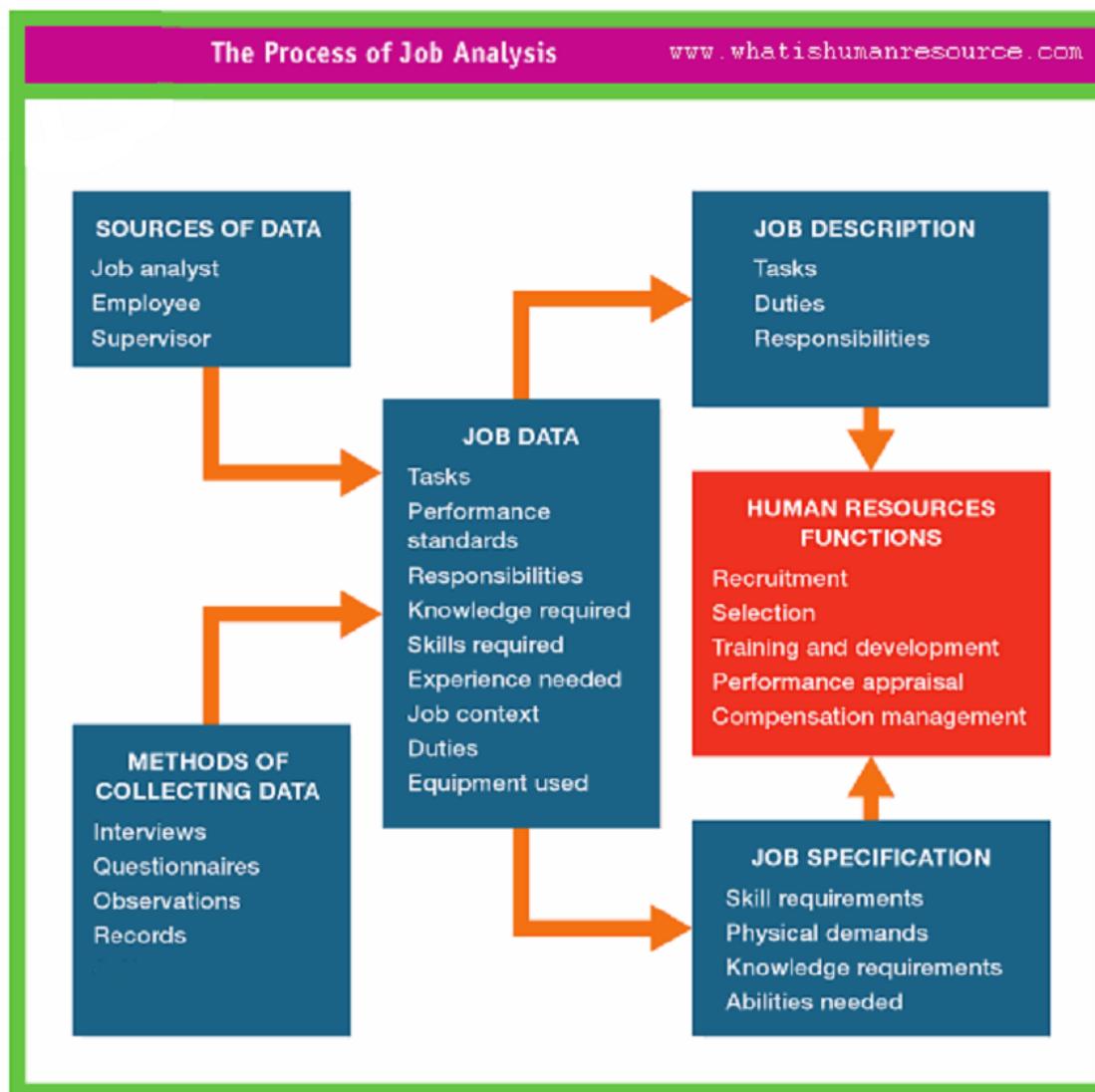
### **Job Analysis**

Job analysis is a procedure through which you determine the duties and responsibilities, nature of the jobs and finally to decide qualifications, skills and knowledge to be required for an employee to perform particular job.

#### **Job analysis is a detailed examination of:**

1. tasks that make up a job (employee role),
2. conditions under which an employee performing his/her job, and
3. what exactly a job requires in terms of aptitudes (potential for achievement), attitudes (behavior characteristics), knowledge, skills, educational qualifications and the physical working condition of the employee.
4. Its objectives include

5. to determine most effective methods for performing a job.
6. to increase employee job satisfaction.
7. to identify core areas for giving training to employees and to find out best methods of training.
8. development of performance measurement systems, and
9. to match job-specifications with employee specifications while selection of an employee.



### Procedure of job analysis

1. **Word oriented approach:** focus on the actual task involved in a Job. this

approach mainly concentrate on duties, functions and responsibilities involved in a job.

2. **Employee oriented approach:** focus on examining of human attributes needed to perform the job perfectly. human attributes have been classified into knowledge, skills, attitude and other characteristics.

## Motivation

Motivation is the act or process of providing a motive that causes a person to take some action.



### Methods for Motivating Employees for Employee Satisfaction

2. Rewards
3. Using Merit Pay
4. Using Spot Awards
5. Using Skill-Based Pay
6. Using Recognition
7. Using Job Redesign
8. Using Empowerment

9. Using Goal-Setting Methods
10. Using Positive Reinforcement
11. Using Lifelong Learning

## Reward & Punishment

A workplace has a collection of different personality types, some of which respond to incentives while others respond to a fear of punishment. A good manager understands the dynamics of individual employees and creates an environment that recognizes exceptional performance.

### Incentives:

- a promise of a reward that can be attained by achieving a certain outcome
- used to generate sales, encourage timely project completion or maintenance of a budget
- given to individuals or be dependent on collaborative group performance
- To be effective, incentives must be worthwhile, clearly defined and attainable.
- cash rewards, paid time off, flexible scheduling, deep discounts on the purchase of the company's products and services

### Punishments:

- is more accurately defined as "**disciplinary action**."
- To be effective, employees must have a clear understanding of workplace policies and guidelines so that they are aware of the penalty for breaching rules or failing to meet performance standards.
- Have a written policy that details expectations and the resulting intervention and action that's taken if rules are violated
- performance counseling, followed by probation, suspension and ultimately termination

## Performance appraisal

The performance appraisal is the process of assessing employee performance by way of comparing present performance with already established standards which have been already communicated to employees, subsequently providing feedback to employees about their performance level for the purpose of improving their performance as needed by the organization.

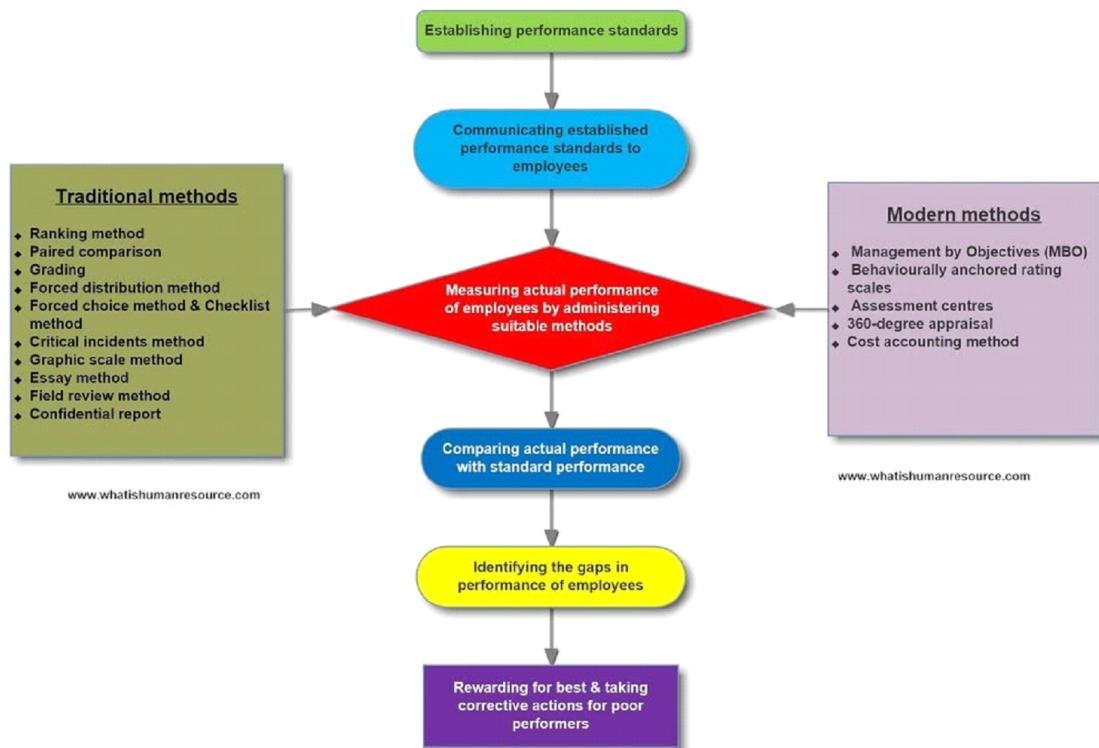
- its purpose is to decide whether training is needed, or promotion with additional pay hike, demoted or sacked

**Appraisal:** Appraisals are judgments of the characteristics, traits and performance of others

#### Performance Appraisal Process:

1. Establishing performance standards
2. Communicating the standards
3. Measuring the actual performance
4. Comparing actual performance with desired performance
5. Discussing results

#### Performance appraisal process



## Career Planning

Career planning is an individual's lifelong process of establishing personal career objectives and acting in a manner intended to bring them about.

- The term 'career' denotes all the jobs that are held during one's working life.
- Career anchors denote the basic drives that create the urge to take up a certain type of a career. These drives are as follows:
  - Managerial Competence
  - Technical Competence
  - Security
  - Creativity
  - Autonomy

### **Nature of Career Planning:**

- A Process
- Upward movement
- Mutuality of Interest
- Dynamic

### **Objectives of Career Planning:**

- To provide and maintain appropriate manpower resources in the organisation by offering careers, not jobs.
- To provide environment for the effectiveness, efficiency and growth of its employees and motivating them to contribute effectively towards achieving the objectives of the organisation.
- To map out careers of various categories of employees suitable to their ability, and their willingness to be 'trained and developed for higher positions.
- To have a stable workforce by reducing absenteeism and employee turnover.
- To cater to the immediate and future human resources need of the organisation on a timely basis.
- To increase the utilisation of managerial reserves within organisation.

### **Steps in Career Planning Process:**

1. Self-Assessment
2. Goal Setting
3. Academic/Career Options
4. Plan of Action
5. Catch Hold of Opportunities

## **Employee ethics**

Workplace ethics, also referred to as business ethics, describes the ethical dimensions of organizations and company activities.

### **The role of Workplace Ethics:**

- Ethical lapses of any kind have the tendency to snowball in a work environment.
- they will break rules if others do it
- so it communicates as if it is acceptable
- Worst case: they view company in negative light and leave
- a culture where misconduct is tolerated could result in **higher turnover, lower productivity, and ultimately, a diminished reputation and profitability.**

### **The Role of Work Ethic:**

Managerial style can work to improve an employee's work ethic by establishing systems and habits for accomplishing tasks efficiently and interacting effectively in the workplace.

The 8 central characteristics of strong employee work ethic are:

2. Punctuality
3. Accountability
4. Focus
5. Initiative
6. Productivity
7. Professionalism
8. Dedication
9. Desire to Improve

## **Human Resource Information System**

Human Resource Information Systems = HRM + IT

HRIS is a system that lets you keep track of all your employees and information about them.

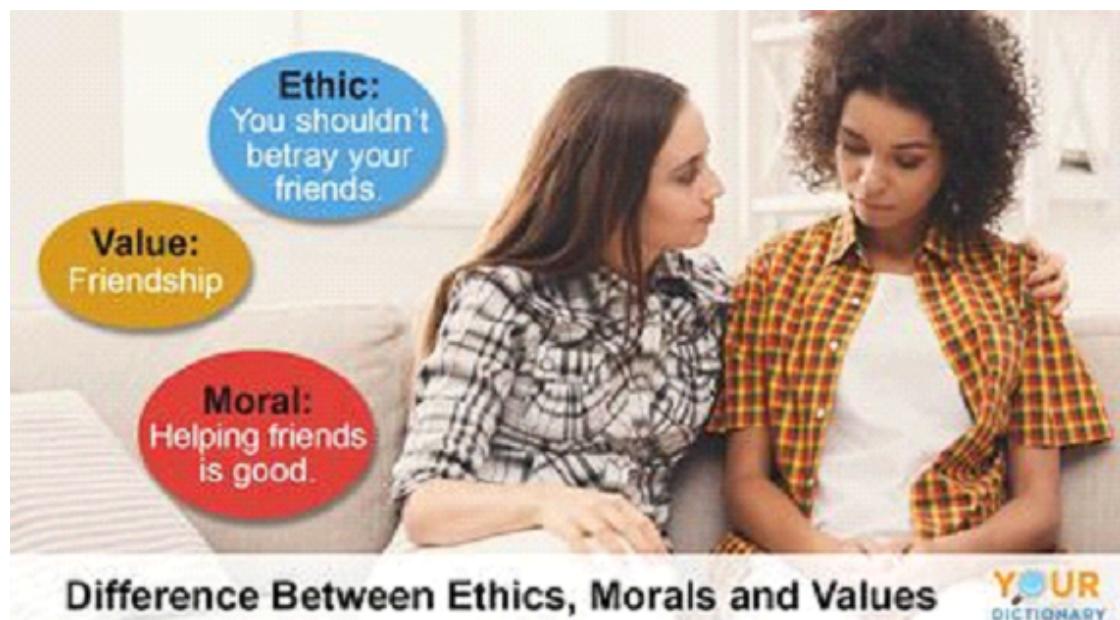
HRIS is the system which seeks to merge the activities associated with human resource management (HRM) and information technology (IT) into one common database through the use of enterprise resource planning (ERP) software.

The **HRIS Specialist** examines and verifies employee information processed by automated HR systems. They compile statistical information and prepare reports relating to payroll, recruiting, position classification, compensation, training, equal opportunity employment, or affirmative action. They also provide assistance with HRIS maintenance, troubleshoot user technical problems, and provide training.

These systems include the employee name and contact information and all or some of the following:

1. department
2. job title,
3. grade,
4. salary,
5. salary history,
6. position history,
7. supervisor,
8. training completed,
9. special qualifications,
10. ethnicity,
11. date of birth,
12. disabilities,
13. veterans status,
14. visa status,
15. benefits selected,
16. and more

## Moral values



Values are everything when dealing with people. Without humane and compassionate approaches when dealing with employees, suppliers, fellow executives, and other societal

and governmental stakeholders, people to people relationships become fraught with friction and introduce an element of tension.

## **Retirement & Socialization**

### **Retirement**

- Retirement is when a person stops or retires working after the service of a certain period of time
- is officially stopping your professional career
- be because of the age set by the government or companies, the voluntary retirement due to some health issues, work conditions or some other issues or the benefits which a person can avail later.
- Benefits after retirement: Pension, Retirement Fund

### **Socialization**

- is a process of adaptation after entering the organization. Socialization refers to the adaptation that takes place when an individual passes from outside the organization to role of an inside member.
- reduces the anxiety of the new hires and allows them to adjust with the other existing employees in the company.

The fundamentals purpose of socialization are discussed below:

- Employment Situation
- Rules and Policies
- Compensation and benefits
- Corporate Culture
- Working as a team
- Dealing with Change

### **Process of socialization:**

1. **Pre- Arrival Stage:** This stage recognizes that every individual employee comes with set of values and hope
2. **Encounter Stage:** the employees bump into the real working conditions of the organization
3. **Metamorphosis Stage:** new employees, in this stage will work out solutions to meet any problems

# **Industrial Relation & Collective Bargaining**

## **Industrial Relations**

Industrial relations has become one of the most delicate and complex problems of modern industrial society. Industrial progress is impossible without cooperation of labors and harmonious relationships. Therefore, it is in the interest of all to create and maintain good relations between employees (labor) and employers (management).

### **Importance of Industrial Relations:**

- Uninterrupted production
- Reduction in Industrial Disputes
- High morale
- Mental Revolution
- Reduced Wastage

### **Objectives of Industrial Relations:**

1. To safeguard the interest of labour and management by securing the highest level of mutual understanding and good-will among all those sections in the industry which participate in the process of production.
2. To avoid industrial conflict or strife and develop harmonious relations, which are an essential factor in the productivity of workers and the industrial progress of a country.
3. To raise productivity to a higher level in an era of full employment by lessening the tendency to high turnover and frequency absenteeism.
4. To establish and promote the growth of an industrial democracy based on labor partnership in the sharing of profits and of managerial decisions, so that ban individuals personality may grow its full stature for the benefit of the industry and of the country as well.
5. To eliminate or minimize the number of strikes, lockouts and gheraos by providing reasonable wages, improved living and working conditions, said fringe benefits.
6. To improve the economic conditions of workers in the existing state of industrial managements and political government.
7. Socialization of industries by making the state itself a major employer
8. Vesting of a proprietary interest of the workers in the industries in which they are employed.

## **Collective bargaining**

Collective Bargaining is a method of determining the terms and conditions of employment and settling disputes arising from those by negotiating between the employer and the employees or their trade union.

Collective bargaining generally consists of four types of activities:

1. Distributive bargaining

- involves haggling over the distribution of surplus
- Under it, the economic issues like wages, salaries and bonus are discussed
- one party's gain is another party's loss
- also known as conjunctive bargaining

2. Integrative bargaining

- negotiation of an issue on which both the parties may gain, or at least neither party loses
- employer and employee sides may bargain over the better training programme or a better job evaluation method

3. Attitudinal restructuring

- involves shaping and reshaping some attitudes like trust or distrust, friendliness or hostility between labour and management
- It develops a bargaining environment and creates trust and cooperation among the parties

4. Intra-organizational bargaining

- generally aims at resolving internal conflicts
- within the union, there may be differences between groups
- Within the management also, there may be differences.

# Economics

Economics is the social science that studies the production, distribution, and consumption of goods and services.

Economics focuses on the behavior and interactions of economic agents and how economies work. **Microeconomics** is a field which analyzes what's viewed as basic elements in the economy, including individual agents and markets, their interactions, and the outcomes of interactions. Individual agents may include, for example, households, firms, buyers, and sellers. **Macroeconomics** analyzes the economy as a system where production, consumption, saving, and investment interact, and factors affecting it: employment of the resources of labour, capital, and land, currency inflation, economic growth, and public policies that have impact on these elements.

## Importance of economics

1. To examine the conditions of social and economic welfare
2. Efficient allocation of resources
3. Business planning
4. Price determination
5. Economic policy
6. Individual behavior analysis
7. Free enterprise economy
8. Foreign trade
9. Simple models
10. Predictions
11. Basis of macro economy

## Characteristics of Nepalese Economy

1. Low Per Capita Income
2. Mass Poverty
3. Underutilization of Natural Resources
4. High trade deficit
5. Dualist and Mixed Economic System
6. Rapid Population Growth
7. Remittance Economy

## GDP

**Definition** Gross domestic product (**GDP**) is the standard measure of the value added created through the production of goods and services in a country during a certain

period (typically 1 year).

**Purpose** GDP is the most commonly used measure of economic activity.

### How to calculate GDP

- Production approach: sum of the “value-added” at each stage of production
- Expenditure approach
- Income approach

### Formula

GDP = private consumption + gross private investment + government investment + government spending + (exports - imports)

$$GDP = C + I + G + (X - M)$$

Nepal (2022)

**GDP:** \$42.41billion

**GDP growth:** 5.84%

**GDP per capita:** \$1,412

## National Income

National Income(NI) is also known as national income on factor cost. It is defined as the total sum of all the factors of population. There are 4 elements of production: land, labour, capital, and organization. These factors of production receive rewards in form of rent, wages, interest, and profit respectively. The total sum of these factors rewards plus net factor income from abroad is the national income.

## Per-capita Income

The meaning of per-capita is per person. It is Latin term that translates to “by the head”. It is commonly used to compare the economic indicators of countries with different population sizes.

$$\text{Per Capita income} = \frac{\text{Real national income}}{\text{Total population}}$$

The per capita income of Nepal is \$1,362.

## **Interest Rate**

An interest rate is the amount of interest due per period, as a proportion of the amount lent, deposited, or borrowed (called the principal sum).

## **Inflation**

Inflation is an increase in the level of prices of the goods and services that households buy. It is measured as the rate of change of those prices. Typically, prices rise over time, but prices can also fall (a situation called deflation).

The most well-known indicator of inflation is the Consumer Price Index (CPI), which measures the percentage change in the price of a basket of goods and services consumed by households.

## **Investment**

Investing, broadly, is putting money to work for a period of time in some sort of project or undertaking in order to generate positive returns (i.e., profits that exceed the amount of the initial investment). It is the act of allocating resources, usually capital (i.e., money), with the expectation of generating an income, profit, or gains.

### **Common types of investments:**

- 1. Stocks
- 2. Bonds
- 3. Funds
- 4. Investment Trusts

## **Saving**

Saving is the portion of income not spent on current expenditures. In other words, it is the money set aside for future use and not spent immediately. Why should we save money? Saving can be used to accomplish objectives in the short-term such as buying a mobile phone, or in the longer run such as continuing to study, or else buying a car or a house.

## **Government Securities**

A Government Security (G-Sec) is a tradeable instrument issued by the Central Government or the State Governments. It acknowledges the Government's debt obligation. Such securities are short term (usually called treasury bills, with original maturities of less

than one year) or long term (usually called Government bonds or dated securities with original maturity of one year or more). In India, the Central Government issues both, treasury bills and bonds or dated securities while the State Governments issue only bonds or dated securities, which are called the State Development Loans (SDLs). G-Secs carry practically no risk of default and, hence, are called risk-free gilt-edged instruments.

## **Balance of Payment**

The balance of payments (BOP) is the method countries use to monitor all international monetary transactions at a specific period. Usually, the BOP is calculated every quarter and every calendar year.

All trades conducted by both the private and public sectors are accounted for in the BOP to determine how much money is going in and out of a country. If a country has received money, this is known as a credit, and if a country has paid or given money, the transaction is counted as a debit.

## **Money market**

The money market refers to trading in very short-term debt investments. At the wholesale level, it involves large-volume trades between institutions and traders. At the retail level, it includes money market mutual funds bought by individual investors and money market accounts opened by bank customers.

In all of these cases, the money market is characterized by a high degree of safety and relatively low rates of return.

## **Capital market**

Capital markets are where savings and investments are channeled between suppliers—people or institutions with capital to lend or invest—and those in need. Suppliers typically include banks and investors while those who seek capital are businesses, governments, and individuals.

Capital markets are composed of primary and secondary markets. The most common capital markets are the stock market and the bond market.

Capital markets seek to improve transactional efficiencies. These markets bring suppliers together with those seeking capital and provide a place where they can exchange securities.

# Strategic & Risk Management

## Strategic Management:

Strategic management is the management of an organization's resources to achieve its goals and objectives.

Strategic management involves setting objectives, analyzing the competitive environment, analyzing the internal organization, evaluating strategies, and ensuring that management rolls out the strategies across the organization.

## Strategic planning framework

A strategic planning framework is a tool you and your team will use to focus on and fill in a specific element of your strategic plan.

The strategic planning process can be daunting, but a strategic planning framework can help. You'll use your framework (or frameworks) to tackle a specific piece of the strategic planning process with zero confusion and eyerolls, and plenty of energy and enthusiasm.

**Difference with strategic planning models:** model is overview of all pieces, framework is for specific piece

## 8 strategic planning frameworks to hash out strategy with confidence:

1. **SWOT analysis:** To grasp what internal and external factors can impact your strategy
2. **Issue-based strategic planning:** To build a strategic plan that addresses your organization's biggest problems
3. **Balanced scorecard:** To define your goals and the steps you'll take to get there
4. **Strategy mapping:** To understand how all of your company's objectives fit together
5. **Objectives and key results (OKRs):** To keep a close eye on progress
6. **Porter's five forces:** To understand the ins and outs of your existing and prospective competitors
7. **Gap planning:** To determine how you'll close the gap between where you are and where you want to be

8. **PEST analysis:** To understand the external factors that can impact your company

## **Strategy formulation process and methods**

Strategy formulation is the process of using available knowledge to document the intended direction of a business and the actionable steps to reach its goals.

This process is used for resource allocation, prioritization, organization-wide alignment, and validation of business goals.

A successful strategy can allow your organization to share one clear vision, catch biases by examining the reasoning behind goals, and track performance with measurable key performance indicators (KPIs).

### **Steps in strategy formulation process:**

1. Setting Organizations' objectives
2. Evaluating the Organizational Environment
3. Setting Quantitative Targets
4. Aiming in context with the divisional plans
5. Performance Analysis
6. Choice of Strategy

### **Modes of strategy Formulation:**

1. **Entrepreneurial Mode:** Under this mode, the entrepreneur, who is the founder of the organization or the descendant of the founder; decides upon strategies – on the basis of his wisdom, experience, foresight, intuition etc.
2. **Adaptive Mode:** Under this mode of strategy making, once the strategy is put into practice; the management keeps a close watch on environmental happenings and trends; and keeps adapting (or adjusting) strategies in the light of environmental developments.
3. **Planning Mode:** This is the scientific mode of strategy making; which is based on SWOT analysis, gap analysis and other logical steps required in strategy formulation, like development of strategic alternatives and their evaluation leading to the choice of final strategy. Organizations governed by professional managers, follow this approach to strategy formulation.

## **SWOT analysis**

SWOT (strengths, weaknesses, opportunities, and threats) analysis is a framework used to evaluate a company's competitive position and to develop strategic planning. SWOT

analysis assesses internal and external factors, as well as current and future potential.

A SWOT analysis is designed to facilitate a realistic, fact-based, data-driven look at the strengths and weaknesses of an organization, initiatives, or within its industry. The organization needs to keep the analysis accurate by avoiding pre-conceived beliefs or gray areas and instead focusing on real-life contexts. Companies should use it as a guide and not necessarily as a prescription.

#### **How to do SWOT Analysis:**

SWOT analysis is a technique for assessing the performance, competition, risk, and potential of a business, as well as part of a business such as a product line or division, an industry, or other entity.

Using internal and external data, the technique can guide businesses toward strategies more likely to be successful, and away from those in which they have been, or are likely to be, less successful. Independent SWOT analysts, investors, or competitors can also guide them on whether a company, product line, or industry might be strong or weak and why.



# Risk Management

## Concept

Risk management encompasses the identification, analysis, and response to risk factors that form part of the life of a business. Effective risk management means attempting to control, as much as possible, future outcomes by acting proactively rather than reactively. Therefore, effective risk management offers the potential to reduce both the possibility of a risk occurring and its potential impact.

## Identification

Risk identification is the process of documenting any risks that could keep an organization or program from reaching its objective. It's the first step in the risk management process, which is designed to help companies understand and plan for potential risks. Examples of risks include theft, business downturns, accidents, lawsuits or data breaches.

When you identify risks, look for events that may prevent a project from achieving its goal. The risk's origin can be the project itself or external sources. There are several situations for which you might need to identify risks, including:

- To support an investment decision
- To assess cost uncertainty or operational costs
- To analyze multiple alternatives
- To test a program before its acquisition

## Types

Broadly speaking, there are two main categories of risk: systematic and unsystematic. Systematic risk is the market uncertainty of an investment, meaning that it represents external factors that impact all (or many) companies in an industry or group. Unsystematic risk represents the asset-specific uncertainties that can affect the performance of an investment.

- **Systematic Risk** – The overall impact of the market
- **Unsystematic Risk** – Asset-specific or company-specific uncertainty
- **Political/Regulatory Risk** – The impact of political decisions and changes in regulation
- **Financial Risk** – The capital structure of a company (degree of financial leverage or debt burden)
- **Interest Rate Risk** – The impact of changing interest rates

- **Country Risk** – Uncertainties that are specific to a country
- **Social Risk** – The impact of changes in social norms, movements, and unrest
- **Environmental Risk** – Uncertainty about environmental liabilities or the impact of changes in the environment
- **Operational Risk** – Uncertainty about a company's operations, including its supply chain and the delivery of its products or services
- **Management Risk** – The impact that the decisions of a management team have on a company
- **Legal Risk** – Uncertainty related to lawsuits or the freedom to operate
- **Competition** – The degree of competition in an industry and the impact choices of competitors will have on a company

## **Measurement**

Risk measures are statistical measures that are historical predictors of investment risk and volatility, and they are also major components in modern portfolio theory (MPT). MPT is a standard financial and academic methodology for assessing the performance of a stock or a stock fund as compared to its benchmark index.

There are five principal risk measures, and each measure provides a unique way to assess the risk present in investments that are under consideration. The five measures include the alpha, beta, R-squared, standard deviation, and Sharpe ratio. Risk measures can be used individually or together to perform a risk assessment. When comparing two potential investments, it is wise to compare like for like to determine which investment holds the most risk.

## **Cyber securities**

Cyber security is the practice of defending computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks. It's also known as information technology security or electronic information security. The term applies in a variety of contexts, from business to mobile computing, and can be divided into a few common categories.

1. Network security
2. Application security
3. Information security
4. Operational security
5. Disaster recovery and business continuity

6. End-user education

## IT risk management

Information risk is a calculation based on the likelihood that an unauthorized user will negatively impact the confidentiality, integrity, and availability of data that you collect, transmit, or store. More specifically, you need to review all data assets to ensure:

- **Confidentiality:** Establish and enforce appropriate authorization controls so that only users who need access have access
- **Integrity:** Establish and enforce controls that prevent changing information without data owner permission
- **Availability:** Establish and enforce controls that prevent systems, networks, and software from being out of service

**IT risk management**, also called “information security risk management,” consists of the policies, procedures, and technologies that a company uses to mitigate threats from malicious actors and reduce information technology vulnerabilities that negatively impact data confidentiality, integrity, and availability.

## Techniques

1. Monitor your IT environment
2. Monitor your supply stream
3. Monitor compliance

## Strategies

1. Identify potential points of vulnerability
2. Analyze data types
3. Evaluate and prioritize the information risk
4. Set a risk tolerance and establish IT risk management processes
5. Continuously monitor your risk

# **Contingency**

## **Planning**

A contingency plan in project management is a defined, actionable plan that is to be enacted if an identified risk becomes a reality. It is essentially a “**Plan B**”, to be put in place when things go differently than expected. The Project Management Institute defines contingency planning as, “involving defining action steps to be taken if an identified risk event should occur.” Contingency plans in project management are a component of risk management, and should be part of the risk management plan.

## **Management**

Methods to create contingency plan

1. Make a list of risks
2. Weigh risks based on severity and likelihood
3. Identify important risks
4. Create contingency plans for the biggest risks
5. Get approval for your contingency plan
6. Distribute your contingency plans
7. Monitor your contingency plans
8. Create new contingency plans if necessary

# Project Management

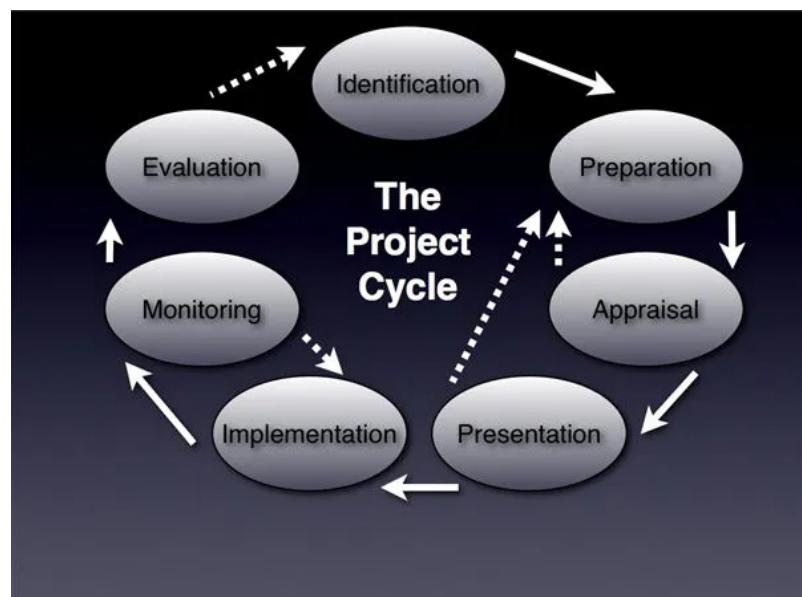
## Concept

Project management involves the planning and organization of a company's resources to move a specific task, event, or duty towards completion. It can involve a one-time project or an ongoing activity, and resources managed include personnel, finances, technology, and intellectual property.

Project management is often associated with fields in engineering and construction and, more lately, healthcare and information technology (IT), which typically have a complex set of components that have to be completed and assembled in a set fashion to create a functioning product.

No matter what the industry is, the project manager tends to have roughly the same job: to help define the goals and objectives of the project and determine when the various project components are to be completed and by whom. They also create quality control checks to ensure completed components meet a certain standard.

## Project Cycle:



Definition of the Project Cycle: Explaining the 7 Distinct Phases - BrightHub Project Management

## **Project Identification**

Project identification is the first step of any project cycle. Entrepreneurs need to identify and zero in on a project that suits their requirements and can help them attain their goals before spending significant time and resources on a project. They also need to study in detail the feasibility of the proposed project well before they start planning the other steps of the project cycle. Usually various aspects are required to be studied before picking a project.

The purpose of project identification is to develop a preliminary proposal for the most appropriate set of interventions and course of action, within specific time and budget frames, to address a specific development goal in a particular region or setting. Investment ideas can arise from many sources and contexts. They can originate from a country's sector plan, programme or strategy, as follow-up of an existing project or from priorities identified in a multi-stakeholder sector or local development dialogue. Identification involves:

- A review of alternative approaches or options for addressing a set of development problems and opportunities;
- The definition of project objectives and scope of work at the degree of detail necessary to justify commitment of the resources for detailed formulation and respective preparatory studies; and
- The identification of the major issues that must be tackled and the questions to be addressed before a project based on the concept can be implemented.

## **Formulation**

Project formulation refers to the development of the project from the generated idea of the firm, the idea is the seed of the project. Project formulation includes the total procedures or activity of altering the project concept, theme etc. from intuitions based to an institutional based and rational based to result feasible work form. It is detail procedure of analyzing the feasibility of any specific project. So various factors are taken into consideration to test the viability of the proposed project. It plays the dominant role into the success of the any project.

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There are various techniques available for the project formulation. Most commonly used techniques are as follows:

1. Cost Benefit Analysis
2. Feasibility Analysis
3. Input Analysis
4. Financial Analysis
5. Network Analysis

## **Appraisal**

Project appraisal is the structured process of assessing the viability of a project or proposal. It involves calculating the feasibility of the project before committing resources to it. It is a tool that company's use for choosing the best project that would help them to attain their goal. Project appraisal often involves making comparison between various options and this done by making use of any decision technique or economic appraisal technique.

Project appraisal is a tool which is also used by companies to review the projects completed by it. This is done to know the effect of each project on the company. This means that the project appraisal is done to know, how much the company has invested on the project and in return how much it is gaining from it.

## **Implementation**

Project implementation is the process of putting a project plan into action to produce the deliverables, otherwise known as the products or services, for clients or stakeholders. It takes place after the planning phase, during which a team determines the key objectives for the project, as well as the timeline and budget. Implementation involves coordinating resources and measuring performance to ensure the project remains within its expected scope and budget. It also involves handling any unforeseen issues in a way that keeps a project running smoothly.

To implement a project effectively, project managers must consistently communicate with a team to set and adjust priorities as needed while maintaining transparency about the project's status with the clients or any key stakeholders.

## **Monitoring**

When considering the project management process, project monitoring (also referred to as "project monitoring and control") comes as step four — following initiation, planning,

and the beginning of execution. Once the project execution begins, project monitoring also commences. But, what exactly is project monitoring?

Project monitoring involves tracking a project's metrics, progress, and associated tasks to ensure everything is completed on time, on budget, and according to project requirements and standards. Project monitoring also includes recognizing and identifying roadblocks or issues that might arise during the project's execution, and taking action to rectify these problems.

## **Evaluation**

Project evaluation is a strategy used to determine the success and impact of projects, programs, or policies. It requires the evaluator to gather important information to analyze the process and outcome of a certain project. Project evaluation prompts changes in internal workflow, detects patterns in the target audience of the project, plans for upcoming projects or reports the value of projects to external stakeholders.

## **Control**

Project controls are a set of processes used to understand and influence the amount of time or money spent on a project. Each project control focuses on a distinct part of the project plan, like the schedule, resources, or potential risks.

The goal of using project controls is to stay within project scope, minimize the project budget when possible, and stick to the project schedule.

# **Fiscal & Monetary Policy**

## **Concept**

### **Fiscal policy:**

Fiscal policy refers to the use of government spending and tax policies to influence economic conditions, especially macroeconomic conditions. These include aggregate demand for goods and services, employment, inflation, and economic growth.

During a recession, the government may lower tax rates or increase spending to encourage demand and spur economic activity. Conversely, to combat inflation, it may raise rates or cut spending to cool down the economy.

Fiscal policy is often contrasted with monetary policy, which is enacted by central bankers and not elected government officials.

### **Monetary Policy:**

Monetary policy is a set of tools used by a nation's central bank to control the overall money supply and promote economic growth and employ strategies such as revising interest rates and changing bank reserve requirements.

## **Feature**

/todo

## **Objectives and instruments of monetary policy & fiscal policy**

### **Fiscal Policy:**

- To promote economic growth
- To reduce income and wealth inequalities
- To provide employment opportunities
- To ensure stability in prices
- To correct balance of payments deficit

- To provide for effective administration

Instruments:

- Public Expenditure
- Taxation
- Public Borrowing

**Monetary Policy:**

Objectives:

- Full employment
- Price stability
- Accelerating the rate of economic development
- Optimum allocation of resources
- Equitable distribution of income and wealth
- Economic stability
- Capital formation and growth
- Encouraging investment

Tools:

- Bank Rate Policy
- Interest rate adjustment
- Change reserve requirements
- Open market operations
- Selective Credit Controls

# **Information Technology**

Information technology (IT) is the use of any computers, storage, networking and other physical devices, infrastructure and processes to create, process, store, secure and exchange all forms of electronic data. Typically, IT is used in the context of business operations, as opposed to technology used for personal or entertainment purposes. The commercial use of IT encompasses both computer technology and telecommunications.

## **Computer System (Input Device, Output Device)**

**Definition:** Is a collection of entities(hardware,software and liveware) that are designed to receive, process, manage and present information in a meaningful format.

### **Components of Computer System**

- **Computer hardware** - Are physical parts/ intangible parts of a computer. eg Input devices, output devices, central processing unit and storage devices
- **Computer software** - also known as programs or applications. They are classified into two classes namely - system software and application software
- **Liveware** - is the computer user. Also known as orgware or the humanware. The user commands the computer system to execute on instructions.

### **Input Device**

In computing, an input device is a piece of equipment used to provide data and control signals to an information processing system, such as a computer or information appliance. Examples of input devices include keyboards, mouse, scanners, cameras, joysticks, and microphones.

### **Output Device**

An output device is any piece of computer hardware equipment which converts information into a human-perceptible form or, historically, into a physical machine-readable form for use with other non-computerized equipment. It can be text, graphics, tactile, audio, or video. Examples include monitors, printers, speakers, headphones, projectors, GPS devices, optical mark readers, and braille readers.

## **Operating System**

An operating system (OS) is the program that, after being initially loaded into the computer by a boot program, manages all of the other application programs in a computer. The application programs make use of the operating system by making requests for services through a defined application program interface (API). In addition, users can interact directly with the operating system through a user interface, such as a command-line interface (CLI) or a graphical UI (GUI).

## **Application software**

Application software is a type of computer program that performs a specific personal, educational, and business function. Each application is designed to assist end-users in accomplishing a variety of tasks, which may be related to productivity, creativity, or communication.

## **MS office system**

Microsoft Office is a suite of desktop productivity applications that is designed specifically by Microsoft for business use. It is a proprietary product of Microsoft Corporation and was first released in 1990. For decades, MS Office has been a dominant model in delivering modern office-related document-handling software environments.

Microsoft Office is available in 35 different languages and is supported by Windows, Mac and most Linux variants.

The core components of Microsoft Office are the six items present in the original package, notwithstanding the later addition of services like OneDrive and SharePoint and a web design tool called FrontPage.

The six core programs in Microsoft Office are:

1. Word.
2. Excel.
3. PowerPoint.
4. Access.
5. Publisher.
6. OneNote.

## **Internet**

The Internet, sometimes called simply “the Net,” is a worldwide system of computer networks – a network of networks in which users at any one computer can, if they have permission, get information from any other computer (and sometimes talk directly to users at other computers). It was conceived by the Advanced Research Projects Agency (ARPA) of the U.S. government in 1969 and was first known as the ARPANET. The original aim was to create a network that would allow users of a research computer at one university to “talk to” research computers at other universities. A side benefit of ARPANet’s design was that, because messages could be routed or rerouted in more than one direction, the network could continue to function even if parts of it were destroyed in the event of a military attack or other disaster.

Today, the Internet is a public, cooperative and self-sustaining facility accessible to hundreds of millions of people worldwide. It is used by many as the primary source of information consumption, and fueled the creation and growth of its own social ecosystem through social media and content sharing. Furthermore, e-commerce, or online shopping, has become one of the largest uses of the Internet.

## **Intranet**

An intranet is a computer network for sharing information, easier communication, collaboration tools, operational systems, and other computing services within an organization, usually to the exclusion of access by outsiders. The term is used in contrast to public networks, such as the Internet, but uses most of the same technology based on the Internet protocol suite.

## **Extranet and e-mail system**

An extranet is a private network that enterprises use to provide trusted third parties – such as suppliers, vendors, partners, customers and other businesses – secure, controlled access to business information or operations.

Extranets, which take the form of external-facing websites or platforms, can sometimes be viewed as part of or an extension of the organization’s intranet. This is because the information hosted on an extranet is typically only accessible on internal networks. Although information on an extranet is accessible to users outside the company, access is tightly controlled and only awarded to authorized users.

## **Database management system**

A database management system (DBMS) is system software for creating and managing databases. A DBMS makes it possible for end users to create, protect, read, update and delete data in a database. The most prevalent type of data management platform, the DBMS essentially serves as an interface between databases and users or application programs, ensuring that data is consistently organized and remains easily accessible.

## **Hardware**

Computer hardware is a collective term used to describe any of the physical components of an analog or digital computer. The term hardware distinguishes the tangible aspects of a computing device from software, which consists of written, machine-readable instructions or programs that tell physical components what to do and when to execute the instructions.

Hardware and software are complementary. A computing device can function efficiently and produce useful output only when both hardware and software work together appropriately.

Computer hardware can be categorized as being either internal or external components. Generally, internal hardware components are those necessary for the proper functioning of the computer, while external hardware components are attached to the computer to add or enhance functionality.

## **Networking**

Networking, also known as computer networking, is the practice of transporting and exchanging data between nodes over a shared medium in an information system. Networking comprises not only the design, construction and use of a network, but also the management, maintenance and operation of the network infrastructure, software and policies.

Computer networking enables devices and endpoints to be connected to each other on a local area network (LAN) or to a larger network, such as the internet or a private wide area network (WAN). This is an essential function for service providers, businesses and consumers worldwide to share resources, use or offer services, and communicate. Networking facilitates everything from telephone calls to text messaging to streaming video to the internet of things (IoT).

## **Backup**

In information technology, a backup, or data backup is a copy of computer data taken and stored elsewhere so that it may be used to restore the original after a data loss event. The verb form, referring to the process of doing so, is “back up”, whereas the noun and adjective form is “backup”. Backups can be used to recover data after its loss from data deletion or corruption, or to recover data from an earlier time. Backups provide a simple form of disaster recovery; however not all backup systems are able to reconstitute a computer system or other complex configuration such as a computer cluster, active directory server, or database server.

## **Related threats**

Information Security threats can be many like Software attacks, theft of intellectual property, identity theft, theft of equipment or information, sabotage, and information extortion.

Threat can be anything that can take advantage of a vulnerability to breach security and negatively alter, erase, harm object or objects of interest.

Software attacks means attack by Viruses, Worms, Trojan Horses etc. Many users believe that malware, virus, worms, bots are all same things. But they are not same, only similarity is that they all are malicious software that behaves differently.

Malware is a combination of 2 terms- Malicious and Software. So Malware basically means malicious software that can be an intrusive program code or anything that is designed to perform malicious operations on system. Malware can be divided in 2 categories:

### **1. Infection Method**

- **Virus:** to replicate themselves by hooking them to the program on the host computer
- **Worms:** also self-replicating in nature but they don't hook themselves to the program on host computer. Biggest difference between virus and worms is that worms are network-aware.
- **Trojan:** Their purpose is to conceal themselves inside the software that seem legitimate and when that software is executed they will do their task of either stealing information or any other purpose for which they are designed.
- **Bots:** advanced form of worms. They are automated processes that are designed to interact over the internet without the need for human interaction

### **2. Maleware Actions**

- **Adware:** not exactly malicious but they do breach privacy of the users

- **Spyware:** program or we can say software that monitors your activities on computer and reveal collected information to an interested party
- **Ransomware:** type of malware that will either encrypt your files or will lock your computer making it inaccessible either partially or wholly
- **Scareware:** masquerades as a tool to help fix your system but when the software is executed it will infect your system or completely destroy it
- **Rootkits:** are designed to gain root access or we can say administrative privileges in the user system
- **Zombies:** similar to Spyware. Infection mechanism is same but they don't spy and steal information rather they wait for the command from hackers

## **Need of core banking system (CBS) in banking business**

**Core Banking Solution (CBS)** is the networking of bank branches, which allows customers to manage their accounts, and use various banking facilities from any part of the world.

In simple terms, there is no need to visit your own branch to do banking transactions. You can do it from any location, any time. You can enjoy banking services from any branch of the bank which is on the CBS network regardless of the branch you have opened your account.

For the bank which implements CBS, the customer becomes the bank's customer instead of the customer of a particular branch.

### **Some needs are:**

- Meet the growing demands of their customers
- Simplify and speed up the basic banking processes so that the banking staff can focus on other areas like upselling and cross-selling, marketing, etc.
- Simplify and speed up the basic banking processes so that the banking staff can focus on other areas like upselling and cross-selling, marketing, etc.
- Making banking services more accessible and convenient for the customers
- The necessity to replace outdated technology
- Redefining the CBS Ecosystem
- Building vendor relationships for a long-term
- Prioritising customer service
- Minimise costs involved in human error

## **Importance & related risks of CBS in banking institution**

### **Importance:**

- Improved operations which address customer demands and industry consolidation
- Errors due to multiple entries eradicated
- Easy ability to introduce new financial products and manage changes in existing products
- Seamless merging of back office data and self-service operations

### **Cons**

- Technology-reliant
- Rigid
- Expensive
- Need for Cyber resilience
- High maintenance
- Impersonal

# **CIVIL-I**

# **Engineering Survey**

## **Introduction**

Surveying is the art of and science of determining the relative positions of various points or stations on the surface of the earth by measuring the horizontal and vertical distances, angles, and taking the details of these points and by preparing a map or plan to any suitable scale

### **Classifications:**

#### **Primary divisions:**

1. **Plane surveying**
2. **Geodetic surveying**
  - extent of area 260km<sup>2</sup>
  - difference bet<sup>n</sup> arc difference 18.2km, 10cm chord
  - diffence betn sum of angles of plane vs spherical is 1''

#### **Classification**

1. **Functional classification**
  - Control survey
  - Topographical survey
  - Engineering survey
  - Mine survey
  - Hydrographic survey
  - Astronomic survey
  - Geological survey
2. **Based on instruments**
  - Chain survey
  - Compass survey
  - Levelling
  - Plane table survey
  - Theodolite survey
  - Tachometric survey
  - Photogrammetry
  - EDM survey

## **Basic Principles**

- Always work from whole to part(\*) According to the first principle, the whole survey area is first enclosed by main stations (i.e. Control stations) and main survey lines. The area is then divided into a number of divisions by forming well-conditioned triangles.
- to locate a new station by at least two measurements(linear or angular) from fixed reference points(\*)
- Consistency of work
  - keep consistency in method, instrument, reading, noting observations, etc to gain desired level of accuracy.
- Independent check
  - every measurement should be re-checked by adopting a suitable method
- Accuracy Required
  - proper method and instrument should be used based on accuracy required

## **Linear measurements**

In an engineering survey, the linear horizontal distance has to be measured. The measurement of this linear horizontal distance between two points on the earth's surface is known as linear measurement.

### **Techniques**

Various methods used for linear measurements may be grouped as:

#### **1. Approximate**

These methods are used in reconnaissance survey or to detect major mistakes committed while measuring with better methods.

Different such methods are:

1. Pacing
2. Using passometer: records number of steps taken
3. Using pedometer: records distance, similar to passometer
4. Odometer: attached to wheel, records no of revolutions
5. Speedometer: calibrated odometer, records distance

## 2. Using chain or tape

Measurement of distances using chain or tape is termed as **chaining**.

### a. Chain

- made of galvanized mild steel
  - **Metric chains:** 20m chain, divided into 100 links
  - for easy reading end of 10<sup>th</sup> link has one tooth, 20<sup>th</sup> – 2,3,4, middle – circular shape

### b. Steel Bands

- \* made of blue steel – 20 or 30m
- \* each link 20cm – accurate than chain
- \* also known as **band chain**
- \* Etching graduations as meters, decimeters and centimeters on one side of the band and 0.2 m links on the other side.

### c. Tapes

- Invar tapes are mainly used (high degree of precision, base lines)
- invar (36% nickel, steel)
- low coefficient of thermal expansion (1/10<sup>th</sup> of steel)
- available in 3m length

### (iii) By optical means and

- using tacheometer (theodolite with two additional cross hairs)
- not accurate as chain or tape

### (iv) using electromagnetic distance measurement instruments.

- rely on measurement of electromagnetic waves
- even fraction by phase difference technique
- costly and delicate

## Chain survey

This is the simplest type of surveying in which only linear measurements are made with a chain or a tape.

- Its land survey

- Only linear measurements are taken
- No angular measurements are made
- Used for areas of small extent having simple details

**Principal of chain surveying:** The principal of chain surveying is to divide the area into a number of triangles of suitable sides

### Survey stations are of two kinds:

- i) Main Stations
- ii) Subsidiary or tie

**Base Line:** It is the main and longest line, which passes approximately through the center of the field. All the other measurements to show the details of the work are taken with respect to this line.

**Check Line:** A check-line also termed as a proof-line is a line joining the apex of a triangle to some fixed points on any two sides of a triangle. A check-line is measured to check the accuracy of the framework. The length of a checking line, as measured on the ground should agree with its length on the plan.

**Tie or Subsidiary Lines:** A tie line joints two fixed points on the main survey lines. It helps to check the accuracy of surveying and to locate the interior details. The position of each tie line should be close to some features, such as paths, buildings, etc

**Offsets:** Offsets are the lateral measurements from the baseline to fix the positions of the different objects of the work with respect to the baseline. two types – perpendicular and oblique

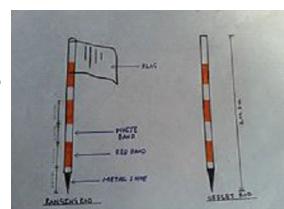
### Well-Conditioned Triangle

A triangle is said to be well conditioned if it can be plotted accurately by the intersection of arcs from the ends of the base line.

- best one is equilateral triangle
- angle should be  $>30$  and  $<120$

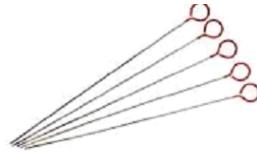
### Ranging rods

A ranging rod (or range rod) is a surveying instrument used for marking the position of stations, and for sightings of those stations, as well as for ranging straight lines.



## **Arrows**

arrows are the marking pins that are most commonly used in chain surveying



## **Representation of measurement and common scales**

### **Scale:**

Measure of representing real objects on drawing or maps

### **Types:**

- a. **Plain scale:** 2D
- b. **Diagonal Scale:** 3D
- c. **Vernier Scale:** measure the fractional part of one of the smallest divisions of a graduated scale
- d. **Scale of chords:** used to measure angle

## **Sources of errors**

- a) **Natural Errors:** caused by variations in nature
- b) **Instrumental Errors:** imperfection in construction and adjustment of survey instruments
- c) **Personal Errors:** limitation of human senses

### **Cumulative/Systematic:**

- in same direction and tends to accumulate
- can be corrected

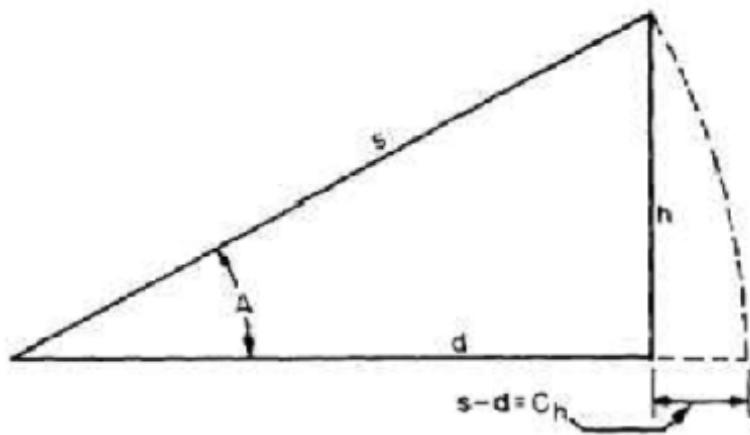
### **Compensating**

- occur in both directions
- cannot be corrected

### **Mistakes/Accidental**

- They are blunders that cannot be rectified

## Effect of slope and slope correction



- always -ve
- $c_h = \frac{h^2}{2s}$ , for less than 5% slope

## Correction for chain and tape measurements

### 1. Correction for absolute length

$$c_a = \frac{Lc}{l}$$

where,

$L$  = Measured length of line

$c$  = correction per tape length

$l$  = designated length of the tape

### 2. Correction for pull or tension

$$C_p = \frac{(P - P_o)L}{AE}$$

### 3. Correction for temperature

$$C_t = \alpha (T_m - T_\alpha) L$$

### 4. Correction for Sag

for same level

$$C_s = \frac{lW^2}{24n^2P^2}$$

where,

$l$  = Total length of tape

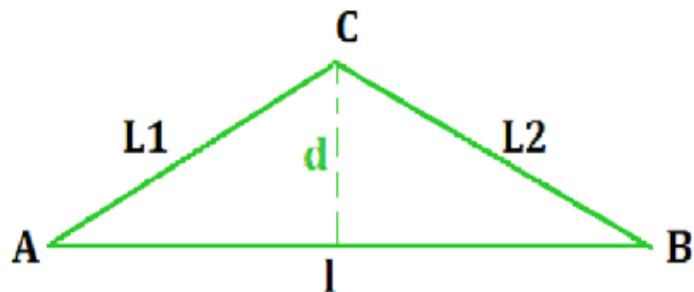
$W$  = total weight of tape

$n$  = Number of equal spans

$P$  = pull applied

5. **Correcton for Slope** (same as effect of slope and slope correction)

6. **Correction for Alignment**



occurs if survey line is not accurately ranged out, always -ve

$$C_h = \frac{d^2}{2L_1} + \frac{d^2}{2L_2}$$

7. **Reduction for sea level**

Horizontal distance should be reduced to distance at sea level, -ve

$$c_{msl} = \frac{Lh}{R}$$

## Abney level and clinometers



A clinometer is a tool that is used to measure the angle of elevation, or angle from the ground, in a right - angled triangle.

Abney level is one of the various forms of clinometers used for the measurement of slopes, taking cross-sections, tracking contours, setting grades and all other rough levelling operations.

- square sighting tube with eye piece in one and cross wire in other end
- mirror is placed at angle  $45^\circ$  to axis of tube
- mirror occupies  $\frac{1}{2}$  width and other is used for sighting

## Compass and plane table surveying

### Compass Survey

- if area is large with undulations
- **true or geographical meridian** is the line in which the plane passing through the given point and the north and south poles intersects the surface of earth
- direction of true meridian is invariable
- true meridians through various stations are not parallel but converge to the poles
- **azimuth, true bearing** = angle between true meridian and line
- **magnetic meridian** is the direction pointed by freely suspended and properly balanced magnetic needle(no local forces)
- **magnetic bearing, simply bearing** = angle with magnetic meridian

- **arbitrary meridian** can be used in small surveys
- difference between azimuth(0-360, clockwise) and bearing(0-90) commonly

**Traverse:** In traverse surveying the direction of survey lines are fixed by angular measurements and not by forming a network of triangles as is done in chain surveying. (**principle**)

A traverse may be (a) Closed or (b) Unclosed.

**Local attraction:** external attractive forces

**Dip:** inclination with horizontal

**Declination:** horizontal angle between magnetic meridian and true meridian

## Bearings

### Designation of bearing

- a) Whole Circle System
- b) Quadrantal System, NE, SE, NW, SW

**Reduced bearing:** Quadrantal bearings

**Fore bearing and back bearing:** bearing of line in direction of progress of survey

$$\text{Back bearing} = \text{fore bearing} \pm 180^\circ$$

## Types of compass

General:

- a) Prismatic Compass(\*)
- b) Surveyor's Compass(\*) -> plain eye slit instead of eye hole

Wikipedia:

- a) Magnetic compass
- b) Non-magnetic compass
  - i. Gyrocompass: finds true north by fast spinning wheel (electrically powered)
  - ii. GPS receivers used as compass

## **Problems and sources of errors of compass survey**

### **Sources of error:**

- i. Instrumental Error
  - The needle of the compass may not be perfectly straight.
  - The pivot point may be eccentric.
  - The ring's graduations may not be uniform.
  - The pivot point is dull.
  - The needle is sluggish due to magnetism.
  - The needle neither moves horizontally nor moves freely on the pivot due to the dip of a needle.
  - The sight vane may not be vertical.
- ii. Errors due to manipulation and sighting
  - Due to inaccurate centering of the compass over the station.
  - Due to inaccurate levelling of compass box when the instrument is set up.
  - Improper bisection of ranging rods at the station.
  - By taking wrong readings through the graduations of the prism.
  - Carelessness in recording the observed readings.
  - Due to any magnetic object nearby.
- iii. Natural Errors
  - Due to magnetic changes in the atmosphere like on a cloudy or stormy day.
  - The magnetic declination may vary.
  - Local attraction that can be due to proximity steel structures, electric lines.

## **Principles and methods of plane tabling**

- both field work and plotting are done simultaneously
- small and medium scale mapping of area of comparatively open area where great accuracy is not required

**Principle of Plane Table Survey:** The law of plane tabling is parallelism, meaning the rays drawn from stations to items on the paper are parallel to the lines in the stations to the objects on the ground.

### **Equipment required:**

- i) Drawing board mounted on tripod
- ii) Alidade: ruler with a form of sighting device
- iii) plumbing fork with plumb bob
- iv) spirit level: for levelling
- v) through compass: for orientation
- vi) drawing sheets

#### **Methods of plane tabling:**

- a) **Radiation:** details are plotted from single set up (small area)
- b) **Intersection:** distant inaccessible points
- c) **Traversing:** radiation + intersection; roads, rivers
- d) **Resection:** setting instrument station based on already plotted station

## **Levelling and contouring**

Levelling is a branch of surveying which deals with the measurement of relative heights of different points on, above or below the surface of the earth.

#### **Important Terms:**

- a) **Level surface:** parallel to mean spheroidal surface
- b) **Level line:** line in level surface
- c) **Horizontal surface:** tangential to level surface
- d) **Vertical surface:** normal to level surface
- e) **Datum surface:** arbitrary from which elevations are measured
- f) **Axis of telescope:** imaginary line from optical center, center of eye piece
- g) **Bench mark:** fixed reference point of known elevation
- h) **Elevation:** vertical distance from R.L.
- i) **Back/Fore sight reading:** reading in staff
- j) **Intermediate sight reading:** unknown point , other readings
- k) **Change Point:** shifting of instrument, Turning Point(T.P.), both reading are taken
- l) **Height of Instrument:**  $H.I. = RL \text{ of BM} + BS \text{ reading}$

## **Principle of levelling**

The principle of levelling is to obtain horizontal line of sight with respect to which vertical distances of the points above or below this line of sight are found.

### **Methods of leveling:**

#### **i. Direct leveling**

- direct measurement
- precise
- most commonly used

##### **a) Simple leveling**

- single set up level
- used if two points are visible

##### **b) Differential leveling**

- no. of set up level
- used if two points are not visible from single position

##### **c) Fly leveling**

- used if work station is too far from BM

##### **d) Profile leveling**

- find elevation along a line or cross section

##### **e) Reciprocal leveling**

##### **f) Precise leveling**

- higher precision (about 1mm in 1km)
- used for fixing BM wrt mean sea level

#### **ii. Indirect or trigonometric leveling**

## **Temporary and permanent adjustment of level**

### **Temporary adjustment:**

It is performed with each setup of instrument.

#### **a. Setting up the level**

- b. Levelling Up the Instrument
- c. Focus the eye piece
- d. Focus the objective

**Permanent adjustments:**

- a. The axis of bubble tube should be perpendicular to the vertical axis
- b. The line of collimation should be parallel to the axis of the bubble tube

**Bench marks**

It is a fixed reference point whose elevation with respect to some datum is known. It is noted that any levelling work is first started from BM.

**Types of Bench Mark:**

1. **GTS benchmark:** established by department of survey, great trigonometrical survey benchmark
2. **Permanent benchmark:** fixed point or mark
3. **Arbitrary benchmark:** for ordinary levelling works
4. **Temporary benchmark:** benchmark for a day, closing for next day

**Booking methods and their reductions**

There are two methods for reducing the levels:

- **The height of the instrument method**

- also called height of collimation
- if number of points need to be surveyed
- no check on reduction of RL of intermediate stations
- generally used for profile levelling
- $\sum BS - \sum FS = Last\ RL - First\ RL$

Station	BS	IS	FS	HI	RL	Remarks

- **The rise and fall method**

- check level difference with higher precision

- complete check of RLS in intermediate points
- Rise: BS>FS
- $\sum \text{BS} - \sum \text{FS} = \sum \text{Rise} - \sum \text{Fall} = \text{Last RL} - \text{First RL}$
- used in differential and other precise levelling

Station	BS	IS	FS	Rise	Fall	RL	Remarks

## Longitudinal and cross sectioning

### Profile levelling:

- results are plotted in the form of profile
- Used in design and construction of roads, curbs, sidewalks, pipelines, etc.
- Profile levelling refers to the process of determining the elevation of points on the ground at mostly uniform intervals along a continuous line.

### Longitudinal Levelling:

- same as benchmark leveling, with one basic difference
- at instrument position, HI is determined by back sight rod reading then additional foresight readings can be taken as required
- in plotting elevation scale is exaggerated(streched) in comparision to horizontal scale

### Cross sectioning levelling:

- cross section refers to relatively short profile view of ground, perpendicular to centerline
- used in estimating earthwork elevations needed to construct roadway
- show existing ground elevations, proposed cut/fill, grade elevation of base road

### Reciprocal leveling:

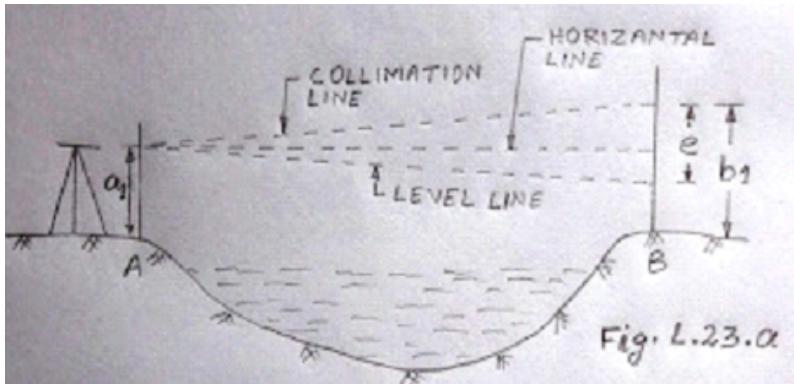


Fig. L.23.a

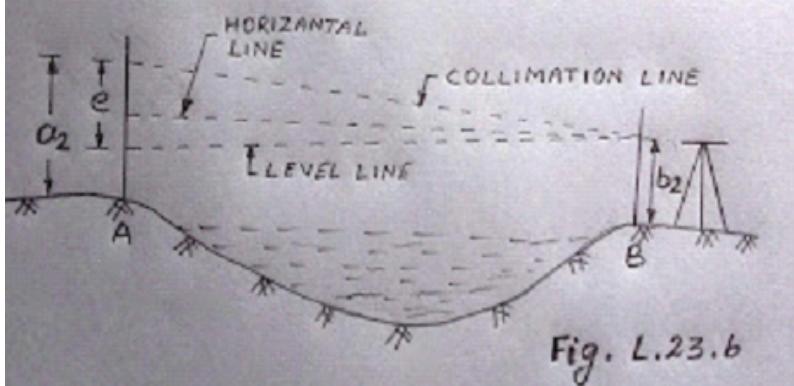


Fig. L.23.b

- Used when it is not possible to set instrument in between two visible points.
- observations are made in both directions to eliminate the effects of atmospheric refraction and curvature of earth
- or points are very far from each other

$$\text{True difference in elevation} = \frac{(b_1 - a_1) + (b_2 - a_2)}{2}$$

### Trigonometric leveling

- process of determining elevation from observed vertical angle and known distance
- vertical angle by theodolite
- distance either measured or computed
- 2 methods: direct(\*), reciprocal

### Contour intervals and characteristics of contours

- contour is imaginary line passing through points of equal elevation

- intersection of level surface with surface of earth
- best way to represent hills, depressions, underwater in 2D paper

### **Contour Interval:**

- the vertical distance between consecutive contours
- depends on:
  - i. Nature of ground
  - ii. Propose and extent of survey
  - iii. scale of map, inverse
  - iv. time and expense of field and office work

### **Characteristics of contours:**

1. All points in a contour line have the same elevation.
2. Flat ground is indicated where the contour are widely separated and the steep ground where they run close together.
3. A uniform slope is indicated when the contour lines are uniformly spaced and a plane surface when they are straight, parallel and equally spaced.
4. A series of closed contour lines on the map represent a hill, if the higher values are inside
5. A series of closed contours on the map indicate a depression, if the higher values are outside
6. Contour lines across ridge or valley lines at right angles. If the higher values are inside the bend or loop in the contour, it indicates a “Ridge”. else “Valley”
7. Contour lines cannot end anywhere but close on themselves elders within or outside the limits of the map.
8. Contour lines cannot merge or cross one another on map except in the case of an overhanging cliff.
9. Contours never run into one another except in the case of a vertical cliff
10. Depression between summits is called a saddle. It represents a dip in a ridge or the junction of two ridges. And in the case of a mountain range, it takes the form of a pass. Line passing through the saddles and summits gives water shed line.

### **Methods of contouring**

1. Direct method

- RL of various point on contour lines are obtained and their positions located
- accurate but tedious and time consuming
- suitable for small area where great accuracy is required

## 2. Indirect method

- random points which are not in contour line
- contour drawn by interpolation
- commonly used, cheaper, quicker and less tedious
- **methods used:**
  - Methods of squares
  - By cross sections
  - Tacheometric method

## Theodolite traversing

**Theodolite:** is an intricate instrument used mainly for accurate measurement of horizontal and vertical angle up to  $10''$  or  $20''$  depending on LC. since it has various uses so called “**Universal Instrument**”

**used on:** horizontal angle, vertical angle, deflection angles, magnetic bearings, horizontal distance, vertical height difference in elevation, ranging of a line

**two types:** **transit**(complete revolution in vertical plane) and **non-transit**.

**centering:** setting exactly over station mark

**transiting:** turning 180 about horizontal axis, causes face change

**face left:** vertical circle on left ;; face right

**swinging the telescope:** turning in horizontal plane

**line of collimation:** line passing through optical center

**temporary adjustment:** centering, levelling, elimination of parallax

**Theodolite Survey:**

In theodolite survey the horizontal angles are measured with the theodolite more precisely than compass and the linear measurements are made with a chain or tape.

## **need to traverse and its significance**

- Traversing is the approach of **control survey** (Control Surveys are used to create long-term, **sustainable reference points** that can be **utilized as the foundation** for and throughout the lifecycle of a project) to **establish control points** (reference points).
- quick and easy way to establish horizontal control especially when the **lines of sight are short owing to heavily built-up areas** and unable to apply **triangulation and trilateration**

## **Purposes(??):**

- Surveys of properties to locate or establish boundaries
- For topographic mapping surveys by using supplementary horizontal control
- Location and construction layout surveys
- Photogrammetric mapping using ground control survey

## **computation of coordinates**

- The latitude of a line is its projection on the north–south.
- Departure =  $L \sin \alpha$ , Latitude =  $L \cos \alpha$

## **adjustment of closed traverse**

- The interior angles of a closed traverse should total:  $(2n \pm 4)(180^\circ)$ , + external, - internal
- $\sum \text{latitude} = 0$ ,  $\sum \text{departure} = 0$
- closing error (c.e.) =  $\sqrt{(\sum L)^2 + (\sum D)^2}$
- permissible angular error allowed:  $\pm LC * \sqrt{N}$
- linear error =  $1/(\text{Perimeter}/\text{c.e.}) = 1/N$

## **closing errors**

1. **Bowditch Rule:** when equal accuracy of linear and angular measurement  
correction to line(lat or dep) = total error(lat or dep) \* length of line/perimeter of traverse
2. **Transit Rule:** when angular is more accurate than linear  
correction to line = total error \* (lat or dep of line )/ arithmetic > sum of (lat or dep)

## **Uses of Total Station and Electronic Distance Measuring Instruments**

### **EDM:**

Electronic distance measurement(EDM) is a method of determining the length between two points using electromagnetic waves.

- based on **generation, propagation, reflection** and **subsequent reception** of electromagnetic waves.
- use infrared, laser or microwaves
- receiver/transmitter in one end, prism on other

### **Total Station:**

- latest developed surveying equipment
- combination of electronic tachometer and EDM instrument
- can observe distance, angles, bearings, elevation coordinate etc
- display on screen automatically

# **Drawing Techniques**

## **Drawing sheet composition and its essential components**

### **1. Drawing board**

- 25mm thick soft wood
- one edge is working edge so should be perfectly straight, for T-Scale, ebony of the board

### **2. T-Square**

- 2 parts: stock and blade
- it should be perfectly straight
- length is selected based on board

### **3. Set-Squares**

- 2 forms are commonly used: 30-60 or 250mm, 45 or 200mm
- used to draw all straight lines except by T-Square
- to draw parallel and perpendicular line
- to create angle of 15, 75, 105, ... by 2 squares
- circle can be divided into 6, 8 and 24 equal parts with set-squares and t-scale

### **4. Drawing Papers**

- should be tough and strong for ordinary pencil drawing
- uniform in thickness and white as possible
- when rubber eraser is used, fibers should not disintegrate
- good quality of paper with smooth surface should be used
- which should be inked (no spread) and preserved for a long time
- thin and cheap quality papers can be used for tracings
- surface area of A<sub>0</sub> is 1m<sup>2</sup>, length half for subsequent
- ratio 1 :  $\sqrt{2}$

## 5- Sheet layout

- a. **Sheet sizes:**  $A_0$  to  $A_5$
- b. **Margin**
- c. **Border Lines:** more space is kept in left side
- d. **Borders and frames:** 20mm for  $A_0, A_1$  and 10mm for others
- e. **Title blocks:** bottom right hand corner, 185mm x 65mm
  - 1. Name of firm
  - 2. Title of drawing
  - 3. Scale
  - 4. Symbol for method of projection
  - 5. Drawing number
  - 6. Initials with date; designed, drawn, checked, standards, approved
  - 7. no. and to number of sheets

## 5. Tracing Paper

- thin transparent paper
- also called drafting vellum and it does not keep its dimensional stability.

## Suitable scales, site plans, preliminary drawings, working drawing,etc

### Scale:

A scale is defined as the ratio of the linear dimensions of the object as represented in a drawing to the actual dimensions of the same.

**scale used to prepare drawing at:** Full size, reduced size, enlarged scale

### Types of scale:

1. **Engineers scale:** relation expressed numerically, 10mm=5m
2. **Graphical Scale:** scale drawn on drawing itself

### Types:

- **Plain Scale:** line is divided into suitable equal no of parts
- **Diagonal Scale:** diagonal scale can be used to measure upto second decimal

- **Vernier Scale:** similar to diagonal scale can be used up to second decimal
  - **Comparative Scale**
3. **Representative Factor(R.F.):** length in drawing / actual length

#### **Site plans:**

A site plan is a large scale drawing that shows the full extent of the site for an existing or proposed development. usually scale 1:500 or 1:200.

#### **Types of Construction Drawings:**

1. **Preliminary drawings:**
  - essential schematic design/concept-development drawings at the initial stages of a project
  - convenient and practical basis for communication between the designer and the owner in the idea formulation stage
  - these drawings go through many alterations
  - reflects the client's needs, as well as functional studies, materials to be used, preliminary cost estimates and budget, preliminary construction approvals, etc.
2. **Presentation drawings:**
  - presentation drawings is to present the proposed building or facility in an attractive setting at the proposed site for promotional purposes
  - They usually consist of perspective views complete with colors and shading(also contain nicely drawn elevation views with shadows and landscaping)
  - essentially selling tools, before it reaches the working-drawing stage
3. **Working drawings:**
  - Also called **project and constructions drawings**
  - all the drawings required by the various trades to complete a project
  - **technical** and are intended to furnish all the necessary information required by a contractor to erect a structure
  - time and effort expended on them comprises a major portion of the consultant's design services
4. **Shop/assembly drawing:**
  - show how their product is to be made

- Those drawing should contain all the necessary information the size, shape, material, and provisions for connections and attachments for each member, including details, schedules, diagrams, and other related data to illustrate a material, product, or system for some portion of the work prepared by the construction contractor, subcontractor, manufacture, distributor, or supplier

#### **5. Specialized and Miscellaneous drawings:**

- numerous other types of drawings used by architects and engineers
- Freehand sketches are drawings made without the aid of any type of drawing instruments

## **Theory of projection drawing**

In engineering, 3-dimensional objects and structures are represented graphically on a 2-dimensional media. The act of obtaining the image of an object is termed “projection”. The image obtained by projection is known as a “view”.

### **Principle of projection:**

If straight lines are drawn from various points on the contour of an object to meet a plane the object is said to be projected on that plane. The figure formed by joining in correct sequence the points at which these lines meet the plane is called a projection of that object. The lines from the object to the plane are called projector and the plane on which the projectors meet is known as the plane of projection.

### **Methods of projection:**

- 1) Orthographic projection
- 2) Isometric projection
- 3) Oblique projection
- 4) Perspective projection

**pictorial projection:** projection in which the description of the object is completely understood in one view.

## **Perspective**

- It is an approximate representation of the object as it would be seen by the eye with respect to depth perception
- Of the four methods, perspective projection is not based on parallel lines
- The projection lines emerge from a single point, showing the closer part larger than the more distant part

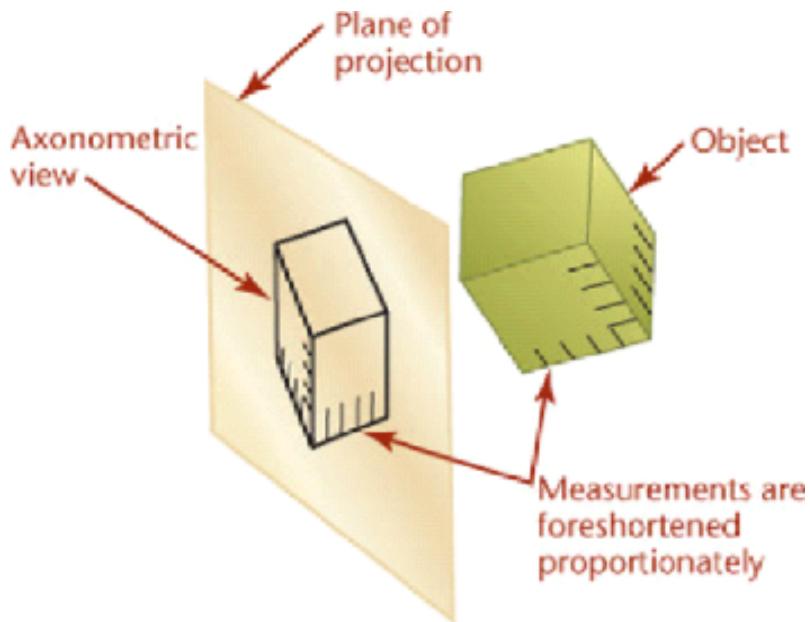
- The object can feel more realistic with this projection

## Orthographic

Orthographic projection shows a 3D object in two dimensions so that you can see three views: the front view, side view, and top view

- projectors are parallel to each other
- it is not a realistic view of the object, because it requires multiple views to get all of the information in order to “see” the design
- more accurate measurements can be obtained because all views have the same scale
- can also include a section view.

## Axonometric projection



- another type of orthographic projection
- only one image is drawn on the paper's plane

According to the foreshortening situation of the edges, there are three types of axonometric projection.

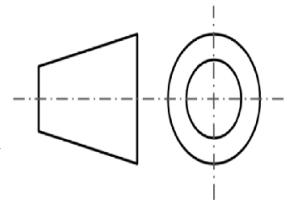
- **Isometric projection:** In a three-axis direction, the amount of the foreshortening is equal. (most common)

- **Dimetric projection:** In this projection, two axes are foreshortened in the same amount and the third axis is foreshortened in different amount.
- **Trimetric projection:** Foreshortenings in three directions are different.

## First and third angle projection

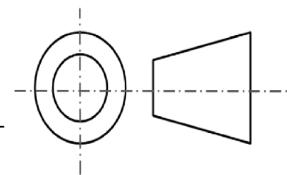
### First Angle Projection:

- the object is placed in the 1st quadrant
- object is positioned at the front of a vertical plane and top of the horizontal plane
- widely used in India and European countries
- object is placed between the observer and projection planes
- plane of projection is taken solid in 1st angle projection



### Third Angle Projection:

- the object is placed in the third quadrant
- The object is placed behind the vertical planes and bottom of the horizontal plane.
- widely used in the United States and Australia
- projection planes come between the object and observer
- plane of projection is taken as transparent in 3rd angle projection



## Drafting tools and equipments

1. Drawing board
2. **T-square**
3. **Ruler**
4. **Scale ruler**
5. **Set square and triangles**
6. **Protractor**

7. **Compass**
8. **Scales:** to reproduce drawing in different size
9. **Template**
10. **French curve**
11. **Pencils**
12. **Drafting machine/Drafter**
13. **Eraser**
14. **Sharpner**
15. **Drafting paper**
16. **Tracing paper**
17. **Drafting tape**
18. **Computer aided design**

## **Drafting conventions and symbols**

The representation of any matter by same sign or mark on the drawing is known as convention.

### **Line weight and line types:**

Line weights and line types help to create an easy understanding of the document and add visual interest to the document.

#### **Line weight:**

- It is the light or darkness and width of the line.
- There are 3 line weights: light , medium & dark

#### **Border Lines** (2B to 4B or 7mm to 9mm pencil/mechanical pen)

- Create margins on sheet or create lines around the title block
- Dark and about twice as thick as bold lines

#### **Guidelines & Construction Lines** (4H to 6H pencil or 3mm mechanical pencil)

- Temporary and used to layout the page and to create the initial

#### **Bold Lines** (soft B to 2B pencil or 5mm or 7mm mechanical pen)

- Primary objects / dark and have a thick width
- Walls in plan + outline around the perimeter of the elevation + 3D objects

### **Medium Lines** (HB pencil or 5mm mechanical pen)

- Secondary objects such as doors, furnishings, counters and cabinets
- Elevation +3D + information inside objects

### **Light Lines** (H to 2H pencil or 3mm to 5mm mechanical pen)

- Action lines → Door swing in plan, hinge direction in elevation, etc.
- Information lines → Dimension lines, center lines, leader lines, section lines
- Fill patterns → Material information

#### **Line Types:**

##### **SOLID LINE:**

Visible objects in plan, elevation and 3D views / leader and dimension lines

##### **Dashed Line:**

Hidden objects or edges – hidden part of the objects + objects below or behind another object + shelving or cabinet above counter

##### **Movement, Ghost & Phantom Line:**

Alternate position of an object that can be moved (swing door, space needed for drawer and cabinet, door openings, sliding door opening direction, hinge points for the doors and Windows in elevation)

##### **Leader Line:**

Connect notes or references to objects / starts as solid line and ends in arrow

##### **Break Line:**

When the extents of a drawing cannot fit on the paper / when you only need to Show a portion of a design

##### **Center Line:**

Center of a plan, object, circle, arc or any symmetrical object

##### **Section Line:**

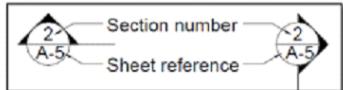
To show cutaway of a floor plan / direction of the arrows show line direction of the section view

##### **Dimension Lines:**

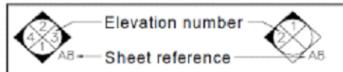


Measurement of objects – length, width and diameter

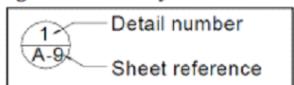
## Symbols:



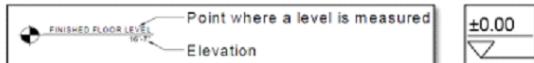
**Fig.1.1.Section Symbol**



**Fig.1.2.Elevation Symbol**



**Fig.1.3.Detailing Symbol**



**Fig.1.4.Levelling Indicator in Plan & Section-Elevation**



**Fig.1.5.Window & Door Symbol in Plan**

## Lettering:

- All letterings should be in capital
- Important properties of the letterings:
  - Height – Letters should be between 2 horizon lines and there should be a line space in between.
  - Style
  - Spacing between letters

## Hatch:

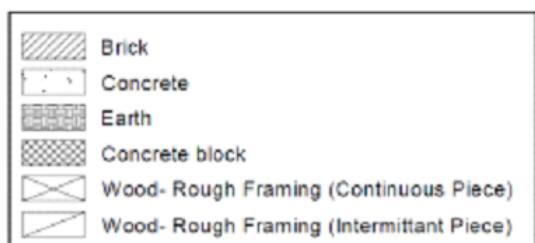


Fig: Common Used Material Symbols in Section/Plan:

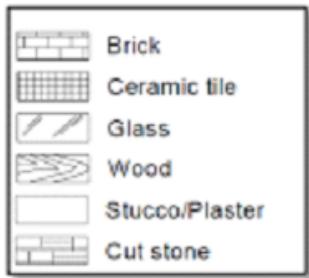
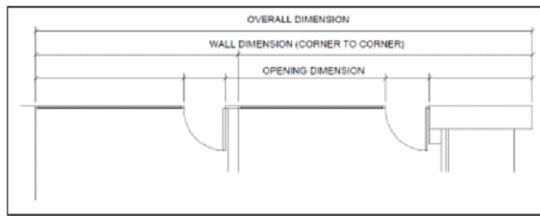


Fig: Common Used Material Symbols in Elevation



## Topographic, electrical, plumbing and structural drawings

### Topographic drawing:

- Topographical plans and maps are drawings that indicate the main physical and geographical features of a particular area
- tell you all you need to know about the buildings, fences, roads, rivers, lakes, forests and more

### Electrical drawing:

- Electrical drawings, sometimes referred to as wiring diagrams, are a type of technical drawing that provide visual representation describing electrical systems or circuits
- used to explain the design to electricians or other workers who will use them to help install or repair electrical systems.

### Plumbing drawings:

- A plumbing drawing is a type of technical drawing that provides visual representation and information relating to a plumbing system
- convey the engineering design to plumbers or other workers who will use them to help install the plumbing system

### Structural drawings:

- A structural drawing, a type of engineering drawing, is a plan or set of plans and details for how a building or other structure will be built.
- prepared by registered professional engineers, and based on information provided by architectural drawings
- primarily concerned with the load-carrying members of a structure
- size and types of materials to be used, as well as the general demands for connections
- do not address architectural details

## **Techniques of free hand drawings**

- Free Hand Sketching is used to transfer the idea of an engineer's abstract world to the real world in 2D and 3D.
- It is used for daily communication in the engineering world ..
- as drawing is the international language of engineering
- also used to quickly present an idea in a graphical form to non-technical peoples

### **Sketching of Straight Lines:**

- i. **Sketching vertical lines:** sketched downward with motion of fingers
- ii. **Sketching horizontal lines:** with motion of wrist and fore arm, left to right
- iii. **Large circle:** using radial lines or plotting points at fixed distance and joining them
- iv. **Small circle:** with square
- v. **Arcs of small radii:** by constructing squares

# Structure Analysis and Design

## Stress and strains

**Stress:**

**Normal, Tensile and compressive stresses**

Stress is the force applied to a material, divided by the material's cross-sectional area. Tension or compression in a member generate normal stresses; they are called "normal" because the cross-section that resists the load is perpendicular (normal) to the direction of the applied forces.

$$\sigma = \frac{F}{A_0}$$

where,  $\sigma$  = stress ( $\text{N}/\text{m}^2$ , Pa)

F = force (N)

$A_0$  = original cross-sectional area ( $\text{m}^2$ )

### Shear Stress

In shear the cross-section area that resists the load is parallel with the direction of applied forces.

### Strain

**Normal strain**

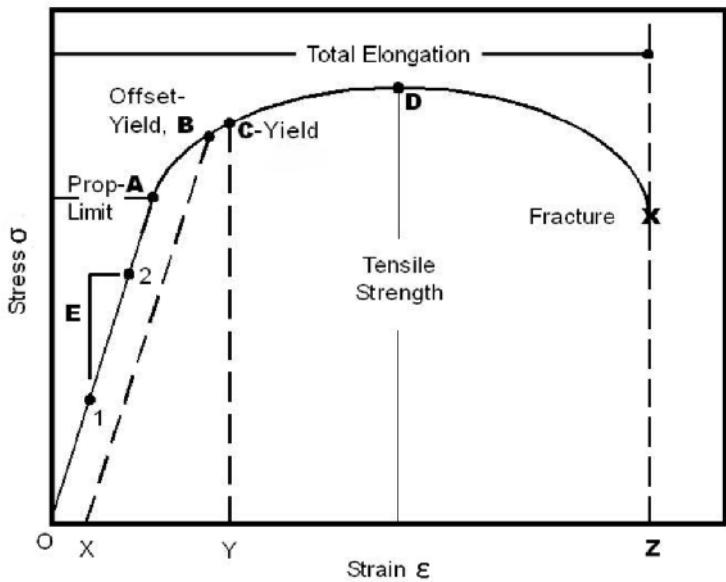
Strain is the deformation or displacement of material that results from an applied stress.

$$\epsilon = \frac{L - L_0}{L_0}$$

where,  $\epsilon$  = strain

L = length after load is applied (mm)

$L_0$  = original length (mm)



Note: A material's change in length ( $L - L_0$ ) is sometimes represented as  $\delta$ .

### Modulus of elasticity

The most common way to analyze the relationship between stress and strain for a particular material is with a stress-strain diagram.

Many materials exhibit a proportional relationship between stress and strain up to certain point, referred to as the proportional limit, shown here as point "A." This stress-strain relationship is known as Hooke's Law, and in this region. The slope of the stress-strain curve is referred to as the modulus of elasticity (aka Young's modulus), denoted E.

$$E = \frac{\sigma}{\epsilon}$$

### Design stress and safety factors

Design stress,  $\sigma_d$ , is the maximum level of actual/working stress that is considered acceptable from a safety point of view. The design stress is determined by:

- Material properties, Ultimate Tensile Strength or Yield Strength, depending if breakage must be avoided or deformation must be limited
- Safety factor (or design factor) N, ratio of maximum strength to the intended load.

The safety factor is chosen by the designer based on experience, judgment AND guidelines/rules from relevant codes and standards, based on several criteria such as risk of injuries, design data accuracy, probability, industry standards, and last but not least, cost.

### Members made from two different materials:

$P = \text{Stress}_{\text{steel}} \times \text{Area}_{\text{steel}} + \text{Stress}_{\text{concrete}} \times \text{Area}_{\text{concrete}}$

$\text{Strain}_{\text{steel}} = \text{Strain}_{\text{concrete}}$

### Stress in bar due to its own weight

Total elongation of bar =  $wl^2/2E$

For conical bar =  $wl^2/6E$

### Poisson's ratio

Poisson's ratio is the ratio of transverse contraction strain to longitudinal extension strain in the direction of stretching force. Tensile deformation is considered positive and compressive deformation is considered negative. It is usually represented as a lower case Greek nu,  $\nu$ .

$$\nu (\mu \text{ or } 1/m) = -\epsilon_{\text{trans}}/\epsilon_{\text{longitudinal}}$$

### Poisson's ratio: relation to elastic moduli in isotropic solids

Poisson's ratio is related to elastic moduli K (also called B), the bulk modulus; G as the shear modulus; and E, Young's modulus, by the following (for isotropic solids, those for which properties are independent of direction). The elastic moduli are measures of stiffness. They are ratios of stress to strain.

$$\nu = (3K - 2G)/(6K + 2G)$$

$$E = 2G(1 + \nu)$$

$$E = 3K(1 - 2\nu)$$

### Principal Stresses and Principal Planes

The maximum stress is called the Principal stress and the plane at which the maximum stress induced is called the Principal plane and the shear stress will be zero on the principal planes.

## Theory of torsion and flexure

### Theory of Torsion

Torsion equation or torsion constant is defined as the geometrical property of a bar's cross-section that is involved in the axis of the bar that has a relationship between the angle of twist and applied torque whose SI unit is  $\text{m}^4$ . The torsion equation is given as follows:

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$$

### Theory of Bending

Bending moment for beam for simple bending.

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

### **Neutral axis:**

Neutral axis for the beam subjected to bending is a line passing through the cross-section at which the fibres of the beam does not experience any longitudinal stress (compressive or tensile).

### **Deflection of Beams**

The general equation for the deflection of beams is given below :

$$M = EI \frac{d^2y}{dx^2}$$

### **Moment of inertia**

- It is a measure of an object's resistance to changes to its rotation
- Also defined as the capacity of a cross-section to resist bending
- It must be specified with respect to a chosen axis of rotation
- It is usually quantified in  $\text{m}^4$  or  $\text{kgm}^2$

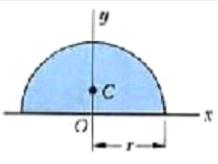
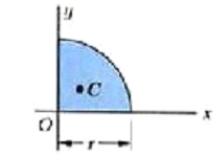
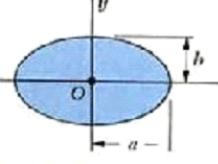
**Perpendicular Axis Theorem:**  $I_z = I_x + I_y$

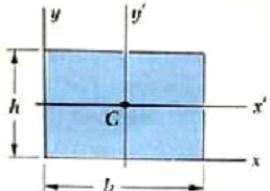
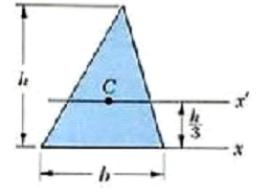
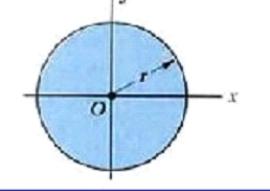
**Parallel Axis Theorem:**  $I_{xx} = I_g + Ad^2$

## Area Moment of Inertia of Common Shapes:

Lecture 10

The following ( MoI ) is for common & standard shapes that can be used to determine the ( MoI ) for composite area:

	$I_x = I_y = \frac{1}{8} \pi \cdot r^4$ $J_o = \frac{1}{4} \pi \cdot r^4$
	$I_x = I_y = \frac{1}{16} \pi \cdot r^4$ $J_o = \frac{1}{8} \pi \cdot r^4$
	$I_x = \frac{1}{4} \pi \cdot ab^3$ $I_y = \frac{1}{4} \pi \cdot a^3 b$ $J_o = \frac{1}{4} \pi \cdot ab (a^2 + b^2)$

	$\bar{I}_{x'} = \frac{1}{12}bh^3$ $\bar{I}_p = \frac{1}{12}b^3h$ $I_x = \frac{1}{3}bh^3$ $I_y = \frac{1}{3}b^3h$ $J_C = \frac{1}{12}bh(b^2 + h^2)$
	$\bar{I}_{x'} = \frac{1}{38}bh^3$ $I_x = \frac{1}{12}bh^3$
	$I_x = I_y = \frac{1}{4}\pi r^4$ $J_o = \frac{1}{2}\pi r^4$

8

## Analysis of beams and frames

Analysing the determinate Beam using Cut Sections.

### Bending moment

$$\curvearrowright MA = 0$$

### Shear force

$$\uparrow F_y = 0$$

### Graphical Integration

$$\frac{dV(x)}{dx} = w(x)$$

$$V(B) - V(A) = \int_A^B w(x) dx$$

$$\frac{dM(x)}{dx} = V(x)$$

$$M(B) - M(A) = \int_A^B V(x) dx$$

## Deflection of beams and frames

### Determinate structure

#### Energy methods Virtual Work:

- Work done by a real force due to virtual displacement is equal to work done by virtual force due to real displacement
- Based on Bernoulli's principle

#### Moment Area Theorem:

**Theorem I:** Change in slope between two point under flexure is equal to area of  $M/EI$  diagram between these two points.

**Theorem II:** Deflection at a point is given by moment of  $M/EI$  diagram about the point where deflection is required.

#### Conjugate Beam Method:

- Can be derived from moment area method
- **Theorem I:** Rotation about a point is equal to shear force in the conjugate beam.
- **Theorem II:** Deflection at a point is equal to BM in the conjugate beam.

**Betti Law:** In a linear elastic structure, work done by first loading due to displacement caused by second loading is equal to work done by second loading due to displacement caused by first loading.

**Maxwell Theorem or Reciprocal Theorem:** Displacement at a point A due to load applied at point B is same as displacement at point B due to same load applied at point A displacement being measured in direction of load.

- Unit load and Castiglano theorem can be used to find the deflection of single joint at a time

- Angle weight or joint displacement method can be used to find deflection of all displacements at a time
- Williot Mohr method is graphical method for finding the displacement of all joints at a time

### **Three hinged systems**

- Arches can be treated as curved beam whose ends are restrained against horizontal movement

#### **Geometric parameters of circular arch:**

$$\text{Radius}(R) = \frac{l^2}{8h} + \frac{h}{2}$$

$$x = l/2 - R\sin\theta$$

$$y = h - R(1 - \cos\theta)$$

#### **Geometric parameters of parabolic arch:**

$$y = \frac{4hx}{l^2}(l - x)$$

$$\text{Horizontal thrust for parabolic arch subjected to udl: } H = \frac{wl^2}{8h}$$

$$\text{Horizontal thrust for circular arch subjected to udl: } H = \frac{4wR}{3\pi}$$

$$\text{Horizontal thrust for circular arch subjected to uniformly vary load: } H = \frac{2wR}{3\pi}$$

### **Indeterminate structures**

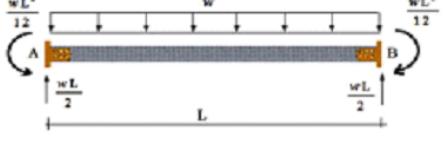
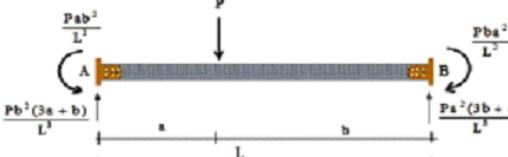
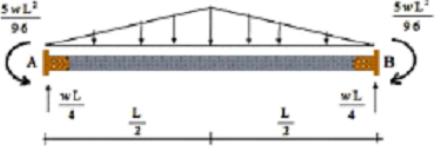
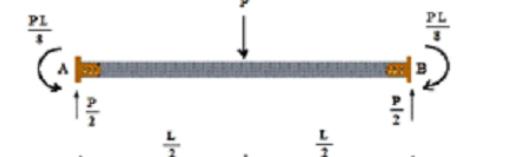
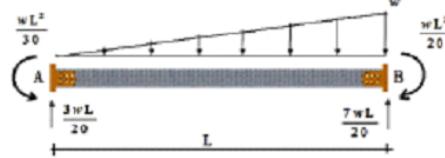
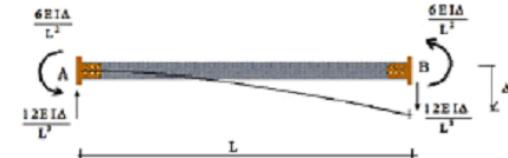
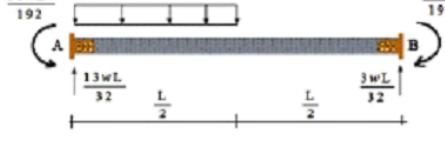
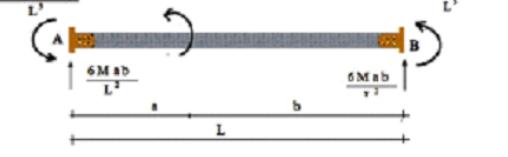
#### **Slope deflection**

- Suitable for continuous beam and rigid jointed frame

#### **Assumptions**

- All joints are rigid
- Axial deformation are neglected
- Shear deflection are neglected

**Table 9.1** Fixed end actions for fully fixed

### Moment distribution method

- Solution for slope deflection equation
- Iterative distribution procedure
- Iteration may be stopped when carryover moments are negligible

**Carryover moment:** When moment is applied at one end of member allowing rotation of that end and fixing the other end, some moment develops at other ends also called carryover moment. Carryover factor = Carryover moment / Applied moment

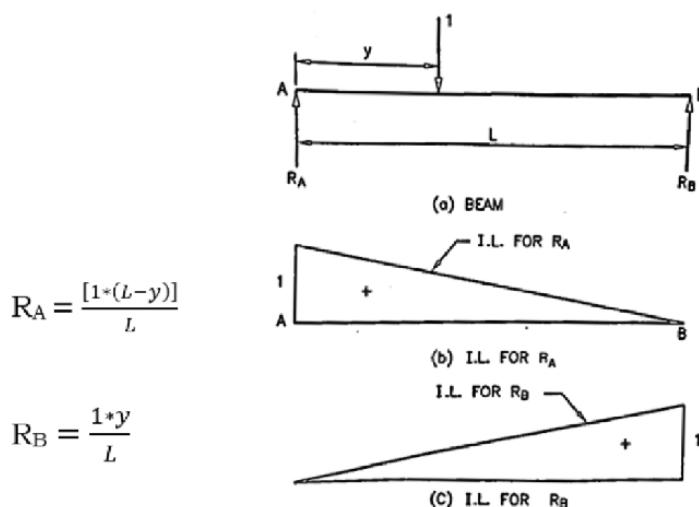
**Stiffness:** Moment required to rotate one end by unit rotation

$$k = M/\theta = 4EI/l$$

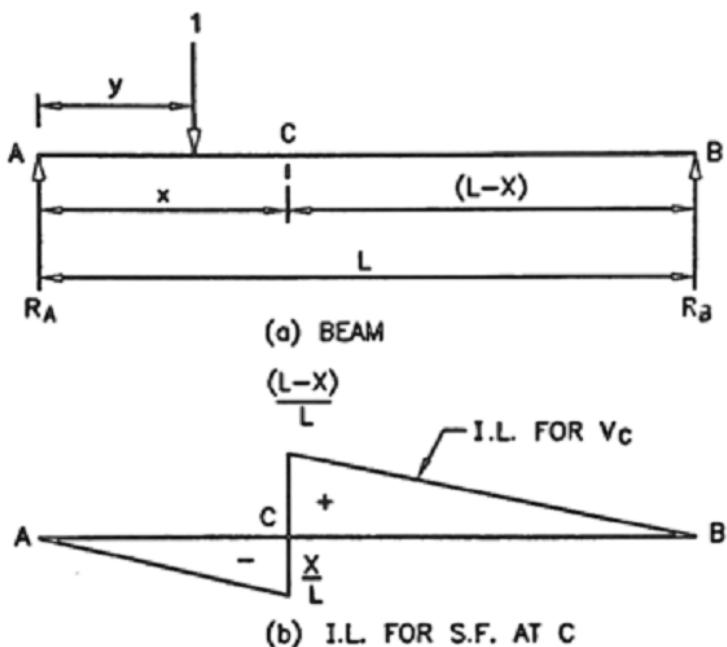
**Distribution factor:** The ratio of moment shared by member to applied moment =  $k_i / \sum k_i$

**Use of influence line diagrams for simple beams** It's a diagram which shows the reactions, Shear force and Bending moment at each and every section or instant at any distance of any span that you want to find out.

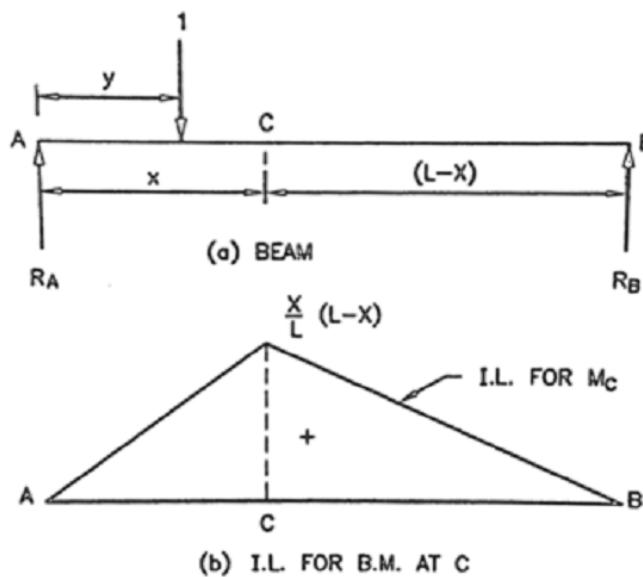
#### I.L.D. for Reactions:



#### I.L.D. for Shear Force:



#### I.L.D. for Bending Moment:



**Unit load method** The principle of virtual force leads to unit load method.

## Reinforced concrete structures

### Difference between working stress and limit state philosophy

Working stress method	Limit state method
Stress strain behavior is linear	Stress strain behavior is non-linear
Stress based design	Strain based design
Elastic design	Plastic design
Plane before bending remains plane after bending	Plane normal to axis remains plane after bending
Safety factor	Partial safety factor
Uneconomical design	Economical design
Material strengths are not fully utilized	Material strength fully utilized
Uneconomical design	

### Analysis of RC beams and slabs in bending, shear, deflection, bond and end anchorage

#### Bending

To calculate area of reinforcement:  $M_u = 0.87 \sigma_y A_{st} (d - \frac{\sigma_y A_{st}}{f_{ck} b})$

For doubly reinforced section, check with  $M_{lim}$ ,

### **Shear**

$$\tau_v = V_u / bd < K_s \tau_c$$

Shear reinforcement is avoided in slab so if  $\tau_v > \tau_c$ , the slab thickness is increased and redesigned

### **Deflection**

$$l/d \leq \text{Basic value} * F1 * F2 * F3$$

### **End anchorage**

$$L_d = \frac{\sigma_s \phi}{4\tau_{bd}}$$

## **Design of axially loaded columns**

### **Considerations:**

- minimum diameter of bar – 12mm
  - minimum no. of bar – 4(rectangular), 6(circular), 8(octagonal)
  - minimum % of steel – 0.8%
  - maximum % of steel – 6%
  - spacing should not be greater than 300mm(longitudinal)
  - if cross section is larger than to support load % of steel is based on area of concrete to resist direct stress
  - helical reinforcement, 6 bars of longitudinal reinforcement
  - minimum diameter of bar – 50 mm (special case over 38mm)
  - unsupported length between end restraints shall not exceed 60x lateral dimension
- a) Effective length:  $l_{eff} = k * l$
- b) Determine column size: assume 1% steel

$$P_u = 0.4 f_{ck} A_c + 0.67 f_y A_{se}$$

- c) Check for slenderness ratio

Short column:  $3 < l/b < 12$  and  $10 < l/r_{min} < 40$

Long column:  $l/b > 12$  and  $l/r_{min} > 40$

- d) Determine eccentricity

$e_{min} = 1/500 + b/30$ , if  $b < 0.05D$  axially loaded

- e) Determine longitudinal reinforcement:  $A_{sc} = 1/100 * A_g$
- f) Design lateral ties
  1. Diameter of ties:  $\geq 6mm, \varphi_{max}/4$
  2. Pitch of ties
    - a. not greater than least lateral dimension of column
    - b. not greater than  $16\varphi$
    - c. 300mm

### Uniaxial moment

- a) Check slenderness ratio
- b) Determine eccentricity
- c)  $e = M/P, 1/500 + b/30$ ; if  $e > e_{min}$  &  $e_{min} > 0.05D$  uniaxial moment
- d) Determine area of reinforcement with chart
- e) Design lateral ties

### Biaxial moment

$$1. M_u = 1.15 * \sqrt{M_{ux}^2 + M_{uy}^2}$$

Find P and area of bars for it

2. Calculate actual P, determine  $M_{ux1}$
3. Calculate  $M_{uy1}$
4. Determine  $P_{uz}$
5. Find corresponding  $\alpha_n$
6. Check integration formula  $(M_{ux}/M_{ux1})^{\alpha n} + (M_{uy}/M_{uy1})^{\alpha n} \leq 1$
7. if not satisfied increase p and try again
8. design lateral ties

### Isolated and combined footings

#### Isolated footing

1. Size of footing, 10% of p as self-weight i.e. load on soil =  $1.1P$
2.  $q_u = P_u/A = 1.5P/A$

3. Determine minimum depth

a. Bending movement

$$M_u = B * q_u * (B-b)/2 * 1/2 * (B-b)/2,$$

$$M_{u,lim} = 0.138 * f_{ck} * B * d^2$$

b. one way shear

$$V_u = q_u * B * ((B-b)/2 - d)$$

$$\tau_u = V_u / Bd$$

The value of  $\tau_u$  should not be more than critical shear stress in concrete

c. two way shear

$$S = q_u * \{B^2 - (b+d)^2\}$$

$$A = 4*(b+d)*d$$

$$\text{punching shear, } \tau_p = S/A$$

$$\text{permissible value, } \tau_{per} = 0.25 * \sqrt{f_{ck}}$$

4. determine soil reaction and spacing of bars,  $M_u$  &  $S$

5. Check for development length

$$L_d = 0.87 * f_y * \varphi / 4 \tau_{bd}$$

sufficient bond length must be available from face of column

### **Combined footing**

The footing provided for two or more columns in a single row is called combined footing. The shape of footing should be such that line of action of two columns load should pass through centroid of the foundation path. It is provided on following cases:

1. Width of footing is restricted
  2. when columns are close to one another so the footings overlap
  3. When bearing capacity of soil is less
  4. When end column is near property line The combined footing may be rectangular, trapezoidal or Tee-shaped in plan.
- The geometric proportions and shape are so fixed that the centeroid of the footing area coincides with the resultant of the column loads. This results in uniform pressure below the entire area of footing.
  - Trapezoidal footing is provided when one column load is much more than the other. As a result, the both projections of footing beyond the faces of the columns will be restricted.

- Rectangular footing is provided when one of the projections of the footing is restricted or the width of the footing is restricted.

### **Design steps:**

- Locate the point of application of the column loads on the footing.
- Proportion the footing such that the resultant of loads passes through the center of footing
- Compute the area of footing such that the allowable soil pressure is not exceeded.
- Calculate the shear forces and bending moments at the salient points and hence draw SFD and BMD
- Fix the depth of footing from the maximum bending moment
- Calculate the transverse bending moment and design the transverse section for depth and reinforcement.
- Check for anchorage and shear.
- Check the footing for longitudinal shear and hence design the longitudinal steel.
- Design the reinforcement for the longitudinal moment and place them in the appropriate positions.
- Check the development length for longitudinal steel
- Curtail the longitudinal bars for economy
- Draw and detail the reinforcement
- Prepare the bar bending schedule

### **Introduction to pre-stressed concrete**

Prestressed concrete is a structural material that allows for predetermined, engineering stresses to be placed in members to counteract the stresses that occur when they are subject to loading. It combines the high strength compressive properties of concrete with the high tensile strength of steel. Steel an timber structures.

It is now commonly used for floor beams, piles and railways sleepers, as well as structures such as bridges, water tanks, roofs and runways. Generally, prestressed concrete is not necessary for columns and walls, however, it can be used economically for tall columns and high retaining walls with high bending stresses.

### **Method**

1. Pre-tensioning
2. Post-tensioning

## **Advantages**

- The inherent compressive strength of concrete is used to its fullest.
- The special alloy steels used to form the prestressing tendons are used to their fullest.
- Tension cracks are eliminated, reducing the risk of the steel components corroding.
- Shear stresses are reduced.
- For any given span and loading condition a reduction in weight can be achieved from using a component with a smaller cross section.
- A composite member can be formed by joining individual precast concrete units together.

## **Disadvantages**

- A high degree of workmanship and control is required.
- Special alloy steels are more expensive than traditional steels used in reinforced concrete.
- Expensive equipment is needed and there are complex safety requirements.

## **Steel and timber structures**

### **Steel structures**

Steel Structures are the structures made up of steel components connected together to sustain and share the applied loads with adequate safety and serviceability and are considered as the better alternatives in comparison to other structures like concrete and timber structure for the place where the structure is supposed to function for greater magnitudes of loads and other engineering materials are scarce.

The advantages of Steel over other materials for construction are:

1. It has high strength per unit mass. Hence even for large structures, the size of steel structural elements is small, saving space in construction and improving aesthetic view.
2. It has assured quality and high durability.
3. Since standard sections of steel are available which can be fabricated in site, there is a lot of saving in construction time.
4. Steel structures can be strengthened at any later time, if necessary. It needs just welding additional sections.
5. By using bolted connections, steel structures can be easily dismantled and transported to other sites quickly.

6. Material is reusable.

Some of the disadvantages of Steel Structures are:

1. It is susceptible to corrosion.
2. Maintenance cost is high.
3. Steel members are costly.

### **Standard and built-up sections**

The steel sections manufactured in rolling mills and used as structural members are known as rolled structural steel sections.

The steel sections which are manufactured in factories is called standard section. Some standard steel sections are as follows:

1. Sheets( $t < 5\text{mm}$ )
2. Plates( $t \geq 5\text{mm}$ )
3. Angles
4. Channels
5. T-sections
6. I-Sections
7. Steel tubes
8. Square bars

Build up section are used when

- strength of build-up section is limited and is not suitable to carry heavy load
- it may be I, C or Z section as per requirement
- rolled section may not meet requirement of actual structural loading
- adding depth to sections

Build up section can be made by bolting or welding.

## Design of riveted, bolted and welded connections

Edge distance

### 1) Single shear failure of rivet,

$$F_s = \frac{\pi}{4} d^2 * \Gamma v f$$

### 2) Double shear failure of rivet,

$$F_{ss} = 2 * \frac{\pi}{4} d^2 * \Gamma v f$$

### 3) Bearing failure of rivet,

$$F_b = d * t_{min} * \sigma_{pf}$$

### 4) Tension (tearing) of plate,

$$F_t = (p-d) t_{min} * \sigma_{tp}$$

A metal pin for passing through holes in two or more plates or pieces to hold them together, usually made with head at one end, the other end being hammered into a head after insertion.

$$P_{min} = 2.5 \varphi$$

$P_{max} = 12 t_{min}$  or 200mm, for compression member

16  $t_{min}$  or 200mm, for tension member

32  $t_{min}$  or 300mm, for both

100mm+4t or 200 which is less

Strength of rivet =  $F_s$ ,  $F_b$ , and  $F_t$  which is less

Strength of solid plate =  $p * t * \alpha$

Diameter of rivet =  $6 \sqrt{t}$

Efficiency of joint = strength of rivet / strength of plate \* 100

## Design of bolt

### Types of Joints in Bolted Connections:

1. Lap joint
2. Butt joint

Most Preferred Joint in Bolted connection: double cover butt joint

- The shear capacity of the bolt is more than in a lap joint
- No eccentricity is present in the connection

1. Bearing Capacity of the Bolt:

$$V_{dpb} = V_{npb}/\gamma_{mb}$$

$V_{npb}$  = Nominal Bearing Strength of the Bolt =  $2.5 * K_b * d * t * f_u$ ;

$K_b$  - smaller of the following values:

$$e/(3 * d_o),$$

$$(p/(3 * d_o)) - 0.25,$$

$$f_{ub}/f_u, \text{ and,}$$

$$1$$

2. Shear Capacity of the Bolt:

$$V_{dsb} = V_{nsb}/\gamma_{mb},$$

$V_{nsb}$  = Nominal Shear Capacity of the Bolt =  $(f_{ub}/\sqrt{3}) * ((n_n * A_{nb}) + (n_s * A_{sb}))$ ;

$$A_{nb} = 0.78 * (\pi * d^2)/4;$$

**Design of weld**

**Types of weld:**

1. Butt weld
  2. Fillet weld
  3. Slot weld
  4. Plug weld
  5. Flash weld
- Effective length of weld:  $l - 2s$
  - Strength of weld =  $A_{eff} * \text{permissible shear strength}$   
 $= l * t * \text{shear}$

$$l = s * \sqrt{2}$$

- Minimum size of weld

3mm for  $<= 10\text{mm}$

5mm for 10-20

6mm for 20-32

8mm for  $>= 32$

- Maximum size of weld,  $S_{max}$

1. for rolled edge,  $\frac{3}{4} * t$
2. for straight edge,  $t - 1.5$ 
  - Minimum effective length of weld: 4S or 40mm
  - Maximum clear pitch for intermittent fillet weld:
    - for compression, 12t or 200mm
    - for tension, 16t or 200mm

## **Design of simple elements such as ties, struts, axially loaded and eccentric columns, column bases**

### **Design of ties**

A tension member used in roof truss is called tie.

1. Calculate the effective area required,  $A_{NR} = \text{Tensile force}/\sigma/0.6f_y$
2. Calculate gross area required,
  - a. for single angle connected by one rivet:  $A_R = 1.4 A_{NR}$
  - b. for double angle connected by one rivet:  $A_R = 1.2 A_{NR}$
  - c. for single angle connected by weld:  $A_R = 1.15 A_{NR}$
  - d. for double angle connected by one rivet:  $A_R = A_{NR}$
3. Select the angle section to satisfy the slenderness ratio,  $A \geq A_{NR}, l_{eff}/r_{min} < 400$  or 350
4. Calculate net effective area
5. Calculate axial tensile stress induced
6. Calculate strength of rivet or length of weld to connect members

### **Design of struts**

Horizontal or inclined members used in truss are called strut.

Hollow cylindrical is most economical section to resist compressive force

- a. Slenderness ratio:
  1.  $\leq 180$  for DL+LL
  2.  $\geq 250$  for DL + LL + wind & seismic without reversal
  3.  $\geq 350$  for DL + LL + compressive force due to reversal
- b. Increase in permissible stress

1. 33.33% for structural steel
2. 25% for rivet, weld & bolt (for column base)

### **Design of column**

- a. Axially loaded column:
  1. Assume slenderness ratio based on column length
  2. Calculate design compressive stress based on slenderness ratio
  3. Calculate area of cross section( $A$ ) =  $P_u / f_{cd}$
  4. Make suitable section
  5. Determine design compressive strength
  6. if not safe revise section
- c. Eccentric column

Column subjected to moment is called eccentric column.

### **Design of column base**

- a. **Slab base**

Slab bases are used where column have independent concrete pedestals.

- b. **Gusseted base**

Gusseted base are provided for column carrying heavier loads requiring large base plates.

## **Design principles on timber beams and columns**

### **Design steps for timber beam**

1. Calculate the total load, including DL + LL
2. Calculate effective span, left
3. Calculate the maximum BM,  $M = wl^2/8$
4. Calculate the minimum width of beam, b
5. Use bending equation to calculate the size of beam
6. Check for shear stress
7. Check for deflection
8. Check for bearing

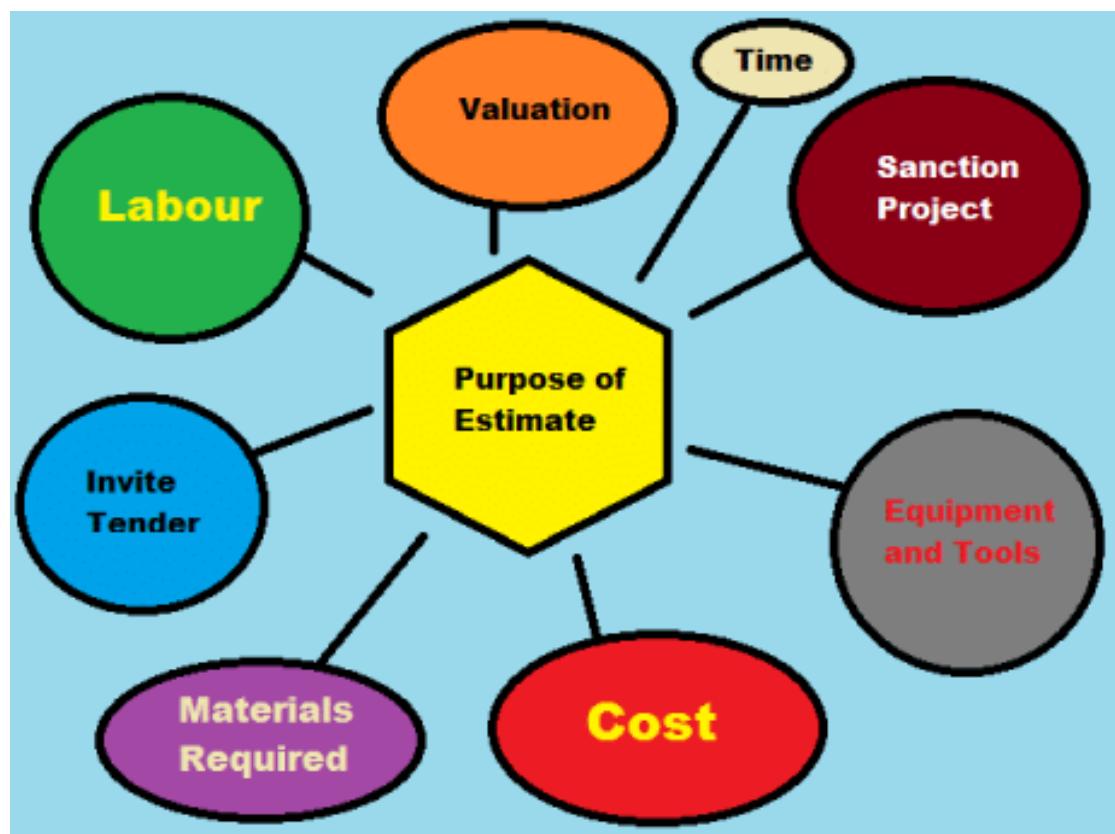
### **Timber columns**

- Solid element is generally used for column
- It may be solid, buildup or spaced
- c/s is determined based on load as well as slenderness ratio

# **Estimating and Costing, Valuation and Specification**

Estimating and Costing are closely the same things. The estimate is defined as the process of calculating or computing the various quantities and the expected expenditure to be incurred on a particular work or project. The estimate gives the probable cost of the work.

The primary objective of an estimate is to enable one to know the probable cost of the work before the completion of the project. If the estimate is prepared carefully and correctly there will not be much difference between estimated and actual cost.



Difference between estimating and costing

Estimating	Costing
Estimating is the process of calculating the probable cost of a structure like a building, bridge etc.	Costing is the actual cost of the production, project or any structure.
Estimating is done before and during the planning of the project.	Costing is done after completing the project.
It is not an exact value so it may vary.	Costing provide us exact expenses and value of the project.
Estimating improves the imagination or thinking skills of the engineers or manpower.	Costing improve the calculating skill of the evaluator or project manager.
Estimation is done according to the survey of the products for different projects.	Costing is done according to the actual products applied to the project.
Estimation requires more skill and experience to get a more accurate probable cost of the project.	It does not require more skill and experience because there is only a calculation of existing products or things on the project.
It requires more time to prepare the estimate.	It requires less time
Estimation may fail due to varying unit prices of the project's materials.	Estimation may fail due to varying unit prices of the project's materials.

## Types of estimates and their specific uses

The different types of the estimate are as follows:

1. Preliminary or approximate or rough estimate
2. Plinth area estimate
3. Unit rate estimate
4. Cube rate estimate
5. Item rate estimate
6. Detailed estimate
7. Revised estimate
8. Supplementary estimate
9. Annual repair estimate and annual maintenance estimate
10. Complete estimate
11. Extension and improvement estimate

## Methods of calculating quantities

The calculations of quantities of materials can be done using various methods of estimates. The application of individual methods is as upon the design and shape of the building. The different methods are as follows:

1. **Centreline method:** This method is used mostly if the offsets are symmetrical and the building is more or less rectangular in shape. This centerline acts as length for the complete calculations of the estimate. If the deductions not cared for the results of estimates may be wrong. All the walls should have the same section.
2. **Crossing Method:** The lengths and breadths of the masonry walls at the plinth level are taken ( internal dimension of the room + thickness of the walls ) for calculating quantities. The symmetrical offset as much as in the case of the centerline method. The centerline length is obtained by calculating the overall perimeter of the building and subtracting the four times the thickness of the wall on it.
3. **Out to Out and Into In ( Long wall and Short wall ) Method:** In this method, the wall along the length of the room is considered to be a long wall while the wall right-angled to longwall is said to be the short wall. To determine the length of the longwall or short wall, calculate first the centerline lengths of individual walls. Then the length of longwall ( out to Out )may be determined, after adding half breadth at each end to its centerline length. Thus the length of the short wall is measured by deducting half breadth from its centerline length at each end.
4. **Bay Method:** This method is generally followed in the case of the building having several bays. The cost of the one classroom is worked out and then multiplied by the number of bays in that building which gives the total cost of the building. The extra cost is required for the end walls and differences in framing.

## Key components of estimating norms and rate analysis

The main items of works in detailed estimate are

1. Earthwork : both in excavation and filling, the quantities are in  $m^3$
2. Concrete in foundation: quantity in  $m^3$
3. Soling: quantity in  $m^3$ , this is nothing but one layer of bricks put below the foundation concrete
4. Damp and proff course : quantity in  $m^2$
5. Masonry: quantity in  $m^2$
6. Lintels over the openings: quantity in  $m^2$
7. Plastering and pointing: quantity in  $m^2$

8. Pillars: quantity in  $m^3$
9. Door and windows:  $m^3$  for frames and trusses,  $m^2$  for door and window shutters
10. Iron and steel: quantity in quintals or tons or kg
11. White-washing or colour-washing: quantity in  $m^2$
12. Painting: quantity in  $m^2$
13. Electrification: about 8% of estimated cost
14. Sanitary and water supply : about 8% of estimated cost

## **Preparation of bill of quantities**

It is a statement showing the item number, description of work, unit rate (in fig and word) and amount in column is unfilled by tender/bidder.

SN	Description of work	Quantity	Unit	Remarks
1	Earthwork in excavation	.....	$m^3$	
2	Providing soling brick	.....	$m^2$	

## **Abstract of Estimated Cost(Abstract of cost)**

SN	Description of work	Quantity	Unit	Rate	Amount	Remarks
1	Earthwork in excavation		$m^3$			
2	Brick work in flat soling		$m^2$			

## **Purpose, types and importance of specification**

### **Necessity of Specification:**

1. The cost of a unit quantity is governed by its specification
2. Specifications of a work are required to describe the quantity and quality of different materials
3. This also specifies marksmanship and method of doing work.
4. A work is carried out according to its specification and the contractor is paid for the same. Any change in specification changes the tendered rate.
5. Tender paper without specifications of work are baseless, incomplete and invalid.

6. Specification is necessary to specify the equipment, tools and plants to be engaged for a work and thus enables to procure them beforehand.
7. The necessity of specification is to verify and check the strength of materials for a work involved in a project.
8. Specification is an essential contract document and is required for Arbitration or court cases.

### **Types of specification**

1. General specification
  - General specification, nature and class of works and names of materials that should be used are described.
  - Only brief description for each. Useful for estimating
  - It is not part of contract
2. Detailed specification
  - Part of contract document
  - Specify the qualities, quantities and proportions of materials and the method of preparation and execution for a particular item of works in a project.
  - The detail specifications of different items of work are prepared separately and they describe what the work should be and how they shall be executed.
  - While writing the detailed specifications, the same order sequence as the work is to be carried out is to be maintained.

### **Purpose, principles and methods of valuation**

#### **Six important purposes of Valuation**

1. Buying and selling property
2. Taxation
3. Rent Function
4. Security of loans and Mortgage
5. Compulsory acquisition
6. Insurance, Betterment changes, speculations, etc.

#### **Methods of Valuation**

1. Rental method of valuation

2. Direct comparison method
3. Profit based valuation
4. Development method of valuation
5. Depreciation method of valuation
6. Plinth Area Method

### **Principles of Valuation**

1. Future Profitability : The price should be based on what a buyer can expect in future earnings, not how the business performed in the past
2. Cash Flow : Insurance or financial service businesses don't have many tangible assets, so the real value is in the cash flow generated through clients
3. Potential Risk: less risk is rewarded with a higher price
4. Objectivity vs Subjectivity: There is a mix of art and science that goes into valuing a book of business. There's an objective review of revenue, expenses but then there's the subjective view on understanding what might make one book more valuable than another (even if they generate the same revenue). The subjective side might include looking at the deal itself; terms of payment, guarantees, claw-back clauses and the seller's involvement in the transition.
5. Motivation and Determination: At the end of the day, it doesn't matter how accurate or realistic the valuation put on a business. The final price will be determined by the two parties involved and how motivated and determined they are to complete the deal. The best outcome is when both the seller and buyer feel that they've met a fair price.

# **Transportation & Construction**

## **Transportation system and classification**

A *transportation system* can be defined as the combination of elements and their interactions, which produce the demand for travel within a given area and the supply of transportation services to satisfy this demand. This definition is general and flexible enough to be applied to different contexts. The specific structure of the system is defined by the problem itself (or class of problems) for whose solution it is employed.

### **Classification:**

1. Roadway
  - National
  - State
  - Normal
- 2- Railway
- 3- Airway
  - Domestic
  - International
- 4- Port way
  - Shipping
  - Inland waterway

## **Road transport and road construction in Nepal**

Road transport or road transportation is a type of transport using roads. Transport on roads can be roughly grouped into the transportation of goods and transportation of people. In many countries licensing requirements and safety regulations ensure a separation of the two industries. Movement along roads may be by bike or automobile, truck, or by animal such as horse or oxen.

### **Road construction in Nepal:**

/todo: not clear context

## Classification of roads in Nepal (NRS and IRC)

### Nepal Road Standard 2070:(NRS)

1. Administrative Classification
  - **National Highways:** major roads running east to west & north to south of the country
  - **Feeder Roads:** roads connecting the district headquarters, major economic centers & tourism centers to national highways or other feeder roads
  - **District Roads:** within a district, serving areas of production & markets, and connecting with each other & with the main highways
  - **Urban Roads:** road within an urban municipality
2. Technical/Functional Classification

Road Type	ADT in 20 yr Perspective Period (PCU)	Design Speed in Plain Terrain (Km/hr)
Class I	20000 or more	120
Class III	5000 - 20000	100
Class III	2000 - 5000	80
Class IV	less than 2000	60

### Nepal Rural Road Standard 2071:

1. District Road Core Network(DRCN): important road joining a VDC HQ's office or nearest economic center to the district headquarters, via either a neighboring district headquarters or the Strategic Road Network.
2. Village road: Smaller roads not falling under District Road Core Network category

### Nepal Urban Road Standard 2076:

1. **Arterial Roads (Path):** roads generally meant for through traffic usually on a continuous route
2. **Sub-arterial Roads (Sadak):** roads of the somewhat lower levels of travel mobility than the arterial roads.
3. **Collector Roads (Marg):** one intended for collecting & distributing traffic to and from local roads & also providing the access to arterial/sub-arterial roads
4. **Local Roads (Upa-Marg):** A local road is one primarily intended for access to the residence, business, and other abutting property.

**IRC(Indian Roads Congress):**

1. National Highways
2. State Highways
3. Major District Roads
4. Other District Roads
5. Village Roads

## **General principles of road network planning**

**The objectives of highway planning are:**

1. Planning a highway network for safe, efficient and fast movement of people and goods.
2. Keeping the overall cost of construction and maintenance of the roads in the network to a minimum.
3. Planning for future development and anticipated traffic needs for a specific design period.
4. Phasing road development programmes from considerations of utility and importance as also of financial resources.
5. Evolving a financing system compatible with the cost and benefits.

**To fulfill these objectives, the following principles have to be borne in mind:**

1. The proposed road links should be a part of the planned road network for the state/nation.
2. The importance of the road shall be based on the traffic demand, and hence its type should fall under the standard classification
3. The maintenance needs of the roads should receive prompt attention by setting aside funds for this purpose.
4. Statutory provisions for traffic regulation should be in place

## **Feasibility study of road projects**

A Feasibility Study involves both a desk top and a site visit and address the key fundamentals of access and access constraints. Investigations will also take place as to the current lawful use of the site and its present potential for generating traffic.

Initial assessments of predicted traffic flows are made and any existing traffic discounted to give a net effect. A judgement is then made as to the most appropriate form of junction to satisfactorily accommodate the level of traffic in relation to ease of access and impact on the network. The ability to physically accommodate the selected junction on land either within the development site or within the site and the public highway is critical to avoid wherever possible third party involvement. For example limits of the public highway are noted and any visible service utility apparatus or arrangements.

An initial view of the impact of the level of additional traffic is gained from the site visit where key junction or highway links on the local road network can be identified. Depending on the nature of the development it may be appropriate to undertake a survey of existing vehicle movements both on the highway network or generated by the existing land use. In addition the access design may require a radar speed survey of vehicles to be undertaken to determine key design features such as junction sight lines to be ascertained.

In the vicinity of the site critical highway measurements are also taken and a photographic record is usually made. The deliverability of the access and the initial view on the impact of the development traffic will inform the nature and scale of the development in relation to confirming that the “mix of development”, dwelling numbers or proposed floor space of retail / industrial / office / warehouse / leisure / health care uses is appropriate.

During the site visit a brief overview of the availability of facilities that assist access by sustainable modes will be undertaken and these will assist in the selection of the trip rate for traffic generations as good access to sustainable travel will be reflected by a lower vehicle trip rate for the development.

Highway Engineer - Feasibility Study

## **Alignment**

Study Materials

### **Introduction**

The position of the center line of the highway in the ground is called highway alignment. Highway alignment includes horizontal alignment and vertical alignment. The projection of highway alignment in horizontal plane is called horizontal alignment and the projection in vertical plane is known as vertical alignment. Alignment must be selected in such a way that the overall cost during construction, operation and maintenance is minimum. Road design outputs are in the form of following drawings:

**Plan:** Includes centre line, structures, Right of Way (ROW), carriage way, shoulders, side drain.

**Longitudinal Profile:** Soil Type, Depth of cut, Height of Fill, Side drain (Information on from which chainage to which chainage), Direction of flow in the drain.

**Cross section:** Ground Level, Formation Level, Super elevation, Area of Cutting and Area of filling thus computation of the volume and then cost estimation can be done.

## **Requirement of Highway Alignment**

The ideal alignment must have the following requirements:

- Safe (S)
- Easy (E)
- Short(S)
- Economical (E)
- Comfort (C)

## **Factors Controlling Highway Alignment**

- Governmental Requirement
- Obligatory Points
  - Positive Obligatory Points: Existing Road, Intermediate Town, Bridge site/Existing Bridge, Mountain
  - Negative Obligatory Points: Valleys, ponds, marshy lands; Religious places, costly structures, conservation areas, densely populated area, boundary
- Traffic(Type, amount and flow pattern)
- Geological condition
- Geometric condition
- Geometric design
- Available of construction materials and labour
- Economy
- Other considerations:
  - Drainage
  - Political
  - Monotony

## **Special consideration in Hill Roads:**

- Stability
- Drainage
- Geometric Standards
- Resisting Length

## **Engineering surveys and its stages**

- Map Study
- Reconnaissance
- Preliminary Survey
- Final Location and Detailed Survey

### **Structure of Route Selection Process**

Sequential Structure of Route Location Process:

Region → Bands (8-16km) → Corridors (3-10km) → Route Strips (1-1.5km) → Alignments (30-50m)

The beginning and the end point is selected and the region is defined. The region is further studied in search of broad bands which are 8-16km wide. From these broad bands, the corridor is studied then the route strips and possible alignments are found out.

### **Engineering Surveys: Map Survey, Reconnaissance, Preliminary Survey and Detailed Surveys:**

#### **Map study:**

The study of the topographical map is done to find out the possible routes of the road. Following information are obtained from the map study:

- Alignment avoiding valley, ponds, lakes.
- When the road has to cross a row of hills, mountain pass may be the suitable alternative.
- Approximate location of the bridge site.

#### **Reconnaissance Survey:**

Simple Survey Instruments are used in the reconnaissance procedure. Following are the information obtained from the reconnaissance survey:

- Valley, pond, lakes and other features that were not present in the topographical map.
- A number of cross drainage structures, High Flood Level (HFL), Natural Ground Level.
- Values of the gradient, the length of gradients and radius of the circular curve.
- Soil type along the routes from field identification tests and observation of the geological features.
- Sources of construction materials.

### **Preliminary Survey:**

Sophisticated Survey Instruments are used during the preliminary survey. Objective of the Preliminary Survey are listed below:

- To collect necessary physical information and details of topography, drainage, and soil.
- To collect necessary physical information and details of topography, drainage, and soil.
- To collect necessary physical information and details of topography, drainage, and soil.
- To finalize the best alignment.

### **Methods of Preliminary Survey:**

- Conventional Approach
- Modern Rapid Approach

### **Conventional Method:**

The procedure for the conventional approach are listed below:

- Traverse
- Levelling work
- Topographical features
- Drainage Studies and Hydrological data
- Soil survey
- Material Survey
- Traffic Survey
- Determination of final Centre line

### **Modern rapid approach:**

The procedure of the Modern rapid approach are listed below as:

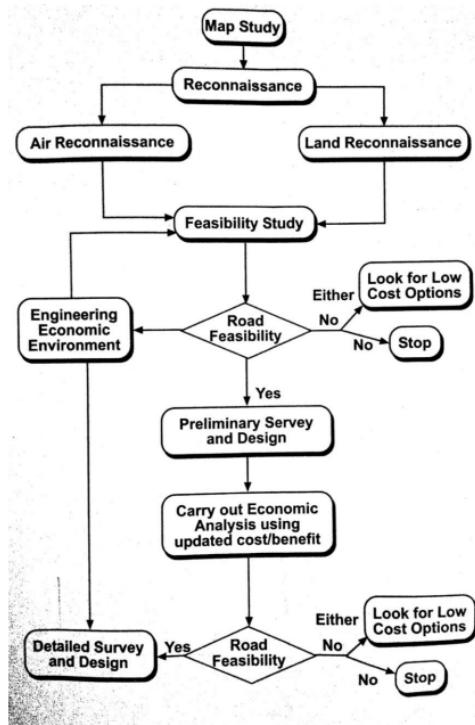
- Taking aerial photographs with required lateral and longitudinal overlaps.
- These photographs are then examined under stereoscopes and control points are selected for the establishment of the traverse.
- The spot levels and contour lines may be obtained from the stereo – pair observations.
- Photointerpretation method is used to grab information on the geological features, soil conditions, drainage requirement, etc.

### **Final Location and Detailed Survey:**

**Location:** The centre line of the road which is finalized in the preliminary survey is then located in the field by establishing the centre line. Major and minor control points are then established on the ground and the central pegs are driven, checking the geometric design criteria. If necessary, the modification of the final location can be altered.

### **Detailed Survey:**

- Temporary Bench Marks (TBM) are fixed at all under pass structures and drainage structures.
- Levels along the final centre line should be taken with great importance as these data are required for vertical alignment, earth work calculation, and drainage details.
- A detailed survey is carried out to enable drawing the soil profile up to the depth of 1.5- 3m below the Ground Line and twice the height of the finished embankment in the case of the high embankment.
- The data during the detailed survey should be elaborated and completed for the preparation of the plans, designing, and estimation of the project.



## Geometric design of roads

Geometric design is that stage of highway design which deals with the dimensions of road. The main objective of highway design is to provide optimum efficiency in traffic operation with maximum safety at reasonable cost. Geometric design of highway deals with the following:-

1. Elements of cross section
2. Sight distance consideration
3. Elements of horizontal alignment
4. Elements of vertical alignment
5. Intersection Elements

## Map study

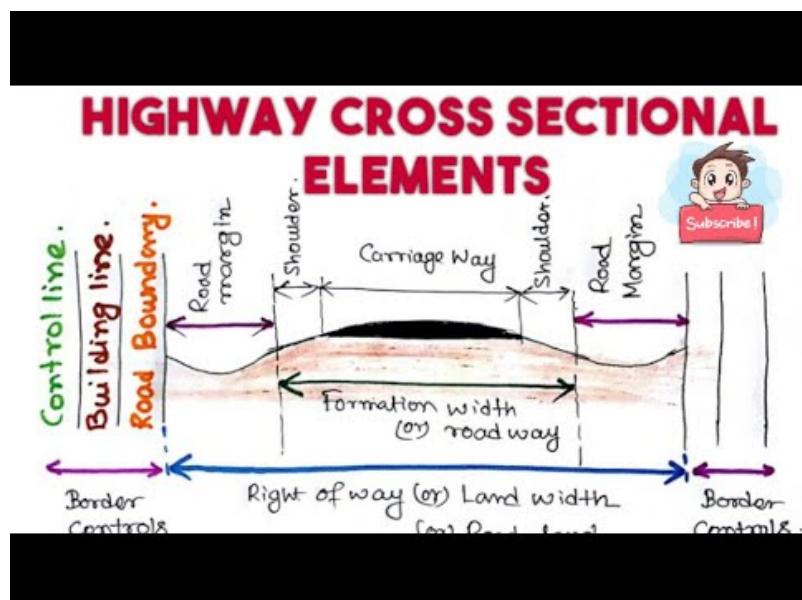
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## Element of cross-section and highway alignment

### Elements of Highway Geometric Design:

1. Cross-section element
2. Sight distance
3. Horizontal alignment details
4. Vertical alignment details
5. Intersection details

### Cross section Elements:



1. No. and width of traffic lane
2. Carriage way: portion of highway for movement of vehicles excluding shoulders
3. Berm/shoulder: stopped vehicles, emergency use and lateral support of sub-base, base and surface courses.
4. Median strip/traffic separator: divide traffic of opposite directions.
  - Recommended width: 5m (NRS 2070)
  - 3m if land is restricted
  - >1.2m, 1.5m for bridges
5. Road Way: carriage way + 2 \* shoulder
6. Formation width: Top/Bottom width excluding side drains

7. Side slopes of cut and fills
8. Camber: difference of level of crown and edge
9. Super elevation at curve: One side slope provided to pavement on curved sections for effective drainage as well as comfort
10. Extra width on horizontal curve:
  - Mechanical widening, due to rigidity of wheel, following wheel do not follow same path:  $w_n = \frac{nl^2}{2LR}$
  - Psychological widening,  $w_{ps} = \frac{V}{9.5\sqrt{R}}$
  - W = sum of both
11. Right of way/land width: land of interest, acquired for transportation purpose of present and future
12. Building Lines: To prevent over crowding and road future development
13. Control Lines: nature of building permitted here is controlled
14. Laybys: for urban road where soldier cannot be provide sufficiently,
15. Kerb: Boundary between shoulders and pavement
16. Bus lay bys: Extra lane for loading and unloading of passengers
17. Side slopes: slope of earthwork
18. Green belt: cannot build factory and houses by law

### **Design of horizontal curve**

The allowable radius R for a horizontal curve can then be determined by knowing the intended design velocity V, the coefficient of friction, and the allowed superelevation on the curve.

$$R = \frac{v^2}{g(e + f_s)}$$

Horizontal curves occur at locations where two roadways intersect, providing a gradual transition between the two. The intersection point of the two roads is defined as the Point of Tangent Intersection (PI). The location of the curve's start point is defined as the Point of Curve (PC) while the location of the curve's end point is defined as the Point of Tangent (PT). The PC is a distance T from the PI, where T is defined as Tangent Length. Tangent Length can be calculated by finding the central angle of the curve, in degrees. This angle is equal to the supplement of the interior angle between the two road tangents.

$$T = R \tan\left(\frac{\Delta}{2}\right)$$

so

$$L = \frac{R\Delta\pi}{180}$$

### **Super elevation**

Superelevation is the transverse slope provided to counteract the effect of centrifugal force and reduce the tendency of vehicle to overturn and to skid laterally outwards by raising the pavement outer edge with respect to inner edge. superelevation is represented by “ e ”.

$$e + f = \frac{V^2}{127R}$$

### **Transition curve**

A transition curve may be defined as a curve of varying radius of infinity at tangent point to a design circular curve radius provided in between the straight and circular path in order that the centrifugal force was gradual. This is also known as easement curve.

$$L_s = \frac{V^3}{CR}$$

where  $C = 80/(75 + V)$

### **Vertical curves**

Vertical Curves are the second of the two important transition elements in geometric design for highways, the first being Horizontal Curves. A vertical curve provides a transition between two sloped roadways, allowing a vehicle to negotiate the elevation rate change at a gradual rate rather than a sharp cut. The design of the curve is dependent on the intended design speed for the roadway, as well as other factors including drainage, slope, acceptable rate of change, and friction. These curves are parabolic and are assigned stationing based on a horizontal axis.

#### **Parabolic Formulation:**

$$a = \frac{g_2 - g_1}{2L}$$

## **Right of way**

The right of way is the total land area acquired for the construction of the roadway. Its width should be enough to accommodate all the elements of the roadway cross section, any future widening of the road and any public utility facilities that will be installed along the roadway. RoW is the area of the road acquired for carriages way + other necessities + future extension, along its alignment. Good practice is to acquire RoW wide enough to accommodate the ultimate development and all components of the road.

### **Factors Affecting Right of Way:**

- Width of formation
- Height of embankment
- Side slopes
- Drainage system
- Sight distances consideration on horizontal curves
- Future extension

## **Drainage consideration in roads**

- Bearing capacity of soil foundation gets decreased when the moisture content in its get increased and is lowest when the same gets saturated.
- Water standing on the carriageway is danger to high speed traffic.

Highway Drainage may be defined as the process of interception and removal of water from over, under and vicinity of the road surface.

### **Importance of Highway Drainage:**

- Road surface becomes soft and loses its strength.
- Road subgrade may be softened and its bearing capacity is reduced.
- Variation in moisture content in expansive soil causes variation in the volume of subgrade and thus failure of road.
- Presence of moisture at freezing temperature may damage road due to frost action.
- Erosion of side slopes, side drains and formation of gullies may result if proper drainage conditions are not maintained.
- Flexible pavement's failure by formation of waves and corrugations is due to poor drainage.
- Formation of pot holes.
- Failure of rigid pavement by mud pumping.

## **Introduction and design of culverts and minor bridges**

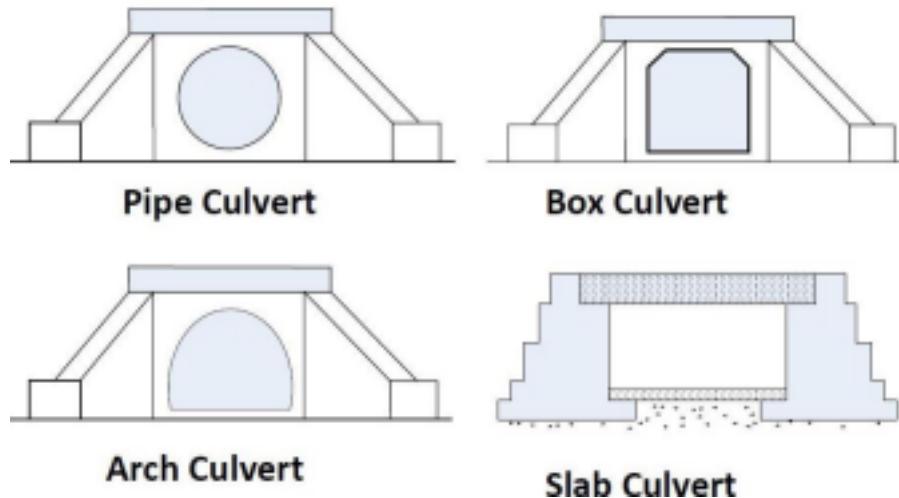
### **Culverts:**

A closed conduit placed under the embankment to carry water across the roadway is termed as culverts. In NRS 2070, culverts are the bridging structures of linear waterway span less than about 6m. It is extensively used in road drainage system. In fact, more than 75% of the cross-drainage structures are culverts. A culvert is more hydraulically efficient than minor bridge and discharge through a culvert is more than a minor bridge.

### **Functions of Culverts:**

- Collection and transport of water across the road so as to not cause damage to the road bank or the stream bed by scouring.
- To provide sufficient waterway to prevent heading up of water above the road surface.

### **Types of Culvert:**



### **Bridge:**

A bridge is a structure constructed over water course to carry traffic over it. In NRS 2070, bridges are the structures having linear waterway span more than about 6m.

## **Cross drainage structures**

Cross drainage structures are those structures which are provided whenever streams have to cross the roadway facility. The water from the side drains is also often taken across these structures in order to divert the water away from the road to a water course or a valley.

- Culvert
- Bridges
- Aqueduct
- Inverted Siphon

## **Subsurface drainage system**

- Stability and strength of the road surface depends upon the strength of subgrade.
- With increase in moisture content the strength of the subgrade decreases.

The variation in moisture content of subgrade is caused by the free water and the ground water. Every effort is needed to reduce the moisture content to a minimum. From usual drainage system, only gravitational water can be drained by the provision of subsoil drainage.

### **Drainage of infiltrated water:**

- During rainy season and snow melting season, water will find its way to the subgrade soil through the permeable surface of the adjoining land, carriageway, shoulder, side slope and cracks.
- Removal of such infiltrated water from the subgrade may be accomplished by the arrangements shown in figures below. The control of subsurface water is classified under three headings:
  1. Control of seepage flow
  2. Lowering of water table
  3. Control of capillary rise
    - Granular capillary cut off
    - Impermeable capillary cut off

## **Special consideration in Hill roads design**

1. Geological Stability
2. Availability Of Construction Materials
3. Cross Drainage Structures
4. Geological Structures
5. Geometric Design
6. Altitude of The Road

Or,

- Alignment of Road
- Most of the length should be in ruling gradient
- Deep Cuttings is avoided
- Tunnels should be avoided
- Grid based Technology should be adopted for 4 lane highways

### **Problems associated with hill roads construction**

1. Landslide
2. Drainage
3. Soil Erosion
4. Ineffective Rise and Fall
5. Hair Pin Bends
6. Sight Distance
7. Snow Clearance

### **Route location, hairpin bends and special structures**

#### **Alignment of Hill Roads:(Features)**

1. It achieves the minimum costs of construction and maintenance.
2. It allows comfortable travel and the expenditures on motive power, as well as wear and tear of vehicles, are also greatly reduced.
3. It contains sharp curves having small radius
4. It gives a stable and safe road
5. It grants the easiest, shortest, and most economical line of communication between the obligatory points or important centers to be connected by the hill road.
6. It has the gradient as easy as possible

#### **Special Features of Hill Road**

1. Floating Grade
2. Half tunneling
3. Protective works

4. Catch water and cross drains
5. Hairpin bends

#### **Hairpin bends:**

- This curve is so-called because it conforms to the form of a hairpin. The band so formed at the hairpin curve during a hill road is understood as the hairpin bend
- This type of curve should be located on a hillside having the minimum slope and maximum stability. It must even be safe from the point of view of landslides and groundwater.
- Hairpin bends with long arms and farther spacing are always preferred. Hey, reduce construction problems and expensive protective works. Hear-pin curves or bends of serpentine nature are difficult to barter and may, therefore, be avoided as far as possible.

#### **Bioengineering practices along hill side**

- **Contour Wattling:** Brak long slopes to short to control erosion
- **Brush Layering:** alternative layers of live branches and soil
- **Trench Packing:** slow and spread water by placing live plants perpendicular to flow
- **Brush Matting:** mattress like layer of branches
- **Live Cuttings:** secure materials in place and increase plantings on slope
- **Coir Fascines:** wattles made from fibrous outer husk of coconuts
- **Prevegetated Mats:** live plants on moveable mat of organic material
- **Interplanting Rip Rap:** used for streambanks and lakeshores, various size of large stones in soil surface
- **Staking**
- **Combinations:** (usually used)

#### **Activities and techniques in road construction in rural roads**

/todo: not found for now

## **Maintenance, repair and rehabilitation of roads**

**Highway (road) maintenance** is defined as preserving and keeping the serviceable conditions highway as normal as possible and practicable. The main objectives of road maintenance men are the allocation of available maintenance resources according to actual needs and priorities. If the maintenance works are not done at all or done faulty or the pavement structure inadequate for present-day and loading.

A **highway (Road)** surface level is deteriorating in its level of serviceability due to many causes, some of them are given below:

1. **Traffic factors:-** The traffic operating on the facility can cause different types of distress like rutting, corrugations, raveling, etc. The amount of deterioration depends upon the intensity of traffic, wheel load, and its repetitions.
2. **Environmental factors:-** The external influence of environmental factors like rainfall, temperature variations, snowfall, landslides, etc. also deteriorate the road pavement. Rainfall causes erosion of shoulders while snowfall cause ingress of water into the pavement structure. Similarly, temperature variation causes adversely affect the performance of the bituminous surface and cement concrete pavements.

Improper maintenance also invites for a huge investment of funds and uncomfortably of highway location, design, and quality of construction. e poor designed roads the cost of maintenance may be higher than the initial cost.” Road maintenance is a series of interdependent activities carried out for preserving and keeping road, roadside, highway furniture, structures and other facilities in the best possible condition provide satisfactory and safe transportation along the highway with the optimum cost”

**Need for Maintenance or Road (Highway):** Dollar one investment in maintenance saves Dollar 3 to 6 required later for rehabilitation and reconstruction.

### **Purpose of Maintenance of Road:**

- Reducing deterioration
- Lowering vehicle operating costs
- Keeping the road open
- Safety
- Environmental issues

**Depending upon the various types of failure and remedial maintenance operations highway maintenance can be classified as::**

1. **Routine maintenance:** Sweeping of roads, Maintenance of shoulder, Cutting of grasses, Cleaning of culverts, Clearing of bridges, Cleaning of minor slides, Cleaning of road furniture, Cleaning of side drains, Minor reshaping of drains

2. **Recurrent maintenance:** six months to years
3. **Periodic maintenance:** several, 6 black top, 4 gravel
4. **Specific maintenance:** as per supervisor
5. **Preventive maintenance:** Slope stabilization works, Catch/intercepting drains, Subsurface/french drains, Horizontal drilling for taking water out, Toe protection, Checkdams, catchpits and Drainage cascades etc
6. **Emergency maintenance:** after 10years or unfavorable conditions

## **Basic knowledge on design, construction and maintenance of suspended and suspension bridge in Nepal**

Long span(LSTB): by calculation

short span(SSTB): by manual

/todo: summarise pdf

## **Low-cost road construction**

The road constructed and maintained at a low cost by utilizing locally available materials & labour is a low cost road.

It is also referred to as a cheap road.

In the villages and underdeveloped areas, the immediate need for roads can be fulfilled at a low cost by these roads and can be improved further if required.

### 1. Earth Road

The type of low-cost road in which pavement structure is constructed with the soil available at the site is called earth road.

1. **Ordinary Earth Road:** The earth road, whose foundation and the wearing surface are made up of one or two compacted layers of natural soil along its alignment, is an ordinary earth road.
2. **Stabilized Earth Road:** The road whose foundation and the wearing surface are made up of one or two compacted layers of stabilized soil is called stabilized earth road.
2. **Kankar Road:** Kankar road is constructed utilizing kankar (or chips of impure limestone) as the chief material. It is only constructed when limestones are available in sufficient quantity.

3. **WBM Road:** WBM road is the pavement whose surface course comprises crushed or broken aggregates mechanically interlocked by rolling. Voids are filled using filler materials with water assistance.

- WBM road produces dust while providing service.
- Powder of Calcium Chloride or Bituminous Materials can be spread on the road's surface to minimize dust.
- It is ideal for wooden or iron-wheeled vehicles like tongas, bullock carts, etc.
- In many villages and rural areas, WBM road is constructed initially and further improved or paved when the fund is available.
- WBM stands for Water Bound Macadam.

4. **Gravel Road:** A gravel road is an unpaved road surfaced with gravel brought to the site from a quarry or stream bed. A gravel road is familiar in less developed nations and rural areas of developed countries.

/todo: more on 4 Types of Low Cost Road (Cheap Road) : Construction, Advantages & Disadvantages

# **Energy System**

An energy system is a system primarily designed to supply energy-services to end-users. The intent behind energy systems is to minimise energy losses to a negligible level, as well as to ensure the efficient use of energy. The IPCC Fifth Assessment Report defines an energy system as “all components related to the production, conversion, delivery, and use of energy”.

## **Hydrological study, planning and design of hydropower projects**

### **Hydrological study**

Hydrology is the study of the distribution and movement of water both on and below the Earth's surface, as well as the impact of human activity on water availability and conditions.

### **Hydropower planning:**

Hydropower planning is initial stage of work of any hydropower development. It mainly involves estimation of present demand, forecasting for future and generation of alternative energy sources and combination of them all to meet need.

Following are the parameters for the planning of any hydropower project:

1. Load forecasting based on different economic growth scenario
2. Generation planning to meet the future demand on the lease cost generation expansion plan
3. Load center
4. Regional balance
5. Available infrastructure
6. Cheaper project first

### **Design of hydropower projects:**

The different steps are done for design based on different stages of hydropower development:-

1. **Reconnaissance studies:** verify layouts, reselection of possible alternatives

2. **Pre-feasibility studies:** preliminary hydraulics based on thumb rules, component sizing, cost estimates
3. **Feasibility studies:** design of each component (hydraulic design and component optimization)

## **Head works, dams, spillways, surge tanks, stilling basin, etc.**

### **Head works**

Any hydraulic structure which supplies water to the off taking canal. Diversion head-work provides an obstruction across a river, so that the water level is raised and water is diverted to the channel at required level. The increase water level helps the flow of water by gravity and results in increasing the commanded area and reducing the water fluctuations in the river.

Diversion head-work may serve as silt regulator into the channel. Due to the obstruction, the velocity of the river decreases and silt settles at the bed. Clear water with permissible percentage of silt is allowed to flow through the regulator into the channel.

### **Types of Canal Headworks:**

1. Storage Headworks
2. Diversion Headworks

### **Dams**

A dam is a barrier that stops or restricts the flow of surface water or underground streams. Reservoirs created by dams not only suppress floods but also provide water for activities such as irrigation, human consumption, industrial use, aquaculture, and navigability. Hydropower is often used in conjunction with dams to generate electricity. A dam can also be used to collect or store water which can be evenly distributed between locations. Dams generally serve the primary purpose of retaining water, while other structures such as floodgates or levees (also known as dikes) are used to manage or prevent water flow into specific land regions. The earliest known dam is the Jawa Dam in Jordan, dating to 3,000 BC.

### **Spillways**

A spillway is a structure used to provide the controlled release of water from a dam or levee downstream, typically into the riverbed of the dammed river itself. In the United Kingdom, they may be known as overflow channels. Spillways ensure that water does not damage parts of the structure not designed to convey water.

Spillways can include floodgates and fuse plugs to regulate water flow and reservoir level. Such features enable a spillway to regulate downstream flow—by releasing water in a controlled manner before the reservoir is full, operators can prevent an unacceptably large release later.

## **Surge tanks**

A surge tank is a water storage device used as a pressure neutralizer in a hydropower water conveyance system to resists excess pressure rise and pressure drop conditions.

### **Functions of Surge Tanks:**

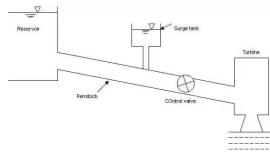
- It should Protects the conduit system from high internal pressures.
- It should help the hydraulic turbine regarding its regulation characteristics.
- It should store the water to raise the pressure in pressure drop conditions.

### **Types of Surge Tanks:**

- Simple surge tank

A simple surge tank is like vertical pipe which is connected in between penstock and turbine generator. These are constructed with greater height and supports are also provided to hold the tank. Whenever the water flow suddenly increased the water is collected in the surge tank and neutralize the pressure.

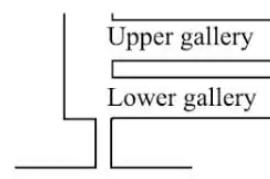
Top of the surge tank is opened to atmosphere If surge tank is filled completely then it overflows to maintain the pressure neutralization.



- Gallery type surge tank

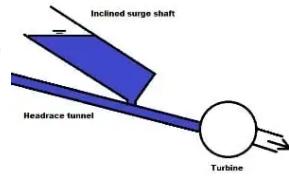
Gallery type surge tank consists of extra storage galleries in it. These storage galleries are also called as expansion chambers. So, gallery-type surge tanks can also be called expansion chamber-type surge tanks.

These expansion chambers are generally provided below and above the surge levels. Below surge level chambers are used to store excess water in them and released when it is required or there is a brief drop in pressure. Upper surge level chambers are used to absorb the excess pressure.



- Inclined surge tank

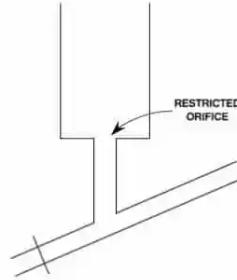
In the case of an inclined surge tank, the surge tank is provided with some inclination. It is provided when there is a limit in height of the tank. By providing an inclined surge tank the overflowed water under excess pressure is entered into the inclined tank and pressure destroyed.



- The restricted orifice surge tank

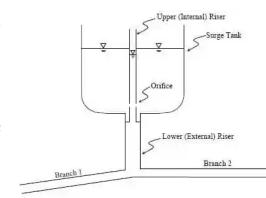
Restricted orifice consists an orifice between pipeline and surge tank. This orifice is also called as throttle so, it is also called as throttled surge tank. This throttle or orifice have very small diameter.

If the water overflows it should enter into the surge tank through this orifice. Because of small diameter frictional losses will developed and excess pressure in main pipe line is destroyed. This will creates quickly a retarding or accelerating head in the conduit. To reduce the water hammer effect, diameter of orifice should be well designed for full rejection of load by the turbine.



- Differential surge tank

In case of differential surge tank, an internal riser is fixed in the tank. This riser have very small diameter through which water enters into the riser when it overflows. The riser also contains annular ports at its lower end.



These ports help the flow into or out of the tank. So, the excess pressure is destroyed by the internal riser of the surge tank and storage of water is done by the outer tank. So, it is called a differential surge tank.

## River diversion works

The diversion structures are the group of works necessary to guarantee that the river can bypass the dam site during the main structure construction. The primary function of the diversion structure is to protect and ensure the site safety during construction.

### Types of river diversion:

1. **River diversion tunnel:** has highest costs, and usually only applies when other solutions are unfeasible
2. **River diversion in conduits:** alternative to tunnel if surrounding rocks has no capacity to perform a tunnel
3. **River diversion in channel:** if it becomes economically unfeasible to carry out tunnel or implant a conduit

4. **Opening left in dam body:** for concrete dams, especially arch dam
5. **Temporary diversion with laterally constriction of the river:** in lateral contraction of river section by constructing cofferdam, obtain dry zone for construction

## Biogas- Introduction

Biogas is a mixture of gases, primarily consisting of methane, carbon dioxide and hydrogen sulphide, produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste and food waste. It is a renewable energy source.

Biogas is produced by anaerobic digestion with anaerobic organisms or methanogen inside an anaerobic digester, biodigester or a bioreactor.

Biogas is primarily methane ( $\text{CH}_4$ ) and carbon dioxide ( $\text{CO}_2$ ) and may have small amounts of hydrogen sulfide ( $\text{H}_2\text{S}$ ), moisture and siloxanes. The gases methane, hydrogen, and carbon monoxide ( $\text{CO}$ ) can be combusted or oxidized with oxygen. This energy release allows biogas to be used as a fuel; it can be used in fuel cells and for any heating purpose, such as cooking. It can also be used in a gas engine to convert the energy in the gas into electricity and heat.

## Alternative energy systems in Nepal

<https://www.aepc.gov.np/>

1. Solar
2. Biomass
3. Wind Energy
4. Biofuel
5. Biogas

## **CIVIL-II**

# **Housing, building and urban planning**

## **Present status and practices of building construction in Nepal**

- BMIS(Building Management Information System) was prepared for recording of government building & for updating, but it has not been materialized it
- Earthquake resistance is being focused on

### **Prevailing Practices for individual building:**

- Owner built system
- Labor intensive system
- Informal market system
- No/minimum focus towards maintenance
- Though construction after getting building permit system is established by law, either no building permit is obtained before construction or permit is obtained just for record & alteration is made in design & construction.

In recent years, trend of apartments & group housing is prevailing, though focused in Kathmandu valley.

In earthquake affected districts, Build Back Better (BBB) approach is being applied

### **Prevailing practices for government building:**

- Formal process
- Labor intensive system
- Through formal contract process
- Though Department of Urban Development & Building Construction(DUDBC) is assigned for government building, one door system is not being followed.
- No maintenance plan is prepared.
- Budget is allocated on ad-hoc basis (both for construction & maintenance).

## **Specific considerations in design and construction of buildings in Nepal**

**General principle for building design:** should be such that it should be safe, adaptive to local condition & affordable.

### **Design phase:**

#### **Principles related to land:**

- Land should not be risk sensitive. If found sensitive, detail investigation should be made & design should be made accordingly. If not economical, the site should be avoided.
- Land should be such that it requires lesser cost for construction.
- It should abide the byelaw such as distance from river or flood prone area (30 m from Perennial River) and regarding slope (less than 30 degree).

#### **Regarding building & associated infrastructure:**

- Design should be such that it should follow Intermediate construction technology (hybrid of traditional & modern) for Nepal.
- Building should be local climate responsive
- Building should be friendly to the occupants
- It should be energy efficient or in modern term green building concept should be followed.
- The design should be such that it needs economic infrastructures and can easily be maintained.
- For low income people, previous design and drawing should be repeated rather than to make new design to make the design economical.

#### **Regarding finance:**

- The design should be such that the housing should be made affordable not only in construction but in maintenance also
- Establishment for financial institution providing loan (at low interest) for building should be encouraged.
- Government should enable financing program for low income group or regulate NGOs/cooperatives for cooperative housing or self-help program.

#### **Building Permit procedure:**

- Compliance of Building byelaw
- Compliance of Building Code

- Taking building permit

### **Design phase:**

#### **Architectural:**

- Form should follow function
- Functional aspect should be dominant rather than aesthetic importance.
- Should be coherent with neighborhood.

#### **Design key features:**

##### **1. Context fit**

- Fit to natural setting
- Climate responsive
- Local material & technology
- Historical & cultural setting
- Social setting

##### **2. Functionality**

##### **3. Visual impression**

- Mass composition (Balance between mass & void, Proportion & rhythm)
- Color & material combination

##### **4. Sustainable design**

- Efficiency in resource use
- Sustainable waste management

##### **5. Friendliness to the people**

- People movement
- Universal design

##### **6. Safety & security**

### **Construction Phase:**

- Though owner built system is prevailing, formal construction market should be established for individual building also.
- Labor intensive construction modality should be transformed to intermediate construction technology (Hybrid of traditional and modern one)

- Client, contractor & Engineer relationship
- Planning of material, labor & equipment supply
- Availability of trained labor regarding earthquake resistance construction
- Site safety

**In modern context:**

- Following Green building technology
- Earthquake resistant
- Consideration of rain water harvesting

## **Indigenous technology in building design and construction**

**Ecological region:**

- Mountain
- Hill
  - Kathmandu valley
  - Outside Kathmandu valley
- Terai

**Indigenous building material in Mountain:**

- Slate
- Wood
- Stone
- Clay



**Indigenous building material in Hill outside Kathmandu valley:**

- Stone
- Wood
- Clay



#### **Indigenous building material in Terai:**

- Clay
- Bamboo
- Thatch(grass)
- WoodLime



#### **Indigenous building material in Kathmandu valley: (?)**

- Stone
- Wood
- Clay
- Lime
- Metal

#### **Newari houses:**

- Masonry is a specific construction material
- requires specific structural configuration even when it is intended to carry only vertical loads, due to mechanical properties
- rules are based on tradition and experience
- dominantly constructed with the help of appa-sun dried bricks with mud mortar
- wooden door and windows
- 2.5-3m story height and up to 10m
- buildings constructed over plinth



## **Local and modern building construction material in Nepal**

### **Local building construction materials:**

- soil
  - molded and dried blocks made of clay
  - filling wooden frame construction
  - layer covering the walls
  - advantages: easily available, high thermal mass, good acoustic parameters, absorption and moisture transmission, extensive plastic possibilities, ease of processing, recyclability.
  - disadvantages: lack of resistance to moisture, not very high bearing properties.
  - Pressed peat briquettes are also used.
- wood
  - Advantages: natural, renewable material, can be used without processing (wall and roof beam structures, plank constructions, finishing material).
  - It is necessary to impregnate it against biodegradation, flammability and to increase durability and resistance to abrasion.
  - The wood is also processed (floor panels, plywood, chipboards, fibreboards or laminated beams).
- stone

- The stone has a high thermal mass, however, due to the weight, difficulty of obtaining and the price in present times, it is not used as a construction material.
- It is usually a layer for finishing internal and external surfaces (floors, wall finishes).

#### **Modern building construction materials:**

- brick
  - The brick is made of clay which, after being formed into the shape of the product, is fired.
  - It has a high thermal capacity, noble color and texture highlighting the relationship of the building with the environment and tradition
  - On its basis, a wide range of ceramic hollow bricks has been created. They have a lower thermal capacity but are lighter and have better thermal insulation properties.
- concrete
- steel
- glass

### **Community buildings: School and hospitals and their design considerations**

- minimum area of opening for ventilation:  $1/8^{\text{th}}$  of room area
- based on occupancy schools are classified as Group C, and hospitals group D as per Nepal National Building Code, Architectural Design Requirements

#### **School:**

- minimum width: primary 1.0m, secondary 1.2m

#### **Hospitals:**

- minimum width: 1.2m

### **Urban planning needs and challenges in Nepal**

Urban planning is concerned with the ordering and design of settlements, from smallest towns to world's largest settlements.

#### **Needs:**

- Helps the Cities to Grow
- Improves Quality of Life
- Predict Disasters
- Positive Impact on Economy
- Safe and Healthy Lifestyle for Everyone
- Develop the Nation

**Challenges:**

- Service and Land Management
- National development policy
- Donor driven development
- Management of migration/displaced person
- Waste and pollution management
- Maintaining infrastructures, service & creating jobs
- Devolution/Decentralization
- High rate of urbanization – Increase in number of municipalities without infrastructures and services
- Population growth in municipalities
- Allocation of Central Government fund to the cities is less as compared to their contribution in GDP

# **Technology, Environment and civil society**

## **Technology**

The number of startups in Nepal has significantly grown over past decade with a number of more than a hundred excelling in national as well as international level.

## **Technological development in Nepal**

- Modern science entered into the kingdom with the introduction of Intermediate science education in Tri-Chandra college in 1919
- Mahabir Pun has played an important role in the penetration of internet to the remote areas of Nepal formulating a Nepal Wireless Networking Project in 2002
- One of the remarkable achievements of Nepal is that it has been able to stand on the 22nd position among emerging economies of the world and 1st position among the South Asian countries in the 2018
- The number of startups in Nepal has significantly grown over past decade with a number of more than a hundred excelling in national as well as international level
- Nepal Academy of Science and Technology (NAST) is an autonomous apex body established in 1982 to promote science and technology in the country. The Academy is entrusted with four major objectives:
  - advancement of science and technology for all-round development of the nation; preservation and further modernization of indigenous technologies; promotion of research in science and technology; and identification and facilitation of appropriate technology transfer.
  - There were 10.78 million internet users in Nepal in January 2021. Increased by 567 thousand (+5.5%) between 2020 and 2021.
  - There were 13.00 million social media users in Nepal in January 2021. Number of social media users in Nepal increased by 3.0 million (+30%) between 2020 and 2021.
  - There were 38.61 million mobile connections in Nepal in January 2021. Decreased by 4.0 million (-9.4%) between January 2020 and January 2021.
  - Smartphone penetration in Nepal is greater than 55% and this trend is directly or indirectly promoting the wireless technology in Nepal.

- E-banking, E-Payment & E-commerce: SEWA, KHALTI; DARAZ, HAMROBAZAAR
- Robotics in Nepal (Robotics Association of Nepal) RAN and Karkhana
- Nepalese youths have done pretty good work in the field of Artificial Intelligence & Robotics. Fusemachines Nepal and Paaila Technology are notable name in AI industry of Nepal
- E-Governance Master Plan (e-GMP) takes a holistic view of e-Governance initiatives across the country, integrating them into a collective vision, a shared causePromotion of local technology and its adaptation
- Some popular technology trend include ride sharing service like TOOTLE, Electric Vehicles( eco- friendly and budget friendly), rise in number if ISP and their healthy competition ,online gaming like Ludo Neo-classic(rank 123 in Playstore), Ktm Race VR, Bhag Chal etc...

## **Promotion of local technology and its adaptation**

### **Some local technologies**

Plough: A plough is a farming tool that works with the power of ax, bull or buffalo. It helps to dig soil in the fields so that seeds can be planted.

Watermill: Watermill is engine that works on principle of transformation of kinetic energy into mechanical energy. It is used in flour or lumber production, metal shaping, etc

Water Pump(Dhiki pump): They are used in rural areas of the Terai region for the purpose of irrigation as well as for drinking water.

Oilseed crushing device(Kol): It is traditional technology of Nepal that is used to crush the oilseeds like mustard, sesame, etc. It is known as “Kol” and “Ghani” in Nepal and India respectively.

Dhiki: Dhiki is a traditional grinder made up of wood.

Jaato: Jaato is a circular grinder made up of stone and a wood handle at the top to make it easier to roll it.

Silauto and Lohoro: A pair of grinding stone machine “Silauto and Lohoro” commonly used to make chutney, pickles (achaar).

Khal Bachha: It is used mostly to beat and separate rice grains from its broken parts (Kanika).

Aaran: kind of oven, used for sharpening the iron rod

Boat: local transportation technology

Tuin: local transportation technology

Pottery: local technology that is used to make pots from the clay

Madani and Theki: used to store milk fat (Taar), make butter (i.e. NAUNE GHYU)out of it;

Gagri and Ghaito: the basic water vessels that are used in Nepal to store water in house

Dalo: normally used to store dry food

Sukul: another type of mat

Chulo: requires wood for burning.

Sarangi: traditional Nepali musical instrument

## **Environmental Impact Assessment**

Environmental Impact Assessment (EIA) is a tool used to assess the significant effects of a project or development proposal on the environment.

EIAs make sure that project decision makers think about the likely effects on the environment at the earliest possible time and aim to avoid, reduce or offset those effects. This ensures that proposals are understood properly before decisions are made.

### **Stages of EIA process:**

EIA has 5 main stages. If an EIA is required, an Environmental Assessment Impact Report will be written and submitted with the application for development consent. The public will have the chance to comment. This makes sure you're given a chance to be involved in decision making.

1. Screening: Deciding if an EIA is required
2. Scoping: Deciding what needs to be covered in the assessment and reported in the 'EIA Report'
3. Preparing the EIA Report: The EIA report has to include the likely significant environmental effects of the development
4. Making an application and consultation: The EIA Report and development application must be publicised (including electronic advertisement), interested parties and the public must be given an opportunity to give their views on it
5. Decision making: The EIA Report and any comments made on it must be taken into account by the competent authority before they decide whether to give consent for the development. The decision notice has to be published
6. Post decision: The developer starts any monitoring required by the competent authority.

## **Initial Environmental Examination**

EIA is generally conducted in tiers. In most countries, EIA processes fall into four tiers

- **Screening:** decides whether the EIA process is applicable at all to the development project. Screening should basically "clear" all those projects where there are no major negative impact issues.
- **Scoping:** helps in understanding the extent of environmental impacts and identifies significant environmental issues for further study. In the activity-component framework, this would mean than scoping should assist in the identification of impacting activities and impacted environmental components for all major negative impact issues.
- **Initial environmental examination:** assesses the severity of the significant issues and finds ways to mitigate or enhance environmental impacts by considering the available information from past experience or the standard operating practices (SOPs; standard mitigation measures).
- **Detailed or comprehensive EIA:** carries out a detailed examination of impacts by conducting relevant surveys. Studies are monitored by applying more rigorous impact evaluation/prediction tools where necessary and ensuring the effectiveness of the mitigation and enhancement measures. Detailed EIA thus focuses on impacts which are critical but not fully understood.

IEE is a process of further inquiry into the impact assessment, taking clues from the exercise of scoping. There is, however, a fairly thin dividing line between scoping and an IEE when it comes to identification and gradation of the impact issue. Some of the discussion and inferencing shown in Box 3.5 could also be done at an IEE level.

Scoping, however, lays an emphasis on the identification of issues and on the boundaries of the analysis. IEE attempts to examine the issues in more detail by carrying out an exercise of prediction and assessment to identify required mitigation measures. In this manner each alternative is assessed. Later, these alternatives are analysed to rank them and find the alternative which may be either cleared or taken to the next tier of detailed EIA.

IEE focuses on the assessment of impacts and identification of obvious mitigation measures. This is generally done by conducting baseline information and by collecting any available secondary data. The issues are assessed by carrying out a prediction exercise by using informal judgement, the opinion of experts, or in some occasions by using screening level mathematical models.

The idea of assessment is to grade the impacts in terms of significance. Significance of the impact is expressed in terms of "highly significant" or "of minor significance", or in terms of additional descriptors such as "reversible", "irreversible", etc. The idea of assessing the significance is to identify suitable mitigation measures. The level of mitigation measures suggested is based on the understanding of the severity of the impacts.

## **Global warming phenomena**

Global warming is the phenomenon of a gradual increase in the temperature near the earth's surface. This phenomenon has been observed over the past one or two centuries. This change has disturbed the climatic pattern of the earth. However, the concept of global warming is quite controversial but the scientists have provided relevant data in support of the fact that the temperature of the earth is rising constantly.

There are several causes of global warming, which have a negative effect on humans, plants and animals. These causes may be natural or might be the outcome of human activities. In order to curb the issues, it is very important to understand the negative impacts of global warming.

### **Causes of global warming**

1. Deforestation
2. Use of Vehicles
3. Chlorofluorocarbon
4. Industrial Development
5. Agriculture
6. Overpopulation
7. Natural causes
8. Volcanoes
9. Water Vapour
10. Melting Permafrost
11. Forest Blazes

### **Effects of global warming**

1. Rise in Temperature
2. Threats to the Ecosystem
3. Climate Change
4. Spread of Diseases
5. High Mortality Rates
6. Loss of Natural Habitat

## **Types of sources of pollution: point/non-point (for air and water)**

a pollutant is a substance that enters the environment and elevates the "natural" background level of that substance.

### **Point Sources**

Pollution originating from a single, identifiable source, such as a discharge pipe from a factory or sewage plant, is called point-source pollution.

- -source pollutants in surface water and groundwater are usually found in a plume that has the highest concentrations of the pollutant nearest the source

- The raw materials and wastes may include pollutants such as solvents, petroleum products (such as oil and gasoline), or heavy metals
- Point sources of pollution from agriculture may include animal feeding operations, animal waste treatment lagoons, or storage, handling, mixing, and cleaning areas for pesticides, fertilizers, and petroleum.
- Some of the most persistent point-source pollutants in groundwater are volatile organic compounds, which include manufactured and refined toxic substances such as solvents, oils, paint, and fuel products.
- The most common point-source pollutants in surface water are:
  - High-temperature discharges;
  - Microorganisms (such as bacteria, viruses, and Giardia ); and
  - Nutrients (such as nitrogen and phosphorus).

### **Non-point**

Pollution that does not originate from a single source, or point, is called nonpoint-source pollution.

Nonpoint-source pollution occurs as water moves across the land or through the ground and picks up natural and human-made pollutants, which can then be deposited in lakes, rivers, wetlands, coastal waters, and even groundwater.

- Nonpoint-source pollution occurs as water moves across the land or through the ground and picks up natural and human-made pollutants, which can then be deposited in lakes, rivers, wetlands, coastal waters, and even groundwater
- It is often difficult to trace the exact origin of these pollutants because they result from a wide variety of human activities on the land as well as natural characteristics of the soil, climate, and topography .
- The most common nonpoint-source pollutants are sediment , nutrients, microorganisms and toxics
- Nonpoint sources of pollution in urban areas may include parking lots, streets, and roads where stormwater picks up oils, grease, metals, dirt, salts, and other toxic materials.
- Bacteria, microorganisms, and nutrients (nitrogen and phosphorus) are common nonpoint-source pollutants from agricultural livestock areas and residential pet wastes

## **Social mobilization in local infrastructure development and utilization in Nepal**

Social Mobilization is the cornerstone of participatory approach in rural development, nutrition enhancement and poverty alleviation programs. It is powerful instrument in decentralization policies and programs aimed at strengthening human and institutional resources development at local level.

Social mobilization strengthens participation of rural poor in local decision making , improve their access to social and productive services and efficiency in the use of locally available financial resources and enhance opportunities for assets building by the poorest of the poor.**Definition of Social Mobilization:**

- A process of motivating communities to organize in a cohesive group for an active participation towards their own development.
- An integrative process where stakeholders are stimulated to become active participants in social change using diverse strategies to meet shared goals
- A comprehensive planning approach that emphasizes
- Political Coalition Building
- Community Action

## **Participatory approach in planning, implementation, maintenance and operation of local infrastructure**

participatory approach means that the person in charge of solving a problem or designing an innovation involves people who are directly concerned by the result of his or her work. Participatory approaches are necessary in agroecology as they facilitate the development of local resources, whether natural, economic or social ones. Joining local actors to the effort does not guarantee an optimal solution, but rather improvements which are acceptable and appropriate for their context of implementation. Problem solving and innovation are thus conducted directly with regards to the situation to be transformed. It therefore becomes possible to learn from the implementation of the found solutions in order to revise them.

Opting for a participatory approach is justified from a pragmatic point of view and by the pursuit of a democratic ideal. The pragmatic objective consists in enhancing the experience, intelligence and creativity of the actors within a context of irreducible uncertainty even with science. The democratic ideal considers the participatory approach as a mean to give citizens the possibility of choosing which innovations to develop. The ends and means are in this case collectively debated within the participative project.

Different tools can be used to implement a participatory approach. They all share the same philosophy which is to facilitate the expression and the participation of different and diverse actors. This includes covering a wide range of forms of expression: oral communication, written communication and schematic representation (participatory modelling/mapping, mind map, rich pictures, cognitive maps ...). These different modes of expression facilitate the transition from a passive attitude of learning to an active and creative attitude. Engaging actors in such a process of co-construction promotes the ownership of results and the involvement of participants in their implementation.

# **Construction Materials**

## **Properties of building materials**

### **Physical Properties**

- Bulk density
- Porosity
- Durability
- Density
- Density index
- Specific gravity
- Fire resistance
- Frost resistance
- Weathering resistance
- Spalling resistance
- Water absorption
- Water permeability
- Hygroscopicity
- Coefficient of softening
- Refractoriness

### **Mechanical Properties**

- Strength
- Hardness
- Elasticity
- Plasticity
- Brittleness
- Fatigue
- Impact strength
- Abrasion resistance
- Creep

### **Chemical Properties**

- Chemical resistance
- Corrosion resistance

### **Thermal properties**

- Thermal capacity
- Thermal conductivity
- Thermal resistivity
- Specific heat

## **Stones-characteristics and requirements of stones as building material**

### **Characteristics of good building stones**

- **Colour**
  - color should go with surrounding from architectural point
  - lighter shades preferred over darker, durable
  - red and brown shades is due to oxide of iron in sedimentary rock, if excess disfigure rock, disintegrate
  - uniform color free from clay holes, bands or spots of color
- **General structure**
  - if broken in direction that is not cleavage should not give dull appearance
  - uniform texture, crystalline in structure of homogenous and closed grained
  - free from cavities, cracks or patches of soft or loose material
  - for ornamental carvings it should be fine grained
  - stratification should not be visible to naked eye except by difference in color
  - these can be split along their planes of stratification known as planes of cleavage and are therefore, useful for use in parings, flooring's and roofing's etc.
- **Heaviness**
  - Heavier varieties of stones are more compact, less porous and have greater specific gravities(under water construction)
  - lighter can be used for domes and roof coverings
- **Strength**
  - construction where unusually bigger forces are likely to come the stone to be used should be tested for its strength.
  - igneous > sedimentary class. fine crystalline texture are stronger
- **Hardness:** resistance of stone to abrasive forces caused by much wear and friction as in floors, pavements and aprons of bridges and weirs in rivers

- **Toughness:**
  - measure of the impact that a stone can withstand
  - places subject to vibrations of machinery and to moving loads, construction of roads
- **Ease of working:** ease with which the stone can be worked upon *i.e.*, cut, dressed, carved and moulded etc. (**economic point of view**)
- **Porosity and absorption:**
  - unsuitable for use in construction especially for exposed surfaces of structures
  - Rain water while coming down carries some acidic gases forming light acids, prevailing winds
  - cold regions water freezes in the pores of stones, disintegration because of increase volume on freezing
- **Seasoning**
  - freshly quarried stones contain a certain amount of moisture known as *quarry sap*, which makes them soft and easier to work upon
  - dressing, carving and moulding etc, should be done as early after quarrying as possible
  - they should be left to season under sheds having no walls so as to permit free circulation of air. (6-12months)
- **Weathering**
  - extent to which the face of a stone resists the action of weather
  - best way of knowing the weathering properties of a particular stone is to inspect ancient buildings made with the same quality of stone possibly in the nearby place or at a place having similar atmospheric conditions (sharp edges and corners)
  - Inspection of an old face of some quarry could also be informative
  - construction of important buildings
- **Resistance of fire**
  - should be free from calcium carbonate and oxide of iron and be not composed of minerals with differing co-efficient of thermal expansion

## **Ceramic materials**

- typically possess high melting points, low electrical and thermal conductivity values, and high compressive strengths
- generally hard and brittle with very good chemical and thermal stability
- traditional ceramics and advanced ceramics (medical implants to refrigerator magnets)

## **Ceramic tile**

- The tiles themselves are generally made from a mixture of water, sand, and clay
- the spaces between the tiles, known as “grout,” are filled with a separate mixture of water, sand, and “cement” like material(sometimes epoxy)

## **Mosaic Tile**

- The term mosaic essentially means a design that's comprised of many smaller pieces of tile.
- can be made from stones like travertine, marble, real pebbles, glass, metal, porcelain and more
- especially useful for achieving a unique look because they come in many different colors, sizes and finishes

## **Types of brick**

Bricks can be of many types depending on

### **1. Quality**

#### **1. First Class Brick:**

- standard size
- color of these bricks is uniform yellow or red
- It is well burnt, regular texture, uniform shape
- The absorption capacity is less than 10%, crushing strength is,  $280\text{kg/cm}^2$  (mean) where it is  $245\text{ kg/cm}^2$  (minimum)
- use: long durability, say 100 years, exposes to a corrosive environment;

#### **2. Second Class Brick**

- slightly over burnt is acceptable
- absorption capacity is more than 10% but less than 15%.
- Crushing strength is  $175\text{kg}/\text{cm}^2$ (mean) where the minimum is  $154\text{ kg}/\text{cm}^2$
- use: one-storied buildings, temporary (15years)

### 3. Third Class Brick

- shape and size are not regular
- The color is soft and light red colored. It is under burnt, slightly over burnt is acceptable. non uniform texture
- under burnt, slightly over burnt is acceptable
- The crushing strength is  $140\text{kg}/\text{cm}^2$ (mean) where the minimum crushing strength is  $105\text{kg}/\text{cm}^2$ .
- It has extensive efflorescence
- emits a dull or blunt sound when struck by another similar brick or struck by a hammer
- leaves fingernail expression when one tries to do with the thumbnail

## 2. Building Process

1. **Unburnt Bricks:** half burnt bricks, yellow, low strength, surki in lime terracing or soiling under RCC footing or basement, should not be exposed to water
2. **Burnt Bricks:** First - Third class
3. **Over Burnt or Jhama Brick:** shape is distorted, absorption capacity is high, strength is higher or equivalent to first class bricks, use: lime concrete for the foundation, coarse aggregate in the concrete of slab and beam

## 3. Manufacturing Method

1. **Extruded Brick:** created by forcing clay and water into a steel die
2. **Molded Brick:** shaped in molds by hand
3. **Dry pressed Brick:** traditional types of bricks which are made by compressing clay into molds

## 4. Raw Material:

Burnt Clay Brick, Fly ash clay Brick, Concrete Brick, Sand-lime Brick, Firebrick

## 5. Using Location

1. **Facing brick**

2. **Backing brick:** behind the facing bricks to provide support
6. **Weather-resisting Capability**
  - **Severe Weather Grade:** covered in snow most of the time of year
  - **Moderate Weather Grade:** tropical countries, can withstand any high temperature.
  - **No Weather Grade**
7. **Purpose of Using**
  - **Common Bricks:** no requirements
  - **Engineering Bricks:** mainly civil engineering works like sewers, manholes, ground works, retaining walls, damp proof courses, etc.
8. **Shape**
9. **Region**

## **Brick testing**

1. **Absorption test**
  - amount of moisture content absorbed by brick under extreme conditions
  - 24 hours
  - good quality brick: < 20% of weight of dry brick
2. **Crushing strength test**
  - placing brick in compression testing machine
  - Minimum crushing strength of brick is  $3.50 N/mm^2$ . If less than  $3.50 N/mm^2$ , then it is not useful for construction purpose.
3. **Hardness test:** sharp tool or finger nail is used to make scratch on brick, no scratch
4. **Shape and size**
  - same size, purely rectangular with sharp edges
  - 19cm x 9cm x 9cm
  - test on 20 and compare
5. **Color test:** bright and uniform color
6. **Soundness test:** nature of bricks against sudden impact, 2 bricks struck with one another

7. **Structure of brick:** pick one and break, no lumps and homogenous inner portion
8. **Presence of soluble salts (Efflorescence Test):** water bath for 24 hours and dry it in shade, check white or grey color deposits

## Cementing materials

### Types and properties of lime and cement

#### Lime

- important binding material used in building construction
- used as the material for construction since ancient times

#### Types of lime

##### 1. Fat lime

It is composed of 95% calcium oxide. when water is added, it shakes vigorously and its volume increases to 2 to 2.5 times. It is white in color. Its properties are

- hardens slowly
- has a high degree of plasticity
- sets slowly in presence of air
- white in color
- slakes vigorously

##### 2. Hydraulic lime

It contains clay and ferrous oxide. Depending upon the percentage of clay present, the hydraulic lime is divided into the following three types:

1. Feebly hydraulic lime (5-10% clay content)
2. Moderately hydraulic lime(11 to 20% clay content)
3. Eminently hydraulic lime(21 to 30% clay content)

The properties of hydraulic lime are:

- Sets underwater
- The colour is not perfectly white
- Forms a thin paste with water and does not dissolve in water
- Its binding property improves if its fine powder is mixed with sand and kept in the form of a heap for a week, before use.

### 3. Poor lime

It contains more than 30% clay. Its color is muddy. It has poor binding property. The mortar made with such lime is used for inferior works.

IS 712-1973 classifies lime as class A, B, C, D and E.

1. **Class A Lime:** It is predominantly hydraulic lime. It is normally supplied as hydrated lime and is commonly used for structural works.
2. **Class B Lime:** It contains both hydraulic lime and fat lime. It is supplied as hydrated lime or as quick lime. It is used for making mortar for masonry works.
3. **Class C Lime:** It is predominantly fat lime, supplied both as quick lime and fat lime. It is used for finishing coats in plastering and for whitewashing.
4. **Class D Lime:** This lime contains a large quantity of magnesium oxide and is similar to fat lime. This is also commonly used for whitewashing and for finishing coat in plastering.
5. **Class E Lime:** It is an impure limestone, known as kankar. It is available in modular and block forms. It is supplied as hydrated lime. It is commonly used for masonry mortar.

### Tests on Limestones

#### 1. Physical tests

Pure limestone is white in colour. Hydraulic limestones are bluish grey, brown or are having dark colours. The hydraulic lime gives out an earthy smell. They are having a clayey taste. The presence of lumps gives an indication of quick lime and unburnt limestones.

#### 2. Heat test: $W_2 - W_1$ , loss of weight is carbon dioxide

3. Chemical test: tea spoonful of lime on dilute HCl, stirred and kept 24hrs, vigorous effervescence and less residue indicates pure. If thick gel is formed after test tube is held upside down, class can be identified as

- Class A, if gel does not flow
- Class B, tends to flow
- Class C, no gel formation

#### 4. Ball test

- To identify class B or C
- Adding sufficient water 400mm size lime balls are made and they left undisturbed for 6 hours. If slow expansion and slow disintegration C, only crack B.

## **Uses of Lime**

1. For whitewashing
2. For making mortar for masonry works and plastering.
3. To produce lime sand bricks.
4. For soil stabilisation
5. As a refractory material for lining open-hearth furnaces.
6. For making cement

## **Cement**

Cement is the most used construction material in the world that has both adhesive and cohesive properties due to which it can make bonding and bind particles of solid matter into a compact durable solid mass. It is obtained by mixing limestone and clay, burning them, and grinding to a fine powder. Here we discuss different types of Cement.

The hydraulic cement is usually known as **Portland cement** because of its resemblance upon hardening to the Portland stone found near Dorset, England. Thus the name was first used by Joseph Aspdin of Leeds, England in 1824 in his patent.

**Cement is mainly classified into two categories on the basis hardening and setting mechanism**

1. **Hydraulic cement:** when mixed in water hardens due to chemical reaction, in about 3-5minutes
2. **Non-hydraulic cement:** should be kept dry to retain strength, like slaked lime hardens due to reaction of carbonation with carbon dioxide

**Many Types of cement have been developed to suit different conditions such as:**

### **1. Ordinary Portland cement (OPC)**

- Most common
- grinding clinker with adding gypsum, water and less than 1% air-entraining agents
- The setting and hardening of cement after addition of water happens due to dissolution and reaction of its constituent. The calcium aluminate formed by the constituent is to set and harden the cement and then calcium trisilicate formed is responsible for early gain its strength during the first 48 hours. Calcium disilicate reacts slowly and responsible for strength at a later stage.

### **2. Portland Pozzolana Cement (PPC):**

- manufactured either by grinding clinker and pozzolana or by blending Portland cement and fine pozzolana(10-25% by weight)
- suitable for waterfront structure or for marine structure as in dams, bridge piers and thick foundation where mass concrete is used, also used for sanitation system like Sewers.
- The **pozzolana** has no cementitious properties or less binding property but in the finely divided form with the presence of water can react with calcium hydroxide at a suitable temperature to form compounds having sufficient binding properties

### 3. Rapid Hardening Cement:

- Manufactured similar to OPC, but contains **high tricalcium silicate** and finer grinding
- retains strength three-day strength of ordinary cement in one day (10% higher)
- this type of cement is subjected to large shrinkage and water requirement for workability is high.
- is frost and freeze resistant as the concrete matures more quickly

### 4. Extra Rapid Hardening Cement:

- manufacture by grinding Calcium Chloride(2% weight) with rapid hardening portland cement
- huge amount of heat is evolved, perfect for concreting in cold weather, 25% more than the rapid hardening cement.

5. **Portland Slag Cement:** is generally developed to utilize the waste product obtained from blast furnaces.

6. **Hydrophobic Portland cement:** mixing ordinary Portland clinker with water repellent film-forming cement such as oleic acid, stearic acid

7. **Low heat Portland cement:** amount of compound like c3s and c3A are reduced whereas the amount of c2s is increased

### 8. Sulphate Resisting Portland cement:

- OPC is susceptible to the attack of sulphates, use where the soil is infected with sulphates
- contains a comparatively low amount of c3A and c4AF and high silica content

### 9. Quick Setting Cement:

- used for aggressive foundation conditions like where pumping is needed, to set fast; also used in typical grouting operations

- property of cement is achieved by reducing the amount of gypsum at the time of clinker grinding
10. **High Alumina Cement:** The absence of  $C_3A$  in this type of cement makes the resistance to sulphate attack. As this type of Cement is resistant to the action of seawater, sulphates, they are used as a refractory concrete in industries and widely used for precast concreting.

### Bogue's Compounds

1. **Tricalcium silicate( $C_3S$ ):** 25-50
  - Generates more heat of hydration
  - Develops early strength
  - Less resistance to chemical attack
2. **Dicalcium Silicate( $C_2S$ ):** 20-45
  - Generates less heat of hydration
  - Develops ultimate strength
  - More resistance to chemical attack
3. **Tricalcium Aluminate( $C_2A$ ):** 5-12
  - First compound to react with water
  - Generates large amount of heat
  - Causes initial setting
  - Responsible for most of undesirable properties
4. **Tetracalcium Alumino Ferrite( $C_4AF$ ):** 6-12
  - Less cementing value
  - Reacts very slowly
  - Responsible for increase in volume of cement and reduce

### Cement Mortar tests

1. **Crushing Test:** This test is carried out on a brick work with the mortar. This brick work is crushed in a compression testing machine and the load is noted down. Then the crushing strength is obtained as load divided by cross-sectional area.
2. **Tensile Strength Test:** The mortar prepared is placed in a mould of bricket which has central cross-sectional area as 38 mm. After curing the briquette is pulled under the grips of tensile testing machine. The ultimate load noted. Then the tensile strength of mortar is load divided by the central cross-sectional area

3. **Adhesive Test:** Two bricks are joined together with mortar to be tested. The upper brick is suspended from an overhead support. A board is hung from the lower brick. Then weights are added to the board till the bricks separate. The adhesive strength is the load divided by area of contact.

## **Metals: Steel; types and properties; Alloys**

some of the most popular metal choices in the construction industry based on their sustainability, versatility, and economic benefits

### **Steel**

- Steel is the most popular, most widely used metal in the construction industry.
- It's also the most recycled material on the planet, making it a very eco-friendly option for construction
- People in the construction industry love steel because it can produce extremely sustainable structures that can be built quickly at low prices.
- Steel is found in countless construction projects, such as deck plates, coastal defenses, metal homes, educational buildings, skyscrapers, hospitals, commercial buildings, stadiums, and security fencing, just to name a few.

### **Aluminum:**

- The metal buildings of today are rarely built without using aluminum.
- Aluminum is lightweight but strong and durable.
- It can resist corrosion better than most materials, and its fluidity provides a great deal of freedom to architects and designers.
- Aluminum is often used in ceilings and walls, window frames, roof covers, HVAC systems, and for constructing massive stadiums and durable bridges.

### **Titanium:**

- Titanium is another lightweight, very durable metal that is very popular in the construction industry.
- Titanium, in particular, is mostly used in heating and cooling systems due to its high level of corrosion resistance.
- It can be found in pipes, roofing, and even some security systems that install plates or frames for extra reinforcement.

### **Iron:**

- Cast iron and wrought iron are two very different products. Each has its own unique purpose in the construction industry.

- Cast iron is melted, poured, and molded. Cast iron is typically used in large architectural products, like the dome of the U.S. Capitol.
- Wrought iron, on the other hand, is rolled in the final stages of its production. Wrought iron can be riveted to make things like beams, trusses, and rafters to be used in construction.

## **Copper:**

- Copper is the oldest known metal that's still used in the construction industry.(one of the most versatile engineering materials)
- The unique combination of copper's physical properties, conductivity, corrosion resistance, durability, flexibility, and strength makes it suitable for an almost infinite amount of projects
- Within the construction industry, copper is most often used for cladding, electrical wiring, heating systems, oil and gas lines, rainwater systems, and roofing.

## **Steel**

### **Types of steel**

#### **4 main types of steel:**

##### **1. Carbon steel:**

- Carbon steel looks dull, matte-like, and is known to be vulnerable to corrosion. Overall, there are three subtypes to this one: low(%carbon = 0.3%), medium(0.6%), and high carbon steel(1.5%).
- They are exceptionally strong, which is why they are often used to make things like knives, high-tension wires, automotive parts, and other similar items

##### **2. Alloy steel:**

- mixture of several different metals, like nickel, copper, and aluminum.
- more on the cheaper side, more resistant to corrosion and are favored for some car parts, pipelines, ship hulls, and mechanical projects. For this one, the strength depends on the concentration of the elements that it contains.

##### **3. Tool Steel:**

- famous for being hard and both heat and scrape resistant
- commonly used to make metal tools, like hammers. For these, they are made up of things like cobalt, molybdenum, and tungsten, and that is the underlying reason why tool steel has such advanced durability and heat resistance features

#### 4. Stainless Steel:

- This type is shiny and generally has around 10 to 20% chromium, which is their main alloying element.
- With this combination, it allows the steel to be resistant to corrosion and very easily molded into varying shapes.
- Because of their easy manipulation, flexibility, and quality, stainless steel can be found in surgical equipment, home applications, silverware, and even implemented as exterior cladding for commercial/industrial buildings.

#### Properties of steel

Steel has a number of properties, including hardness, toughness, tensile strength, yield strength, elongation, fatigue strength, corrosion, plasticity, malleability, and creep.

The properties that are most important in wear and abrasion-resistant steel are:

- **Hardness:** ability to withstand friction and abrasion
- **Toughness:** absorb energy without fracturing or rupturing
- **Yield:** strength is a measurement of the force required to start the deformation of the material
- **Tensile:** strength is a measurement of the force required to break the material.
- **Elongation:** “Degree” to which the material can be stretched or compressed before it breaks

Basic Physical properties:

- Density:  $7,850 \text{ kg/m}^3$
- Melting point:  $1,510^\circ\text{C}$
- Coefficient of linear expansion at  $20^\circ\text{C}$ :  $1.1 \mu\text{m} / {}^\circ\text{C}$

#### Timber and wood

Wood is one of the most used natural building materials in the world.

- A number of valuable properties such as low heat conductivity, small bulk density, relatively high strength, amenability to mechanical working etc. makes wood as famous building material.
- Timber can be used in most economical way without wasting any of the derivative of it. Even the saw dust obtained during wood sawing can also be used to make fiber boards, paper etc.

## Timber trees in Nepal

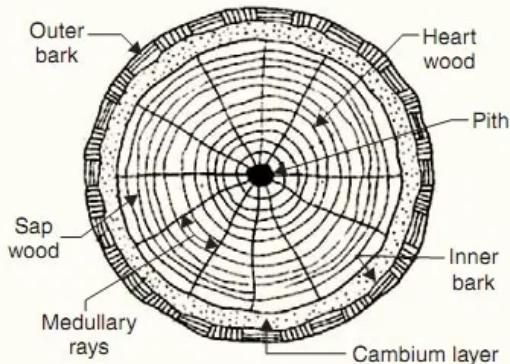
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### Types of trees

#### 1. Based on mode of growth

1. **Endogenous:** Endogenous trees are inward growing trees which contains fibrous mass in their longitudinal section. The timber from these trees is useful in some limited engineering purposes. eg. bamboo, palm, cane, etc.
2. **Exogenous:** Exogenous trees are outward growing trees. Horizontal section of such tree contains several rings which are nothing but annual rings. These rings can be used to predict the age of tree. Most of the exogenous trees are useful for many engineering purposes.
  1. **Conifers:** soft wood producing trees which are also called as ever green trees. The timber of these trees is light colored, light in weight, low dense and poor against fire. Examples: Pine, Fir, redwood, spruce, deodar, cedar etc.
  2. **Deciduous:** hard wood producing trees. The leaves of this type of trees are generally broad in size and they fall in autumn and grow in spring. Deciduous trees are most suitable for constructional purposes. Timber of deciduous trees is dark colored, dense, heaviest and good against fire. Examples: Maple, Mahogany, Oak, teak, walnut, babul etc.

### Microstructure of trees:



### Properties of wood

#### 1. Physical Properties

1. Colour: The wood is available in a wide range of colours starting from white to dark brown etc
2. Lustre: Luster refers to the tendency of elements with the reflection of light
3. Density
4. Hardness

## 2. Mechanical Properties

- Compression: depends on direction of load applied
- Tension: very effective on wood when it is parallel to wood's grain
- Bending: shows the strength and stability of wood even if the load is increased in a parallel direction.

# Miscellaneous materials

## Asphaltic materials

### Asphalt

The asphalt is a mixture which consists alumina, lime, silica and asphaltic bitumen. At low temperatures, it is in solid state and at high temperatures it is in liquid state. Types: Natural(lake asphalt) , Residual(distilation).

### Bitumen

Bitumen is obtained by the partial distillation of crude petroleum. It is also called as mineral tar and is present in asphalt also. It contains 87% carbon, 11% hydrogen and 2% oxygen.

### Tar

Tar is a high viscous liquid which contains high amount of carbon content. It is used for laying surface layer for pavements, preserving wood etc..

## Paints and varnishes

### Paints

Paint is a liquid or mastic material that can be applied to surfaces to colour, protect and provide texture. They are usually stored as a liquid and dry into a thin film after

application. Paints be categorised decorative, are applied on site, or industrial, applied in factories as part of the manufacturing process

Some of the attributes normally required from a paint include:

- Capable of easy application.
- Good flow out of application marks (e.g. brush-marking).
- Capable of forming a continuous protective film.
- High opacity.
- Quick drying.
- Corrosion resistance.
- Water and heat resistance.
- Colour stability against visible and ultraviolet radiation.
- Abrasion and scratch resistance.
- Durability.
- Flexibility.
- Easily cleaned.

**Constituents of paint:** Paints may be manufactured using pigments, binders, extenders, solvents and additives.

## Varnishes

Varnish is a solution of resin in either oil, turpentine or alcohol. It dries after applying, leaving a hard, transparent and glossy film of resin over the varnished surface.

Varnish is applied:

1. to the painted surface to increase its brilliance and to protect it from the atmospheric action
2. to the unpainted wooden surface with a view to brighten the ornamental appearance of the grains of wood.

The ingredients of varnish are: Resins, Solvents, Driers

## Polymers

Polymer materials account for the highest growth area in construction materials. In basic terms, polymers are very long molecules typically made up of many thousands of repeat

units. They include plastics, rubbers, thermoplastic elastomers, adhesives, foams, paints and sealants.

Examples of polymer materials in construction applications:

- **Epoxy resins:** Solid resin, Terrazzo flooring, anchor fixings and adhesives.
- **Ethylenetetrafluoroethylene (ETFE):** Fabric structures.
- **Ethyl vinyl acetate (EVA):** Solar panel encapsulants.
- **Expanded polystyrene (EPS):** Concrete moulds, insulation and packaging.
- **Polycarbonate:** Lighting housings, fittings in hot water systems and glazing.
- **Polyester:** FRP Bridge sections, cladding panels, sinks, surfaces and coatings.
- **Polyethylene:** Foam underlay, damp-proof membranes and coatings.
- **Polyisobutylene (PIB):** Sealants and waterproof membranes.
- **Polymethylmethacrylate / Acrylic (PMMA):** Surfaces and sinks.
- **Polypropylene (PP):** Sound insulation, and pipes.
- **Polyurethane (PU):** Sealants and concrete jointing.
- **Polyvinylchloride (PVC):** Sealants, concrete jointing and fabric structures.
- **Rubber:** Bridge bearings and flooring.

# **Building Construction Technology**

## **Foundations**

### **Subsoil exploration**

Field and laboratory investigation is required to know the physical property and arrangement of the underlying solid layers.

The main objective of soil exploration is to know the general picture of the geology of the area to get adequate information of type and nature of soil available at different depths for designing safe, sound and economical foundation for a structure.

### **Site Investigation Requirements**

As per NBC 109:1994 for load bearing masonry buildings and reinforced concrete frame buildings with masonry infills, site exploration should be carried out by digging test pits, two as minimum and more if subsurface soil conditions show a variation in soil types. Generally the depth for exploration for building should be minimum of two meters. In hilly area exploration up to depth of sound bed rock, if it lies shallower than two meter should be suffice. No exploration shall be required if the site is located on rock or fluvial terrace with boulder bed.

### **Methods of Soil(Site) Exploration:**

1. Inspection of site
2. Probing: hammer steel bar until hard sub-surface is met
3. Means of Test Pit
4. Boring

### **Improving Bearing Capacity of Soil:**

1. Increase the Depth of foundation
2. Drainage of Sub-soil Water
3. Compaction of Soil

### **Load Test:**

1. Plate Load Test

2. Penetration Test
  1. Standard Penetration Test
  2. Dynamic Cone Penetration Test
  3. Static Cone Penetration Test

## **Types and stability of different foundation shallow, deep**

### **1. Shallow Foundation**

1. Spread footing
2. Combined footing
3. Strap footing
4. Continuous footing
5. Mat foundation

### **2. Deep Foundation**

1. Pile foundation
2. Pier foundation
3. Well or caisson foundation

## **Shoring and dewatering**

### **Shoring**

Shoring is the process of temporarily supporting a building, vessel, structure, or trench with shores (props) when in danger of collapse or during repairs or alterations

Shoring is commonly used when installing the foundation of a building. A shoring system such as piles and lagging or shotcrete will support the surrounding loads until the underground levels of the building are constructed. Commonly used shoring equipment includes post shores, shoring beams, and timber jacks.

During excavation, shoring systems speed up excavation and provide safety for workers since trenches can be prone to collapse. In this case, shoring should not be confused with shielding. Shoring is designed to prevent collapse where shielding is only designed to protect workers when collapses occur. Concrete-structure and stone-building shoring, in these cases also referred to as falsework, provides temporary support until the concrete becomes hard and achieves the desired strength to support loads.

### **Dewatering**

Dewatering is the removal of water from solid material or soil by wet classification, centrifugation, filtration, or similar solid-liquid separation processes, such as removal of residual liquid from a filter cake by a filter press as part of various industrial processes.

Construction dewatering, unwatering, or water control are common terms used to describe removal or draining groundwater or surface water from a riverbed, construction site, caisson, or mine shaft, by pumping or evaporation. On a construction site, this dewatering may be implemented before subsurface excavation for foundations, shoring, or cellar space to lower the water table. This frequently involves the use of submersible “dewatering” pumps, centrifugal (“trash”) pumps, eductors, or application of vacuum to well points.

## **Design of simple brick or stone masonry foundations**

Designing a Foundation | Foundation of building | Process of foundation work - GharExpert.com

### **Foundation:**

Foundation is the part of structure below plinth level up to the soil. It is in direct contact of soil and transmits load of super structure to soil. Generally it is below the ground level. If some part of foundation is above ground level, it is also covered with earth filling. This portion of structure is not in contact of air, light etc, or to say that it is the hidden part of the structure.

### **Depth of Foundation:**

Depth of foundation depends on following factors.

1. Availability of adequate bearing capacity
2. Depth of shrinkage and swelling in case of clayey soils, due to seasonal changes which may cause appreciable movements.
3. Depth of frost penetration in case of fine sand and silt.
4. Possibility of excavation close by
5. Depth of ground water table
6. Practical minimum depth of foundation should not be less than 50 cm. to allow removal of top soil and variations in ground level.
7. Hence the best recommended depth of foundation is from 1.00 meter to 1.5 meter from original ground level.

### **Footing:**

Footing is a structure constructed in brick work, masonry or concrete under the base of a wall or column for distributing the load over a large area.

### **Width of Foundation/Footings:**

The width of footings should be laid according to structural design. For light loaded buildings such as houses, flats, school buildings etc having not more than two storeys, the width of foundation is given below.

1. The width of footing should not be less than 75 cm for one brick thick wall.
2. The width of footing should not be less than 1 meter for one and half brick wall.

#### **Different Processes in Foundation Work:**

1. Excavation of earth work in trenches for foundation
2. Laying out cement concrete.
3. Laying the footing in case of raft or column construction
4. Laying Anti termite treatment
5. Laying Brick work up to plinth level.
6. Laying Damp proof course on the walls.
7. Refilling of earth around the walls
8. Refilling of earth in the building portion up to the required height according to plinth level.

#### **Precautions while designing ‘Foundation’:**

1. A foundation should be designed to transmit combined dead load, imposed load and wind load to the ground.
2. Net loading intensity of pressure coming on the soil should not exceed the safe bearing capacity.
3. Foundation should be designed in such a way that settlement to the ground is limited and uniform under whole of the building to avoid damage to the structure.
4. Whole design of the foundation, super structure and characteristics of the ground should be studied to obtain economy in construction work.

#### **Ratio of Cement Concrete and Mortar for Foundation:**

1. The cement concrete 1:8:16 is generally used in the foundation of walls in construction work.
2. In case of column raft cement concrete 1:4:8 is the best recommended ratio for it in the foundation.
3. For brick masonry cement mortar 1:4 to 1:6 is used as loading condition

#### **Precautions during Excavation of Foundation Work:**

1. The depth of the foundation should not be less than 1 meter in case the design is not available.

2. The length, width and depth of excavation should be checked with the help of center line and level marked on the burjis.
3. The excavated material/ earth should be dumped at a distance of 1 meter from the edges.
4. Work should be done on dry soil.
5. Arrangement of water pump should be made for pumping out rain water.
6. The bottom layer of the foundation should be compacted.
7. **There should be no soft places in foundation due to roots etc.**
8. **Any soft/ defective spots should be dug out and be filled with concrete/ hard material**

## **Walls**

### **Types of wall & their functions**

1. **Load Bearing Wall:** carries loads imposed on it from beams and slabs above including its own weight and transfer it to the foundation
2. **Non Load Bearing Wall:** Non-load bearing walls only carry their own weight and does not support any structural members such as beams and slabs
3. **Cavity Walls:** It is a wall constructed in 2 leaves / skins with a space / cavity between them. Cavity walls helps to prevent the penetration of rain to the internal surface of the wall
4. **Shear Wall:** Shear walls are a framed wall designed to resist lateral forces. It is a vertical elements of the horizontal force resisting system. It is used to resist wind and earthquake loading on a building. It is typically a wood frame stud walls covered with a structural sheathing material like plywood
5. **Partition Wall:** Partition wall is an interior non-load bearing wall to divide the larger space into smaller spaces. The heights of a partition wall depends on the use which may be one storey or part of one storey. These walls are made up of glass, fiber boards or brick masonry.
6. **Panel Wall:** Panel wall is generally made of wood and is an exterior non-load bearing wall in framed construction. It is used for aesthetics of the buildings both inside and outside.
7. **Veneered Walls:** Masonry veneer walls is a single non-structural external masonry wall made of brick, stone or manufactured stone. It has an air space behind and is called as anchored veneer.
8. **Faced Wall:** Faced walls has the facing and backing of two different materials are bonded together to ensure common action under load.

## **Choosing wall thickness, Height to length relation**

<http://www.nzdl.org/cgi-bin/library?e=d-00000-00—off-0dlsZz-e-00-0—0-10-0—0—0direct-10—4—0-1l-11-en-50—20-home—00-0-1-00-0-4—0-0-11-10-0utfZz-8-00&cl=CL4.8&d=HASH593bba37f3fa9bc1455599.4.3.1>=1>

### **Choosing wall thickness**

Factors affecting type of masonry and brick:

- **Climate:** In addition to the necessary strength, the walls must also provide acceptable thermal insulation
- **aesthetic component:** Single-brick masonry looks much more elegant than one-and-a-half or double brick masonry.

As for the thickness of the wall, it can vary from 12 to 64 cm:

- laying in half a brick (its thickness is 12 cm);
- in 1 brick (25 cm);
- 1.5 bricks (38 cm);
- 2.0 bricks (51 cm);
- 2.5 bricks (64 cm).

The thickness of a wall depends on three things:

- whether the wall is exterior or interior: interior walls usually do not support the weight of the roof and can therefore be thinner; interior walls also play a less important role in insulating the building from heat and cold
- what the wall is made of: walls made of stronger materials can be thinner than walls made of weaker materials;
- the climate: buildings in desert-like climates need thicker walls, while buildings in tropical climates need thinner walls

### **Height to Length relation**

When the walls will be made of rammed earth, stone, concrete, bamboo, or any other material other than block or bricks, the height and length of the walls should be exactly as planned in the basic wall design.

However, when using blocks of any kind (adobe, sand-cement, cement, etc.) it may not be possible to build a wall exactly the height and length Planned.

For example, if the blocks used will measure 12 cm. high, a wall could be 2.88 meters (24 blocks) high or 3 meters (25 blocks) high; but it couldn't be 2.96 meters high unless one layer of blocks was cut in half, and this is difficult to do. In the same way, if the blocks used will measure 40 cm. long, a wall could be 7.20 meters (18 blocks) long or 7.60 meters (19 blocks) long; but it couldn't be 7.35 meters long unless one block in each layer of the wall were cut 5 cm. short.

## **Use of scaffolding**

Scaffolding is a temporary structure that is typically made from metal poles and wood planks and used to support construction workers, inspectors, cleaners, and others who need to work at height.

### **Uses:**

- **Cleaning:** Workers commonly can stand on scaffolding to clean windows and other parts of skyscraper buildings.
- **Construction:** it allows workers to stand at height on a stable surface.
- **Industrial inspections:** allows inspectors to reach areas they couldn't otherwise access in order to perform visual inspections or other kinds of NDT testing.
- **Maintenance:** they uncover areas that may require maintenance
- **Other uses:** Art installations, Concert stages, Exhibition stands, Grandstand seating, Observation towers, Shoring, Ski ramps

## **Damp Proofing**

Damp proofing or a Damp-Proof in construction is a type of moisture control applied to building walls and floors to prevent moisture from passing into the interior spaces. Dampness problems are among the most frequent problems encountered in residences

### **Causes of Dampness in Buildings:**

Absorption of moisture by the building materials is one of the chief causes of dampness. On account of granular nature of materials, moisture finds an easy access through the voids and this aided by capillary action assists the moisture to travel in different directions.

Thus, either on account of faulty design of structure or bad workmanship or by use of defective structures or by use of defective materials, moisture may find its way on the interior of the building either through the wall, floor or roof.

## **Sources of Dampness**

1. Dampness rising through the foundation walling – Moisture from wet ground may rise well above the ground level on account of capillary action.
2. Splashing rain water which rebounds after hitting the wall surface may also cause dampness.
3. Penetration of rain water through unprotected tops of walls, parapet, compound walls, etc may cause dampness.
4. Sloped roofs, rain water may percolate through defective roof covering. Faulty *eaves course* and *eave* or *valley gutters* may allow the rain water to descend through the top supporting wall and cause dampness.
5. In case of flat roofs, inadequate roof slopes, improper rainwater pipe connections, and defective junction between roof slab and parapet wall may prove to be the source of dampness.

## **Remedial measures to prevent Dampness**

1. Membrane damp proofing
2. Integral damp proofing
3. Surface treatment
4. Guniting
5. Cavity wall construction

## **Concrete Technology**

### **Constituents of cement concrete**

1. Cement/Lime
2. Fine Aggregates or Sand
3. Coarse Aggregates
4. Water

### **Grading of aggregates**

The particle size distribution of an aggregate as determined by sieve analysis is termed as gradation of aggregates. If all the particles of an aggregate are of uniform size, the compacted mass will contain more voids whereas aggregate comprising particles of various

sizes will give a mass with lesser voids. The particle size distribution of a mass of aggregate should be such that the smaller particles fill the voids between the larger particles. The proper grading of an aggregate produces dense concrete and needs less quantity of fine aggregate and cement waste, therefore, it is essential that coarse and fine aggregates be well graded to produce quality concrete.

Grading limits and maximum aggregate size are specified because these properties affect the amount of aggregate used as well as cement and water requirements, workability, pumpability, and durability of concrete. In general, if the water-cement ratio is chosen correctly, a wide range in grading can be used without a major effect on strength.

### **The Grading Curve of Aggregates:**

The grading of aggregates is represented in the form of a curve or an S-CURVE. The curve showing the cumulative percentages of the material passing the sieves represented on the ordinate with the sieve openings to the logarithmic scale represented on the abscissa is termed as Grading Curve. The grading curve for a particular sample indicates whether the grading of a given sample conforms to that specified, or it is too coarse or too fine, or deficient in a particular size.

### **Types of Grading of Aggregates:**

1. Dense-or well-graded aggregate – Has gradation close to the FWHA maximum density grading curve.
2. Gap-graded aggregate – Has only a small percentage of particles in the mid-size range.
3. Uniformly graded aggregate – Composed mostly of particles of the same size.
4. Open-graded aggregate – Contains only a small percentage of small-size particles.

## **Concrete mixes**

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required, strength, durability, and workability as economically as possible, is termed the concrete mix design.

### **Types of Mixes:**

1. **Nominal Mixes:** In the past the specifications for concrete prescribed the proportions of cement, fine and coarse aggregates. These mixes of fixed cement-aggregate ratio which ensures adequate strength are termed nominal mixes. These offer simplicity and under normal circumstances, have a margin of strength above that specified. However, due to the variability of mix ingredients the nominal concrete for a given workability varies widely in strength.
2. **Standard mixes:** The nominal mixes of fixed cement-aggregate ratio (by volume) vary widely in strength and may result in under- or over-rich mixes. For this reason,

the minimum compressive strength has been included in many specifications. These mixes are termed standard mixes.

IS 456-2000 has designated the concrete mixes into a number of grades as M10, M15, M20, M25, M30, M35 and M40. In this designation the letter M refers to the mix and the number to the specified 28 day cube strength of mix in N/mm<sup>2</sup>. The mixes of grades M10, M15, M20 and M25 correspond approximately to the mix proportions (1:3:6), (1:2:4), (1:1.5:3) and (1:1:2) respectively.

3. In these mixes the performance of the concrete is specified by the designer but the mix proportions are determined by the producer of concrete, except that the minimum cement content can be laid down. This is most rational approach to the selection of mix proportions with specific materials in mind possessing more or less unique characteristics. The approach results in the production of concrete with the appropriate properties most economically. However, the designed mix does not serve as a guide since this does not guarantee the correct mix proportions for the prescribed performance.

For the concrete with undemanding performance nominal or standard mixes (prescribed in the codes by quantities of dry ingredients per cubic meter and by slump) may be used only for very small jobs, when the 28-day strength of concrete does not exceed 30 N/mm<sup>2</sup>. No control testing is necessary reliance being placed on the masses of the ingredients.

### **Water cement ratio**

Water-Cement ratio means the ration between weight of water to the weight of cement used while preparing concrete mix. Water Cement ratio plays important role in developing the strength of concrete.

The water-cement ratio is also responsible for the porosity of the hardened cement paste. Water cement ratio is stated as the amount of water used to the significant amount of cement in the mixture by weight for proper workability.

A minimum water-cement ratio of about 0.3 by weight is necessary to ensure that the water comes in contact with all the cement particles, Which assures complete hydration of the cement paste.

Water-cement theory states that for a given combination of materials and as long as workable consistency is obtained, the strength of concrete at a given age depends on w/c ratio.

In 1918, Duff Abrams made water cement ratio law for strength of concrete.

$$\sigma_c = \frac{A}{B^{1.5(w/c)}}$$

where,

$\sigma_c$  = compressive strength at fixed age

A = empirical constant (96.5MPa)

B = constant that depends mostly on cement properties(about 4) & water cement ratio by weight

### How To Calculate Water Quantity in Concrete Mix.

Normally the water cement ratio varies from 0.4 to 0.6 as per IS 10262 (2009) for nominal mix (M10, M15...) However the maximum strength of concrete is obtained at a water cement ratio of 0.4, besides we know that for a complete hydration of concrete the water requirement is about 38%.

Generally the formula used to calculate the amount of water is given below :

Reqd Amount of Water = W/C Ratio \* Cement Volume.

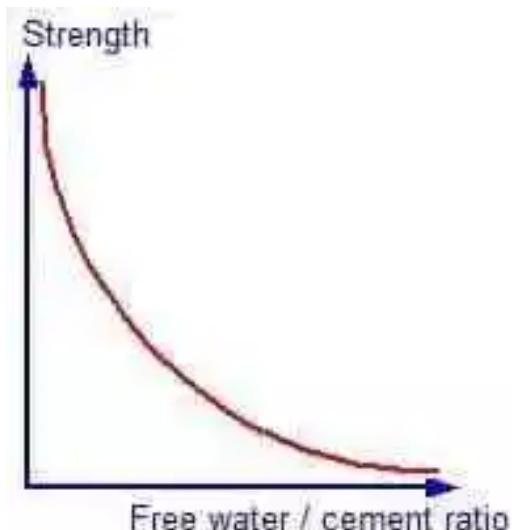
### Factors affecting strength of concrete

#### 1. Quality of Raw Materials:

- **Cement:** Provided the cement conforms with the appropriate standard and it has been stored correctly (i.e. in dry conditions), it should be suitable for use in concrete.
- **Aggregates:** Quality of aggregates, its size, shape, texture, strength etc determines the strength of concrete. The presence of salts (chlorides and sulphates), silt and clay also reduces the strength of concrete.
- **Water:** frequently the quality of the water is covered by a clause stating “..the water should be fit for drinking..”. This criterion though is not absolute and reference should be made to respective codes for testing of water construction purpose.

#### 2. Water / Cement Ratio:

The relation between water cement ratio and strength of concrete is shown in the plot as shown below:



The higher the water/cement ratio, the greater the initial spacing between the cement grains and the greater the volume of residual voids not filled by hydration products. There is one thing missing on the graph. For a given cement content, the workability of the concrete is reduced if the water/cement ratio is reduced. A lower water cement ratio means less water, or more cement and lower workability. However if the workability becomes too low the concrete becomes difficult to compact and the strength reduces. For a given set of materials and environment conditions, the strength at any age depends only on the water-cement ratio, providing full compaction can be achieved

### 3. Coarse / fine aggregate ratio:

Following points should be noted for coarse/fine aggregate ratio:

- If the proportion of fines is increased in relation to the coarse aggregate, the overall aggregate surface area will increase.
- If the surface area of the aggregate has increased, the water demand will also increase.
- Assuming the water demand has increased, the water cement ratio will increase.
- Since the water cement ratio has increased, the compressive strength will decrease.

### 4. Aggregate / Cement Ratio

Following points must be noted for aggregate cement ratio:

- If the volume remains the same and the proportion of cement in relation to that of sand is increased the surface area of the solid will increase.
- If the surface area of the solids has increased, the water demand will stay the same for the constant workability.

- Assuming an increase in cement content for no increase in water demand, the water cement ratio will decrease.
- If the water cement ratio reduces, the strength of the concrete will increase.

The influence of cement content on workability and strength is an important one to remember

#### 5. Age of concrete:

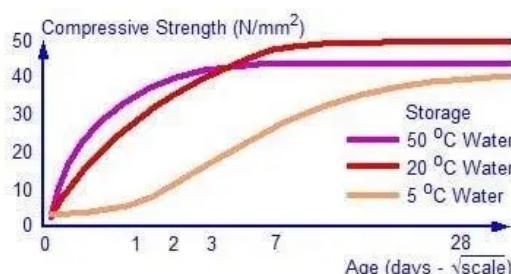
The degree of hydration is synonymous with the age of concrete provided the concrete has not been allowed to dry out or the temperature is too low. In theory, provided the concrete is not allowed to dry out, then it will always be increasing albeit at an ever reducing rate. For convenience and for most practical applications, it is generally accepted that the majority of the strength has been achieved by 28 days.

#### 6. Compaction of concrete:

Any entrapped air resulting from inadequate compaction of the plastic concrete will lead to a reduction in strength. If there was 10% trapped air in the concrete, the strength will fall down in the range of 30 to 40%.

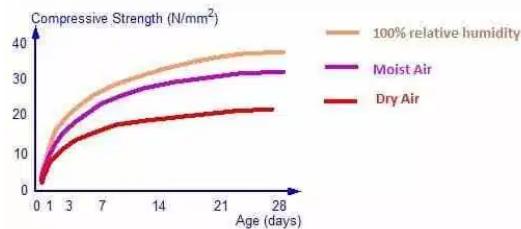
#### 7. Temperature:

The rate of hydration reaction is temperature dependent. If the temperature increases the reaction also increases. This means that the concrete kept at higher temperature will gain strength more quickly than a similar concrete kept at a lower temperature. However, the final strength of the concrete kept at the higher temperature will be lower. This is because the physical form of the hardened cement paste is less well structured and more porous when hydration proceeds at faster rate. This is an important point to remember because temperature has a similar but more pronounced detrimental effect on permeability of the concrete.



#### 8. Relative humidity:

If the concrete is allowed to dry out, the hydration reaction will stop. The hydration reaction cannot proceed without moisture. The three curves show the strength development of similar concretes exposed to different conditions.



### 9. Curing:

It should be clear from what has been said above that the detrimental effects of storage of concrete in a dry environment can be reduced if the concrete is adequately cured to prevent excessive moisture loss

## Form work

Formwork is the term used for the process of creating a temporary mould into which concrete is poured and formed. Traditional formwork is fabricated using timber, but it can also be constructed from steel, glass fibre reinforced plastics and other materials.

While formwork is a broad term that is used in relation to the forming process using a wide variety of materials, shuttering is a term that is often used to refer to the process of using plywood to form the mould.

Shuttering is perhaps the most popular type of formwork and is normally constructed on site using timber and plywood. A special grade of plywood is necessary for shuttering, and it must be water-resistant. It is easy to produce, although it can be time consuming for larger structures. It is used when the labour costs are lower than the cost of producing re-usable formwork from materials such as steel or plastic. It also has the advantage of being able to pour a significant amount of concrete at once.

Simple plank shuttering can be used for the construction of a path or hardstanding. The planks should be trimmed so they are level with the top surface of the slab, allowing a tidy concrete finish to be achieved.

## Curing

Curing of Concrete is a method by which the concrete is protected against loss of moisture required for hydration and kept within the recommended temperature range. Curing will increase the strength and decrease the permeability of hardened concrete. Curing is also helps in mitigating thermal and plastic cracks, which can severely impact durability of structures.

A curing practice involves keeping the concrete damp or moist until the hydration of concrete is complete and strength is attained. Curing of concrete should begin soon after initial setting time of concrete or formwork/shuttering is removed and must continue for

a reasonable period of time as per the specified standards, for the concrete to achieve its desired strength and durability.

### Why Curing of Concrete is Necessary?

- Enhance Hydration of Concrete to achieve desired Strength
- Improved durability of concrete by reducing cracks
- Higher serviceability performance by increasing abrasion resistance
- Improved microstructure by developing better hydrate gels and solid mass.

### Methods to Cure Concrete

Depending upon the site constraints, type of structure and other material parameters, different methods of curing are adopted at site. Methods of curing concrete fall into the following categories:

1. **Water Curing:** Water curing prevents the water loss from the concrete surface by uninterrupted wetting of the exposed surface of concrete. It's done by spraying or sprinkling water or curing agents over the concrete surface to ensure that the concrete surface is continuously moist. Moisture from the body of concrete is retained from evaporating and contributes to the strength-gain of concrete.
2. **Membrane Curing:** Membrane curing lessens moisture loss from the concrete surface by wrapping it with an impermeable membrane. Curing compounds are wax, acrylic and water based liquids. These are sprayed over fresh concreting to create an impermeable membrane this will reduces the loss of wetness from the concrete.
3. **Steam Curing:** Steam curing keeps the surface moist and raises the temperature of concrete to quicken the rate of strength achievement. It is a process done to speed up the early hardening of concrete and mortars by subjecting it to steam and humidity. This method is most commonly used for precast concrete plants where products are mass-produced and the turnaround or striking time of the formwork is very quick.

# **Construction Management**

Construction Management is a professional service that uses specialized, project management techniques to oversee the planning, design, and construction of a project, from its beginning to its end. The purpose of CM is to control a project's time, cost and quality. CM is compatible with all project delivery systems, including design-bid-build, design-build, CM At-Risk and Public Private Partnerships. Professional construction managers may be reserved for lengthy, large-scale, high budget undertakings (commercial real estate, transportation infrastructure, industrial facilities, and military infrastructure), called capital projects.

## **Construction scheduling and planning**

### **Planning in Construction Management:**

It is the process of selecting a particular method and the order of work to be adopted for a project from all the possible ways and sequences in which it could be done. It essentially covers the aspects of 'What to do' and 'How to do it'.

### **Scheduling in Construction Management:**

Scheduling is the fitting of the final work plan to a time scale. It shows the duration and order of various construction activities. It deals with the aspect of 'when to do it'.

## **Network techniques (CPM, PERT)**

PERT and CPM are techniques of project management useful in the basic managerial functions of planning, scheduling and control. PERT stands for "Programme Evaluation & Review Technique" and CPM are the abbreviation for "Critical Path Method". These days the projects undertaken by business houses are very large and take a number of years before commercial production can start.

The techniques of PERT and CPM help greatly in completing the various jobs on schedule. They minimise production delays, interruptions and conflicts. These techniques are very helpful in coordinating various jobs of the total project and thereby expedite and achieve completion of project on time.

PERT is a sophisticated tool used in planning, scheduling and controlling large projects consisting of a number of activities independent of one another and with uncertain completion times. It is commonly used in research and development projects.

## **Key Steps in the Critical Path Method:**

1. Specify Each Activity
2. Establish Dependencies
3. Draw the Network Diagram
4. Estimate Activity Completion Time

### **forward pass and backward pass technique:**

**Forward pass:** This is used to calculate early start (ES) and early finish (EF) dates by using a previously specified start date. ES is the highest EF value from immediate predecessors, whereas EF is ES + duration. The calculation starts with 0 at the ES of the first activity and proceeds through the schedule. Determining ES and EF dates allows for early allocation of resources to the project.

**Backward pass:** This is used to calculate late start (LS) and late finish (LF) dates. LS is LF - duration, whereas LF is the lowest LS value from immediate successors. The calculation starts with the last scheduled activity and proceeds backward through the entire schedule.

5. Identify the Critical Path
6. Update the Critical Path Diagram to Show Progress

## **PERT:**

PERT uses three estimates to find a range for the duration of an activity:

1. Most likely estimate (M)
2. Optimistic (O)
3. Pessimistic (P)

The calculation for PERT is: Estimated time =  $(O + 4M + P) / 6$

## **Bar chart**

A bar chart or bar graph is a chart or graph that presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent. The bars can be plotted vertically or horizontally. A vertical bar chart is sometimes called a column chart.

A bar graph shows comparisons among discrete categories. One axis of the chart shows the specific categories being compared, and the other axis represents a measured value. Some bar graphs present bars clustered in groups of more than one, showing the values of more than one measured variable.

## **Gantt Chart**

A Gantt chart, commonly used in project management, is one of the most popular and useful ways of showing activities (tasks or events) displayed against time. On the left of the chart is a list of the activities and along the top is a suitable time scale. Each activity is represented by a bar; the position and length of the bar reflects the start date, duration and end date of the activity. This allows you to see at a glance:

To summarize, a Gantt chart shows you what has to be done (the activities) and when (the schedule).

## **Contractual procedure and management**

### **Types of contract**

1. **Lump Sum or Fixed Price Contract:** Under a Lump Sum or Fixed Price Contract, the contractor agrees to perform the work specified and described in the contract for a fixed price. The price of a fixed contract can only be changed upon the execution of a change order, under which the owner and the contractor either
2. **Measurement contract:** Measurement contracts (sometimes called “re-measurement” or ‘measure and value’ contracts) contains a Bill of Quantities ( BOQ ) provided by the employer or its consultants, can be used in situations where the design (or type of works) can be described in reasonable detail, but the amount cannot. The contractor will quote against each BOQ item and enter a unit rate or unit price to build up the total contract price on basis of those BOQ quantities. During the construction period, the actual quantity of works executed under each BOQ item will be jointly measured and valued at the quoted rate for interim payment purpose.
3. **Turnkey Contract:** A turnkey contract is a business arrangement in which a project is delivered in a completed state. Rather than contracting with an owner to develop a project in stages. The developer is hired to finish the entire project without owner input. The builder or developer is separate from the final owner or operator, and the project is turned over only once it is fully operational. In effect, the developer is finishing the project and “turning the key” over to the new owner.
4. **Design and Build:** Design and Build procurement works on the basis that the main contractor is responsible for undertaking both the design and construction work on a project, for an agreed lump-sum price.
5. **Cost Plus Contracts:** The Cost Plus Contract is a type of a construction contract under which the owner agrees to pay the complete cost of the materials and labor needed to build the project along with a fee for the contractor’s overhead and profit. This contract type is favored where the scope of work is highly uncertain

or indeterminate and the type of labor, material, and equipment needed to build the project is also uncertain in nature.

6. **Unit Price Contracts:** Unit Price Contracts are based on anticipated quantities of items which are counted in the project in addition to their unit prices. The final price of the project depends upon the quantities required to carry out the work. Generally, these types of contracts are suitable only for construction and supplier projects which involve accurate identification of different types of items, but not their numbers, in the contract documents. These types of contracts are oftentimes used on excavation projects.
7. **Time and Material Contracts:** Time and Material Contracts are usually preferred if the project scope is not clear, or has not been defined. The owner and the contractor must establish an agreed hourly or daily rate, including additional expenses that could arise in the construction process. The costs must be classified as direct, indirect, mark-up, and overhead. Sometimes the owner might want to establish a cap or specific project duration to the contractor that must be met, in order to have the owner's risk minimized.
8. **Item rate contract:** For this contract, contractors are required to quote rates for individual items of work on the basis of schedule of quantities furnished by the client's department.
9. **Percentage rate contract:** In this form of contract, the client's department draws up the schedule of items according to the description of items sanctioned in the estimate with quantities, rates, units and amounts shown therein.
10. **Labour contract:** This is a contract where the contractor quotes rates for the item work exclusive of the elements of materials which are supplied by the client's Department.
11. **Piece-Work agreement:** This is that for which only a rate is agreed upon without reference to the total quantity of work to be done or the quantity of work to be done within a given period.
12. **Target Contract:** This is the type of contract where the contractor is paid on a cost-plus percentage work performed under this contract. In addition, he receives a percentage plus or minus on savings or excess effected against either a prior agreed estimate of total cost or a target value arrived at by measuring the work on completion and valuing at prior agreed rates.

### **Tender and tender notice**

A **tender** is an invitation to bid for a project or accept a formal offer such as a takeover bid. Tendering usually refers to the process whereby governments and financial institutions invite bids for large projects that must be submitted within a finite deadline. The

term also refers to the process whereby shareholders submit their shares or securities in response to a takeover offer.

#### **Tender Notice:**

The notice inviting tender is a very important document on which tenders and subsequently agreements with the contractors are based. The tender notice should stipulate short description of the work, period of construction, date and time for submission of the tender, amount of earnest money to be deposited, manner of depositing the earnest money, estimated amount of the tender, source of receiving the tender documents and the name and address of the officer/person to whom the completed tenders are to be deposited and any important information which need be communicated to the tender.

#### **Preparation of bidding document**

To notify publicly, the tender document fulfilling the requirements is prepared before inviting tender. Approval of tender documents by the concerned authority is essential.

#### **Contract prequalification/Post qualification**

To limit the number of firms allowed to submit tenders on a project, some owners require that contractors be **pre-qualified**. They must submit information about their experience, competence and financial condition, after which the owner decides whether they are qualified.

#### **Evaluation of tenders and selection of contractor**

/todo: search in book too many unrelated search results

#### **General Condition of contract**

The General Conditions of Contract (GCC) form part of all public bid documents and no one can amend them. They allow for Special Conditions of Contract (SCC). If you want to do business with the public sector, you often have to agree to them. You'll find that private sector customers use different names for theirs, but the effect is the same. All these conditions of contract favour the customer and place many obligations on you, as a vendor of goods or services.

#### **e-bidding**

E-Bidding is one of three stages of E-procurement.

#### **Merits:**

- more transparent
- helps to check unwarranted pressure on bidding
- promotes free and fair competition
- saves time
- record of bidding can be easily extracted for future reference

### **Single envelope & double envelope system**

#### **Single-Stage: One-Envelope Bidding Procedure:**

- Bidders submit bids in one envelope containing both the price proposal and the technical proposal.
- The envelopes are opened in public at the date and time advised in the bidding document. The bids are evaluated.
- the contract is awarded to the bidder whose bid has been determined to be the lowest evaluated substantially responsive bid.

#### **Single-Stage: Two-Envelope Bidding Procedure**

- Bidders submit two sealed envelopes simultaneously, one containing the technical proposal and the other the price proposal, enclosed together in an outer single envelope.
- Initially, only the technical proposals are opened at the date and time advised in the bidding document. The price proposals remain sealed and are held in custody by the purchaser. The technical proposals are evaluated by the purchaser. No amendments or changes to the technical proposals are permitted. This allows the purchaser to evaluate the technical proposals without reference to price. Bids of bidders who do not conform to the specified requirements may be rejected as deficient bids, with ADB's approval.
- at a date and time advised by the purchaser, the price proposals are opened in public. The price proposals are evaluated.
- , the contract is awarded to the bidder whose bid has been determined to be the lowest evaluated substantially responsive bid.

# **Professional Practices**

The term ‘professional practice’ refers to the conduct and work of someone from a particular profession.

Professions are occupations that require a prolonged period of education and training. They are often overseen by professional bodies who may accredit educational establishments and qualified professionals. Qualification may be recognised by the designation ‘member of...’, ‘certified’, ‘chartered member’, ‘fellow’, and so on. For example, a professional member of the Chartered Institute of Architectural Technologists may use the letters MCIAT after their name (member of).

Professional bodies may set standards of ethics, performance, competence, insurance, training and so on that must be met to remain within the profession. These are typically set out in a code of conduct.

## **Ethics and professionalism**

**Ethics:** concepts of right and wrong; moral principles guiding behavior

**Professionalism:** conduct or qualities marking a professional person

### **What are Ethics?**

Ethics are guidelines for individuals, which clearly state the dos and don’ts. Ethics exists in many contexts. Especially in the industrial setting, ethics are considered as vital. In this context, a work ethic is imposed on all employees. This guides the employees to be ethically correct in all their actions. Ethics include a number of features such as confidentiality, respect, honesty, transparency, competency, etc. This can be understood through an example. Counseling is a profession where the significance of the ethical code is very high. A counselor is expected to be ethical throughout his or her practice so that it is beneficial for the counselor and counselee, the society at large and also the counseling profession. Let us take the case of competency. It is expected that all counselors should be competent in practicing counseling. If the counselor is not competent, he will not be able to assist the client and can even cause damage to the client. This is why in any profession ethics is established.

### **What is Professionalism?**

Professionalism can be defined as the skills, competence and the conduct displayed by an individual of a certain profession. It is also expected that such a person cultivate

a polite demeanor when dealing with clients and fellow professionals. Professionalism encompasses a variety of dimensions. It is not only polite behavior or else academic competence; on the contrary, it is a mixture of a number of qualities that contribute to professionalism. A professional needs to have specialized knowledge in his particular field. This is one of the main characteristics of a true professional. If the individual has gaps in his knowledge, the contribution, that he can make, is minimal. Being competent is also important. If an individual has all the academic certificates but, still fails to work competently, then it is also disruptive to the individual as well as organizational performance. Other traits such as honesty, integrity, politeness are also important for a professional. This can be considered as one of the great assets of the corporate sector as it allows the individual to perform well.

### **What is the difference between Ethics and Professionalism?**

- Ethics refers to the guidelines that state the dos and don'ts in a specific context whereas professionalism refers to the specific traits that are expected of a professional.
- Ethics are usually stated whereas professionalism is cultivated by the individual personally.

### **Code of conduct and guidelines for professional engineering practices**

<https://www.nec.gov.np/uploads/brochure/vqWyQ2eizB170618111120.pdf>

The professional Code of Conduct to be followed by the registered Engineers of the Council, subject to the provision of the Nepal Engineering Council (NEC) Act, 2055 (1998) and the Nepal Engineering Council Regulation, 2057(2000), has been published as follows :

1. **Discipline and Honesty** : The Engineering service/profession must be conducted in a disciplined manner with honesty, not contravening professional dignity and well-being .
2. **Politeness and Confidentiality:** Engineering services for customers should be dealt with in a polite manner and professional information should remain confidential except with written or verbal consent of the customers concerned. This, however, is not deemed to be a restriction to provide such information to the concerned authority as per the existing laws.
3. **Non-discrimination** : No discrimination should be made against customers on the grounds of religion, race, sex, caste or any other things while applying professional knowledge and skills.
4. **Professional Work:** Individuals should only do professional work in their field or provide recommendations or suggestions only within the area of their subject of

study or obtained knowledge or skills. With regard to the works not falling within the subject of one's profession, such works should be recommended to be done by an expert of that subject matter.

5. **Deeds which may cause harm to the engineering profession :** With the exception of salary, allowance and benefits to be received for services provided, one shall not obtain improper financial gain of any kind or conduct improper activities of any kind, which would impair the engineering profession.
6. **Personal responsibility:** All individuals will be personally responsible for all works performed in connection with his/her engineering profession.
7. **State name, designation and registration no:** While signing the documents or descriptions such as the design, map, specifications and estimates etc, relating to the engineering profession, the details should include, the name, designation and NEC registration No. and should be stated in a clear and comprehensible manner.
8. **No publicity or advertisement must be made which may cause unnecessary effect:** In connection with the professional activities to be carried out, no publicity or advertisement shall be made so as to cause unnecessary effect upon the customers.

## **Nepal Engineering Council Act, 2055 and regulations, 2056**

<https://www.studocu.com/row/document/purbanchal-vishwavidyalaya/epp-engineering/the-nepal-engineering-council-act/12265184>

/todo: find regulations

## **Relation with clients, contractor and fellow professionals**

### **Relationship with clients:**

- Strict professional relationship, even if the client is closely familiar (relative, friend)
- No discrimination among client based on culture, race, religion, sex, ...
- Work in the best interest of the client with loyalty with legal limit
- Deliver in time, with quality
- Not expect extra favour for works performed as per an agreement
- “An engineer shall not accept financial or other compensation from more than one party for services rendered on one project unless the details are fully disclosed and agreed by all parties.”
- Supervise work and prevent misuse/abuse of client's property/trust

- Assist in decision making by providing options
- Warn potential risks of decisions
- Going beyond ToR, when professionally required
- Keep information confident, unless required by law
- Full disclosure of potential conflict of interest, if any
- Not take a client for granted: remembrance of bad experience lingers much longer than a good experience

### **Relationship with contractor:**

- Strict professional relationship, even if the contractor is closely familiar (relative, friend)
- Provide due respect to the contractor
- No discrimination among contractors based on belief, race, religion, culture, sex, sexual orientation, ...
- Provide all the detailed drawings, quantity and quality (including specification) of works (goods and services) to the contractor in time
- Check and approve running bills in time, as per specification
- Not expect or accept (directly or indirectly) extra favour of significant value, for works performed as per an agreement
- Supervise work and prevent use of sub-standard methods and materials being used
- Participate in co-decision making by providing options when necessary
- Assist the contractor when variations are technically needed
- Warn potential risks of decisions/actions
- Going beyond ToR, when professionally required

### **Relationship with fellow professionals:**

- Professional relationship with all the engineers, regardless of their status, and even if the fellow engineer is a close relative
- “Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputations, prospects, practice or employment of other engineers, nor indiscriminately criticize the work of other engineers”
- Criticize cautiously and objectively with respect to the person’s professional status
- Have professional relationship

- Encourage fellow engineers to follow Code of Ethics
- Guide, train and orient freshly graduate engineers
- Create platform for information and knowledge sharing
- Support fellow engineers in professional development

## **Public procurement practices for works, goods and services and its importance**

### **Procedure for inviting tender**

1. Preparation of tender documents
2. Issue of notice inviting tender or tender call notice
3. Submission and opening of tenders and their security
4. Acceptance of tender and award of Contract

### **Procurement Method**

1. International Competitive Bidding
2. National Competitive Bidding
3. Sealed Quotation
4. Direct Purchase
5. Direct Purchase
6. Work through Users' committee or Beneficiary Community

### **Public procurement act, 2063**

[https://ppmo.gov.np/image/data/files/acts\\_and\\_regulations/public\\_procurement\\_act\\_2063.pdf](https://ppmo.gov.np/image/data/files/acts_and_regulations/public_procurement_act_2063.pdf)

### **Why is procurement important?**

Many decisions taken by departments have a procurement implication that can impact on the overall cost of carrying out the decision. Here cost includes the total cost of the good or service and not simply the price that is paid.

In the private sector, procurement is viewed as a strategic function working to improve the organisation's profitability. Procurement is seen as helping to streamline processes, reduce raw material prices and costs, and identifying better sources of supply. In essence, helping to reduce the 'bottom line'. Indeed, in many organisations the importance of procurement is recognised by having their head of procurement placed at an Executive Board level.

In the public sector, the concept of a ‘bottom line’ is less well defined - there are no shareholders’ dividends to be paid out or publicly declared profit (or loss) announcements. There is however a need to maximise the output, in terms of teaching within the available funds. These funds come, substantially, from public funding in the form of grants, student fees etc. We are the sector’s shareholders as tax payers, students and/or staff. This, therefore, places an inherent requirement that the funds provided are managed in a manner that is accountable and demonstrates both probity and value for money.

At higher levels of expenditure, this need for openness, transparency and non-discriminatory action is required by legislation. The European Procurement legislation, implemented in the UK, means that all requirements for supplies, services and works that exceed the value thresholds defined in the Regulations are advertised and tendered in accordance with published rules.

Within an institution, its expenditure is made up of two distinct elements - pay (salaries and wages) and non-pay (all other expenditure). Procurement is concerned with the management of a significant proportion of the non-pay expenditure and ensuring that the best possible value for money is obtained when committing this expenditure. Non-pay spend includes the day-to-day running costs of the institution as well as its capital expenditure. This expenditure can be further divided into that which is used to obtain goods and services from suppliers and other expenditure such as payments made to other educational establishments or to HM Revenue and Customs. The procurement function is concerned with obtaining the required goods and services from appropriate suppliers to enable the institution to meet its strategic objectives in an economic, efficient and effective manner.

Research has shown that within an institution, its non-pay expenditure is usually between 30 - 40% of its total expenditure.