

## CONSTRUCTION STUDIES

### Ordinary Level and Higher Level Courses

#### Aims

The courses have been designed so as

- (a) to introduce pupils to the knowledge and skills involved in construction technology and construction materials and practices; through theoretical study and integrated practical projects;
- (b) to develop the pupils' ability to communicate ideas and information by appropriate methods, and to encourage them to apply accurate observation and scientific investigation through the exploration of materials and processes;
- (c) to contribute towards their general education, and
- (d) to provide a basis for those who may wish to study construction technology at third level.

The study of the subject should be primarily related to domestic buildings. It is, however, expected that the teacher will deal with the subject in its broader aspects. Regard should be had to Consumer Education as, for example, in considering the merits and demerits of materials and assembly details. Pupils should be encouraged to develop positive attitudes to their architectural heritage and the impact of the construction industry on the environment.

#### Form of the Examination

The examination will consist of

**Part I:** An Ordinary Level and a Higher Level written-paper, including a compulsory drawing question in each case.

**Part II:** A practical test.

**Part III:** An assessment of workshop/laboratory work and projects.

**Parts II and III** will each be marked out of 150 marks. **Part I** will be marked out of 200 marks at Ordinary Level and out of 300 marks at Higher Level. The grades awarded in the subject will be based on the aggregate marks obtained in the three parts.

**Note:** Candidates studying Construction Studies in the Leaving Certificate Vocational Programme may also study from the material in Appendix 1 as shown at the end of this section. Examination questions in relation to this appendix will be optional.

## SYLLABUS

**N.B.** The parts of the syllabus which are in *italics* will not be examined at Ordinary Level.

### **Part 1 – Construction Theory and Drawings**

#### **General**

Historical development of buildings. Simple aesthetic principles related to the appearance of buildings. Elements of the built environment. Controls over the built environment. Obtaining planning permission. Choosing a site. House purchase, mortgages, insurance.

The role of the construction industry in the national economy and as a service to society. Activities and occupation in the industry. Drawings and documents used in the construction process. Use of scales, standard symbols and notation. Preparation of dimensioned drawings using instruments. Freehand sketches of conventional details. Site investigation information required and typical processes. Conservation orders for trees and buildings. Office and storage accommodation for a typical site. Structural principles of simple forms of construction. Problems associated with exposure of structures to the elements. Safety precautions on site. B.S. fire tests on building materials and structures. The principal building regulations.

#### **Substructure**

Excavation for various types of foundations. Removal of vegetable soil. Problem of water in excavations. Functions of a foundation. Factors involved in choice of foundations. Problem of subsoil movement. Materials used for foundation constructions. Construction of slab, and strip foundations. Construction of short bored pile and pad foundations. Purpose and location of steel reinforcement in foundations. Materials used in concrete production. Storage of concrete materials on site. Batching concrete by volume and weight. Effect of water/cement ratio and inadequate mixing. Choice between site mixed and ready mixed concrete.

#### **Superstructure**

Relationship of superstructure to substructure: Typical structural forms. Form and constituent parts of superstructure. Elements of the external envelope. Primary functions of the external envelope. Choice of materials for external walls. Bonding, choice of bond and attached piers. Parapet walls. Damp proof courses and membranes. Lintels and arches.

Conventional types of windows, component parts and ironmongery. Choice of windows. Details of head, sills and jambs of casement windows. Types of glass and methods of glazing. Basic door types, component parts and ironmongery. Door schedules including ironmongery. Sizes of doors, door sets and openings. Details at head, threshold and jambs.

Typical roof forms, component parts and functions. Timber pitched roofs up to 7,500mm span and application of typical coverings. Principles of trusses and trussed rafters. Construction and erection of timber roof trusses. Double lap and single lap roof coverings. Material for sarking and thermal insulation. Timber falt roofs up to 4,000mm span. Component parts, functions and choice of materials. Mastic asphalt and built-up roof finishes. Details of eaves, verges and abutments.

## **Internal Construction**

Elements of internal construction. Function and construction of internal walls. Details of brick and block internal walls and openings. Finishes for walls.

Primary functions of ground floors. Details at junction of solid ground floor and external wall. Function and names of common materials used. Relative advantages and disadvantages of solid and timber ground floors. Detail at junction of suspended timber floor and external wall. Suspended timber upper floor. Trimmings for openings. Strutting and typical details. Floor finishes for domestic construction.

Constituent parts and lay out of stairs with landings. Constructional details of rise, going, handrail, height and headroom.

Construction of stud partitions: Details of finishes, fixings and openings. Factors affecting choice of door type. Door schedules including ironmongery. Internal door details at head and jamb including fixing, provision for second fixing and finishes.

Principles and practice of dry lining walls: Methods of forming ceilings with plasterboard. Mixing and application of plasters. Characteristic of plaster finishes. Properties of oil and water bound paints used for decoration. Application by brush, roller and spray. Reasons for defects in painted finishes.

## **Services and External Works**

Provision required in substructure for entry and outlet of services. Characteristics of materials used in service installations. Protection of service installations against physical and climatic damage.

Direct and indirect hot and cold water systems. Typical pipework layouts, components, control and fittings. Storage cisterns and methods of support. Indirect hot water storage cylinders. One and two pipe small bore heating systems. Methods of controlling temperature and flow. Methods of heat conservation.

Collection and removal of surface water from roofs and paved areas. Fixing and joining eaves, gutters and rainwater pipes. Principal types of effluent and their characteristics. Construction and principles of underground drainage systems. Selection of sanitary fittings. Space required for installation and services. Waste and water connections to these fittings. Single stack system of above ground drainage. Details of separate and combined systems. Septic tanks. Methods of laying rigid and flexible drains.

Construction of flues to domestic fireplaces: Details of ground floor open fireplaces including junction with a suspended timber floor.

Layout of typical domestic electrical installation including power and lighting circuits: Types and sizes of cables used in domestic installations. Protection of circuits. Consumer control gear and equipment required by the Electricity Supply Board at the intake position.

## **Heat and Thermal Effects in Buildings**

Thermal resistance and conductivity of materials. *Thermal resistivity and thermal transmittance. Resistance of a surface to thermal transmittance. Thermal transmittance of composite barriers. Thermal properties of construction materials. Thermal bridges. High void and reflective insulating materials. Effects of insulating materials.*

*Calculations of steady state heat loss in buildings. Annual running cost of domestic central heating systems. Costs-in-use calculations. Statutory thermal transmittance values. Solar heat gain. Sources of heat gain in a building. Calculation of total heat gain in a structure.*

*Radiant temperature, dry bulb temperature and wet bulb temperature. Humidity and relative use of psychrometric chart. Effect of varying ventilation rates. Thermal requirements for human comfort. Surface condensation. Various forms of vapour barriers and their positioning within a structure.*

## **Illumination in Buildings**

The way we see. *Nature of light, Reflection, Refraction, Concept of illumination.*

Units of illumination: *C.I.E. Standard overcast sky. Daylight factor and its components. Calculation of approximate average illumination of a room by the degree of efficiency method. Glare and the glare index. Control of glare. Acuity and vision. Conditions necessary for good illumination.*

## **Sound in Buildings**

The way we hear. *The nature and propagation of sound waves in solids, liquids and gasses. Absolute quantities of sound power, sound intensity and sound pressure. Response of the ear. Threshold of audibility.*

The decibel (dB). *Inverse Square Law. Reverberation and reverberation time. Calculation of reverberation time. Principles of airborne and impact noise insulation. Factors influencing airborne sound insulation. Factors influencing impact sound insulation. Materials used to increase airborne and impact sound insulation.*

Loss of hearing with age and exposure to high frequency noise. Temporary and permanent threshold shift. *Recommended noise levels for industrial and domestic buildings. Attenuation of noise at source. Protection devices.*

## **Part II – Practical Skills**

The aim of the syllabus is to develop a sound grasp of woodworking techniques and skills based on practical experience. The practical test in the examination will be an extension of Woodwork at Intermediate Certificate level and will test the candidates' knowledge and experience of equipment and processes through tests which will be largely based on workshop practice. All drawings will be in accordance with BS 1192, 1969.

### **Tools**

The need for maintenance and for care in the use of tools. Common woodworking tools and their uses, construction and mechanical principles. Grinding, sharpening and general maintenance of workshop equipment. Safety precautions associated with edged tools and electricity.

### **Processes**

Construction of types of joint used in partitions, floors, stairs, roofs, structural timbers, doors, windows, frames, box and carcass construction and simple fitments. Methods of jointing boards together. Correct use of manufactured boards. Storage methods.

The principles underlying the choice of the above joints for strength, resistance to stress and strain, ease of assembly and decorative effect. Measuring and testing for accuracy. Surface preparation and finishing.

The preparation of cutting lists and the use of the setting-out rod. Workshop preparation and the selection and use of glues and adhesives. Methods of holding and supporting work. The design and use of jigs to facilitate the operation of cutting and locating.

## **Part III – Course Work and Projects**

The aim of the course work is to develop the pupils' ability to put their knowledge of theory into practice using forms of construction and concepts outlined in the syllabus.

As part of their study of the subject, pupils are required to carry out the following two main types of workshop/laboratory work;

- (a) experiments which are assigned and closely supervised by the teacher.

and

- (b) projects in which the pupils are given a degree of freedom in carrying out their tasks.

Pupils must submit:

- (a) workshop/laboratory course work reports on assignments carried out

and

(b) the result of a project undertaken during the course.

The project may be

(i) a Building Detail, incorporating a minimum of three craft practices,

or

(ii) a Building Science Project relating to craft practice,

or

(iii) a Written/Drawn Project relating to the craft heritage of the architectural heritage or the built environment.

Projects must be supported by written reports in the case of (i) and (ii) and by an element of practical work in the case of (iii) e.g. a scale model or detail from the subject under investigation.

The following factors will be taken into consideration when projects and course work are being assessed:

- (i) Manipulative skills;
- (ii) Selection, care and maintenance of equipment
- (iii) The ability to design an appropriate plan of procedure;
- (iv) The ability to plan or carry out simple experiments to test and/or compare building materials and assembly details;
- (v) The ability to draw conclusions from practical experience and from information produced by practical work;
- (vi) The ability to present project and course work.

As far as possible, pupils should submit individual assignments and projects. In cases where pupils undertake joint coursework, each pupil must keep records of the complete project or experimental assignment.

### **Suggested Experiments:**

As a guide to teachers the following list has been compiled. It is not intended that all of these experiments must be done, nor is it intended to exclude other experiments which a teacher may find suitable. The order in which the experiments are listed here does not specify the sequence to be followed by the teacher.

## Leaving Certificate Syllabus – Construction Studies

Characteristics of soft and hard woods: seasoning and storing; characteristics of manufactured boards. Grading of timber.

Basic types of glues and adhesives and their use: Properties and requirements of glues and adhesives. Selection of appropriate glue or adhesive for a given situation.

Poor structure of typical building materials: Methods of measuring porosity, rate of water absorption, surface tension, capillarity, permeability, saturation coefficient. Crystallisation, efflorescence, disruptive effect of sulphate action on stone mortars, bricks and concrete. Sources of sulphates.

Voids in granular materials; grading of sands and aggregates, effect of grading on mortar and concrete mixes. Concrete – reduction on volume on mixing, relation between (a) strength and density and (b) strength and water cement ratio.

Setting of gypsum and portland cement as examples of hydration. Use of retarders and accelerators, heat of hydration, strength-time relation, strength tests. Setting of lime, determination of insoluble and soluble matters, fineness, soundness and hydraulic strength tests.

Pigments, tinting strength, light fastness, bleeding characteristics; particle size and shape, thermal stability. Solvents – abrasion resistance, drying time, opacity.

Hardness – alkaline or temporary non-alkaline or permanent hardness, water-softening processes. Electro-chemical series. Vapour pressure. Comfort conditions. Humidity and condensation.

Nature and effects of heat: transmission of heat thermometry, calorimetry co-efficient of thermal conductivity, temperature gradients through composite constructions.

Nature of light reflection, refraction, photometry, daylighting, illumination, light source, measurement of light

Electrical circuits: measurement of electricity, generators, motors, earthing considerations.

Acoustics: attenuation of noise at source. Reverberation

Other topics selected from the syllabus.

*The following textbooks and reference books may be found useful by pupils or teachers.*

### **Textbooks**

Grundy	Construction Technology Volumes (i) and (ii)	Edward Arnold
R. McMullen	Environmental Science in Building	Macmillan

**Reference Books**

E.C. Adams	Science in Building (Material)	Hutchinson Educational Ltd
E. Neufert	Architect's Data	Crosby Lockward Staples
A.J. Elder	A.J. Handbook of Building Enclosure	The Architectural Press
N. Pevsner	An Outline of European Architecture	Allen Lane
Maurice Craig and the Knight of Glin	Ireland Observed	Mercier
P. Harbison	Guide to the National Monuments In the Republic of Ireland	Gill and Macmillan
Patrick & Maura Shaffrey	Buildings of Irish Towns	The O'Brien Press
Timothy O'Neill	Life and Tradition in Rural Ireland	J.M. Dent & Sons Ltd
Christopher Fagg & Adrian Sington	How they Built Long Ago	Hutchinson

**CONSTRUCTION STUDIES - Appendix 1**

For the Leaving Certificate Vocational Programme the Construction Studies syllabus will be that set out in the Rules and Programme for Secondary Schools. The workshop/laboratory work and projects listed should emphasise technological applications and good design practice. The following has been compiled as a guide for teachers.

**Design**

**The components of design problems:** Descriptions of the design process. Measurement criteria and judgement in design. Design problems and design solutions. The application of simple aesthetic principles related to the appearance of buildings.

**Functions of models in design:** Models as graphic aids in design. Uses of modelmaking materials and finishes. Design presentation models.

**Designing with computers:** Simple working drawings on screen and plotter. Hardware. Software.

## **Structures**

**Structural forms:** Projects in relation to space frames, wide-span structures, air-supported membranes, curved and doubly-curved membranes, cable nets, cable-supported roofs, domes, bridges, etc.,. The relationship between some of these forms and ones that occur in nature.

**Structural functions:** The ability of simple structures to resist dead loads and dynamic loads. Structural tests/analyses using models and test rigs.

## **New Technology Applications**

The principles of electronic control circuits and devices and their applications in relation to models and mechanisms. The operation, control and management of computer aided machine. The role of block models in computer-aided manufacture.

## **Marketing**

The establishment of school-based enterprise activities. Market research, cost analyses, and quality control. Sales techniques including presentation and exhibition of goods.