Ancient Indian Architecture—A Pillar of Civilization

Any Indian familiar with the history of Indian civilization, culture and heritage feels proud of India’s outstanding achievements in the fields of architecture and civil engineering. The whole of India is dotted with magnificent structures comprising of stupas, temples, mosques, churches, palaces, fortresses, etc. which have stood for centuries bearing testimony to Indian ingenuity, creativity, aesthetic sense and professional skills in the above fields. Be it the temples at Ellora or the Taj Mahal at Agra, examples abound to make it a wonder on architectural excellence, aesthetic, engineering skills in design, workmanship and construction technology.

Architect and New Construction Materials & Techniques

The architect of today is both an artist and an engineer, who must synthesise his architectural ideas with scientific knowledge of design and construction of civil structures. He must be conversant with the available resources in labour, techniques and materials to produce a harmonious, durable and functional structure in line with his architectural concept.

Architecture has always been constrained by the availability of materials and restricted by techniques of design and construction. Discovery of newer materials of construction along with the development of sophisticated design and construction technology, steel-framed superstructures and reinforced and prestressed concrete have provided the architect an unlimited scope to use their creative imagination to put up structures which not only display architectural elegance but also meet the functional requirements without jeopardizing structural safety in any manner. Thus, the modern structures represent a harmonious blending of art, aesthetics, environmental considerations, application of sophisticated design and construction technology and expression of modern culture.

It is understandable that architecture and engineering play complementary roles from conception to construction, though the relative importance of either would vary from structure to structure. In the case of a temple, a church or a mosque, the architectural considerations may outweigh the engineering requirements of economy but the same is reversed in the case of a bridge, a hospital or an industrial building. The fact remains that for proper planning, designing and erecting a structure, its intended functions, architectural needs, quality of construction, durability and overall cost have all to be weighed and a judicious application of the sciences of architecture and engineering have to be made. Thus, an architect, to be true to his profession, needs to be an engineer as well.

Role of Architectural Engineers

In the planning and execution of large and complex civil engineering works, India has made rapid strides in the last two decades. It is now recognised that architecture and aesthetics are no longer confined exclusively to buildings but play an important part in the construction of bridges, flyovers, warehouses, factories, special structures for hydro/thermal power projects, marine structures, landscaping along highways, etc.
AGRICULTURAL ENGINEERING

Compulsory Subjects
I C 402 Engineering Management
AR 403 History of Architecture
AR 404 Building Services
AR 405 Quantity Surveying, Specifications, Contracts and Valuation
AR 406 Surveying, Building Construction and Materials
AR 407 Architectural Design

Optional Subjects
*(Any three from any one group)*

Group I Structural Engineering
AR 411 Soil Mechanics and Foundation Engineering
AR 412 Construction Technology
AR 413 Theory of Structures
AR 414 Prestressed and Precast Concrete Structures
AR 415 Structural Design

Group II Design and Planning
AR 421 Ekistics
AR 422 Town Planning and Landscape Architecture
AR 423 Climatology

Group III Professional Practice
AR 431 Professional Practice
AR 432 Mapping a Thesis Project
AR 433 Interior Design
AR 434 Computer Graphics

Project Work
and
Laboratory Experiments
[10 (ten) experiments are to be undertaken from the prescribed list]
## Indian Architecture


**Islamic architecture:** Cultural differences and similarities of local inhabitants and invaders. Influence of advanced technology—domes, arches, vaults, conversion of places of worship into new needs of invaders.

Study of early buildings in India expressing vigour in the form of buildings. Study of advancement of building technology and space conception in places like Bijapur, Mandu, Fatehpur Sikri.

Study of the examples of Moghul architecture such as tomb, forts and palaces, and the development of various provincial styles of architecture like Sudh, Bijapur, Gujarat, etc.

### Group A

- **Recommended Books**
  - P K Acharya. A Dictionary of Indian Architecture.
  - P Brown. Indian Architecture—Buddhist and Hindu.
  - P Brown. Indian Architecture—Islamic.

## Foreign Architecture

Developments of styles and forms in Europe, Egypt, West Asia, Greek and Roman architecture. Developments in Renaissance and Baroque periods. Integration of indoor and outdoor frames, study of development of art forms with respect to cultural events.

**Modern architecture:** Role of steel, RCC, aluminium, plastics, glass and timber technology in modern buildings. Modern skyscrapers, Chicago school works, Frank Lloyd, Machintosh, Le Corbusier, Nervi, etc.

### Group B

- **Recommended Books**
  - P K Acharya. A Dictionary of Indian Architecture.
  - P Brown. Indian Architecture—Buddhist and Hindu.
  - P Brown. Indian Architecture—Islamic.
Recommended Books
w H M Sharp. Introduction to Lighting.

QUANTITY SURVEYING, SPECIFICATIONS, CONTRACTS AND VALUATION

Group A

Estimating: Introduction, definition, objective, scope and importance. Approximate estimate on plinth area basis, estimate based on cubic content method as approved by Indian Bureau of Standards. Estimate based on detailed quantities and mode of measurements as per BIS 1200.


Rate analysis: Rate analysis of important items like materials, labour, plant and contractor's profit.

Specifications: Importance of specifications, methods of developing specifications, typical specifications for building items, standard reference.

Group B


Recommended Books

SURVEYING, BUILDING CONSTRUCTION AND MATERIALS

Group A

Ideas about chain survey, compass survey, plane table survey, levelling and theodolite survey.


Setting out building works.

Building Construction


Floor systems: Beam and slab floors, flat slab, rectangular and diagrid systems, present units, hollow tile flooring, timber flooring, precast floors.

Access: Various types of staircases, ramps, lifts, escalators, emergency exits, bye-law requirements. Principles of barrier-free access to handicapped persons.

Basements: Planning, design and construction of basements, waterproofing, disposal of seepage, security measures in bank vaults, precautions against flooding and fire, groundwater uplift in basements.

Roofs: Study of various types of roofs, steel, timber, and pre-cast trusses, corrugated sheets of steel, aluminium, etc., tiled roofs, RCC roofs, domes and shells.
**Recommended Books**

- W De-Charia. Time Saver Standards for (a) Architectural Design, (b) Residential Development, (c) Building Types, and (d) Site Planning.

**Recommended Books**


**SOIL MECHANICS AND FOUNDATION ENGINEERING**

- **Group A**
  - **Soil identification and classification:** Introduction—soil as a three-phase system. Atterberg’s limits and indices; weight-volume relationship; particle size analysis; specific gravity.
  - **Physical and mechanical properties:** Compaction characteristics; determination of field density; standard and modified Proctor’s tests. Permeability and laboratory determination; field pumping tests; effective stress principles; flow nets and their applications. Elements of shear strength; study of laboratory direct shear; unconfined compression and triaxial shear tests. Theory of one-dimensional consolidation; principles of methods of estimation of settlements.
  - **Subsurface investigations:** Exploratory borings, depth of exploration; spacing and number of boring; methods of sampling and types of samples; bore logs; core recovery; rock
quality designation; field vane shear test; standard penetration test and its applications; field plate load test and limitations.

**Group B**

Ultimate bearing capacity of shallow foundations: Concepts of ultimate bearing capacity; important parameters influencing the ultimate bearing capacity; estimation of safe allowable bearing capacity. Plate load test. Elements of combined and raft foundations.

Deep foundations: Classification of piles; bearing capacity of deep foundations; settlement predictions in case of piles in compressible soils. Elements of well foundations. Pile load test and use of relevant BS code.

Improving the soil at site: Different methods of improving soil characteristics at site. Elements of soil stabilization, sand drains and vibroflotation techniques. Use of geotextiles.

**Recommended Books**


**Group A**

Clearing of site, diversion of services, planning and execution of temporary works, provision of infrastructural facilities, line out/layout of works.

Foundations: Open foundations, shoring and strutting, pile foundations, various types of piles such as under reamed, cast-in-situ prefrcast, etc., sheet piles, diaphragm wall, problems in water-logged soil, black cotton soil problems, brick and stone masonry in foundations. Raft foundations, machine foundations, use of bentonite, foundations for timber and steel–framed structures, anti–termite treatment of foundations.

**Group B**

Load bearing and framed structures: Comparison—mode of action, rigid frames, earthquake resistance, timber, steel and RCC frames. Precast columns and beams. Connections. Bye-law requirements. Design of formwork, stationary formwork, sliding and slip forms, materials for economical and reusable forms, material storage practices, design, erection and removal of scaffolding. Structural steel construction—shop fabrication, erection, rivetted and welded connections, fire and corrosion protection. RCC and prestressed concrete construction practices, prefabrication and precasting. Joining, detailing, bar bending, schedule and shop drawings, modular coordination, standardization, manufacture, storage, transportation and rejection of precast components. Advantages and limitations of ready mixed concrete. Construction equipment—use of tractors, bulldozers, shovels, draglines, cablewarp and belt conveyors; batching plants, transit mixers and agitator trucks used for ready mixed concrete; concrete pumps, grouting pumps, air compressors, welding equipment, cranes, hoists and other lifting devices, vibrators, water pumps, trolleys, etc. Field tests on materials and finished components, quality control techniques.

**Recommended Books**

- P N Khanna. Indian Practical Civil Engineers’ Handbook. Engineers’ Publishers, Delhi.

**THEORY OF STRUCTURES**

**Group A**

Slopes and deflections in simply supported beams; double integration and moment area methods. Theorem of moments, fixed and continuous beams. Eccentric loads on short columns. Long columns, secant and empirical formulae. Columns subjected to lateral loads. Basic elastic theorems; Castigliano’s, Maxwell’s, Betti’s theorem and Mueller Breslau’s principle.

**Group B**


**Recommended Books**

- S Timoshenko and D H Young. Elements of Structures of Materials. D Van Nostrand Inc.

Precast concrete: Requirements of industrialised buildings, standardization of precast elements and unification of building design. Influence of manufacture, transport and erection technologies on design solution; expansion and contraction joints. Joints and connections; classification and their requirements. Advantages and disadvantages of precast concrete construction; different types of units involved in general building construction, including residential, factory and industrial framed structure; their general principles of design; mechanical handling of large projects.

Group B

Pre-stressed concrete: Historical development, basic concepts of pre-stressing, materials used and their properties; methods and systems of pre-stressing. Losses in pre-stress. Analysis of sections subjected to pre-stress and external load; general principles of design; Kern points, cable profile; choice of sections, principal tension; advantages of pre-stressed concrete over reinforced concrete. Use of pre-stressed concrete for long span bridges, hangers, auditoria, etc.

Recommended Books
w Koncz-Barrierlag. Manual of Precast Concrete Construction Principles of Roof and Floor Units.

GROUP A

BS loading: Dead loads, live loads, wind and earthquake loadings.


Group B


(Use of relevant BS codes and steel tables allowed in the examination hall.)

Recommended Books
w A S Arya and J L Ajmani. Design of Steel Structures. Nem Chand and Bros (Publishers), Roorkee (UP).
w S Ramamutham. Design of Reinforced Concrete Structures. Dhanpat Rai and Sons, Delhi.


GROUP A


Perspectives for ekistics: Ekistics analysis—anatomy and physiology of human settlements. Rural and urban settlements.

Group B

Ekistic evolution: Evolution of species, growth of settlement, transformation of settlements, ekistics pathology and diagnostics.

Ekistic theory: Principles and laws of ekistics, laws of development, internal balance and physical characteristics, human needs, forces shaping settlements, ekistics synthesis. Ekistics therapy—ekistics goals, new tasks ahead, ekistics practice.

Recommended Books


GROUP A

Introduction: Evolution of town planning; aims and objectives of urban and rural planning; study of socioeconomic and demographic characteristics of villages, towns and cities; their present growth trends and future needs; contemporary planning concepts—Goddes, Howard, Dusciaidis, Perry and La-Corbisier.

Planning problems: Identification of planning problems related to land use, distribution and change; communication system; overcrowding; slums, sporadic growth and conurbation;
development of satellite towns; urban renewal.

Planning surveys: Importance and techniques of planning surveys; sources of information; analysis of data and use of inferences for working out planning proposals.

Planning standards: Formulation of planning standards for land use, density, roads and various community facilities at local and town levels.

Development plan: Planning process; concept of master plan, its elements, preparation and implementation; detailed planning proposals for residential neighbourhood.

Regional planning: Concept of regional planning, types of regions and locational factors of settlements. A critical review of regional theories.

Planning legislation: Review of the development of planning legislations in India, UK and some other countries; detailed study of latest planning of Acts on Housing.

Group B

History and modern trends: Introduction to landscape architecture—its importance for human well-being. Early experiments and development. Integration of buildings and landscape, indoor and outdoor spaces, form, colour and texture.

Landscape planning: Landscape planning of large township and estates. Landscape planning for individual building projects. Landscape planning for public spaces, educational institutions. Site developments by exploiting natural forms. Problems of earthwork, grading of alignments, circulation and utilities.

Plantation: Local plants, materials and adoption for landscaping with reference to behaviours and climate, field identification of a new Indian plants and flowers and study of their ecological characteristics.

Environmental design: Application of principles of architecture and landscape for environmental design of projects.

Recommended Books


Group A

Effect of climate on men, shelter and environment; conditions for human comfort.


Group B

Air flow patterns inside the building. Effect of winds on layouts. Thermal effect on building materials, heat transfer coefficients of different materials. Protective devices for buildings against heavy monsoons. Regional approach of principles of climatology to the design of buildings with respect to site selection.

Town structures, public spaces, orientation, colour positions of windows, types of walls and roofs.

Recommended Books


Injunctions: Easements and its definition, features of easements, interim, permanent and mandatory injunctions.


Recommended Books
- Cinematographic Act, 1952.
- Development Control Rules & Building Bye-laws as applicable to the States.
- Indian Arbitration Act, 1940.

Group A
Designing of one live project: Design of a proposed project. The project should include physical survey of site, analysis and formulation of requirements, climatic study of site, circulation diagram, local architectural history and character, local materials, planning process, structural analysis, quantity surveying and specifications, construction method, landscaping, model.

Group B
Optional services: Sanitation, water supply, sewage disposal, acoustics, air-conditioning, heating, ventilation, fire-fighting, electrical supply.

Group A
Interior Design

Group B

Group A
Introduction—point plotting, line drawing, raster graphics and vector displays—two-dimensional transformations. Clipping, windowing—graphic input devices and input techniques—graphic packages, segmented display files, geometric models, and picture structures.

Group B
Three—dimensional graphics—curves and surfaces—transformations, perspective—hidden surface elimination—device independent graphic systems.

Recommended Books