Elements of Construction Technology

Curriculum Guide Supplement

Ontario Department of Education

1970
Senior Division

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Curriculum Guide
Supplement

Inquiries pertaining to the preparation or implementation of courses within the scope of this document are invited. Communicate with the Regional Program Consultant (Technical and Industrial Arts) or correspond directly with the Superintendent of Curriculum,
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Contents

Use of the Curriculum Guide

This publication is a teacher's guide that expands the Elements of Construction Technology outline issued early in 1969.

Teachers may use the material provided to whatever degree they wish. They should not consider this Guide as mandatory subject content.

All Divisions, Units, Sections, and Topics are identical to those in the previous outline. The Elements column which continues the breakdown beyond the Topic level completes the approach in which each division is expanded and analysed. Thus, Section content is made explicit by its associated Topics and each Topic made explicit by its associated Elements.

A numbering system used to designate each subdivision of the course is organized in such a way that, reading from left to right:

- The first number indicates the Division
- The second number indicates the Unit
- The third number indicates the Section
- The fourth number indicates the Topic
- The fifth number indicates the Element

As an example of this arrangement, 2132.1 refers to Division 2. Unit 1. Section 3, Topic 2 and Element 1. The number of digits denotes the degree of breakdown: as a case in point, 32.2 indicates Section 2, Unit 2 of Division 3.

Although each Unit, Section, and Topic is developed in a logical manner, chronological sequence of material is not intended and divisions of the course into lessons is not implied. Likewise, since the complete two-year course is treated as an entity, the arrangement of subject material into weekly, monthly, and yearly sequences is not defined. Teachers should shape the subject content into cohesive packages so that mutual relationships and principles can be stressed.

The Cross Reference column utilizes the number system to facilitate the integration of the course as a whole. Many of the cross references have been listed but undoubtedly the teacher will add or delete as he sees fit.

The Fundamentals column contains the basic concepts and principles which should make the study of Construction Technology a formative educational experience for the student. This column is intended to generalize from the particular Section, Topic,and Element material and is not a further breakdown of the Elements column. Concepts, principles, laws, and rules are included, along with relevant mathematical expressions. If a student gains a clear grasp of these fundamentals, he will possess a sound foundation for the Construction Technology field.

The Technical Terms column consists of many terms that the student should know to grasp the Topic under consideration. Many items may need to be formally defined, others may already be familiar to the students and require little more than an expansion of their application at the appropriate time. Note however, that the lists are not considered all-inclusive. The teacher may judge many other terms equally appropriate for the particular Topic involved.

The Suggestions for Student Activity column refers to activities which the student might undertake. These have been selected with a view either to reinforcing directly related theories or providing, in a practical way, the underlying fundamentals of several Topics within a Section.

The Discussion column is intended to communicate relevant information or ideas not conveyed elsewhere. Items are clarified or amplified and some suggestions as to method are proposed.

Teachers should encourage their students to embark upon major projects which involve knowledge from several Divisions. Such projects provide a valuable integrating experience and relate more to real-life situations. Note that student activity should account for approximately 60 per cent of the available time, and if learning situations include the individualized inductive approach, the ratio could be increased. Whatever the method, student comprehension rather than content completion should be the main objective of the course.

Course Implementation	Possible Courses	Contents	Teacher Requirements	Duration
The complete course as suggested in this Guide could be implemented over a two-year period in approximately [illegible] hours of student time. This would meet the needs of the committed student who intends either to seek employment upon graduation or proceed to a college of applied arts and technology for further study. The Guide material however, is also adaptable to satisfy students with other aspirations. The chart indicates some of these possibilities but additional packages or courses could be involved. If local administrators decide to offer other combinations, these courses should be defined on the basis of individual student needs.	**Elements of Construction Technology I** An integrated technical course for the student who wishes an in-depth study of the over-all practices and principles of the construction industry. The graduate may proceed to tertiary education or seek employment in the broad field of building design or construction.	Divisions 1, 2, & 3	Two	600 hours over a two-year period
	Elements of Construction Technology II An integrated technical course primarily intended for the student who is working towards university education.	Divisions 1, 2, & 3	Two	300 hours over a two-year period
	Elements of Construction Technology III This is proposed as a truncated course which omits the actual Construction Division of the full program. Some similar exercises however would be beneficial as part of Division I. This course is intended to cover a two-year period, but the student could elect to take it for only one year.	Divisions 1 & 2	Two	240 hours over a two-year period
	Elements of Construction Technology IV This is a modified version of the full program which omits the Architectural Drafting Division of the course. Sketching and blueprint reading however, should be included as part of the program. Although the course is proposed to cover a two-year period, a student could elect to take it for only one year.	Divisions 1 & 3	Two	240 hours over a two-year period
	Materials and Processes A course designed for the student who wants a general appreciation of the materials and the building processes as they relate to the construction industry today.	Division 1	One or Two	120 hours over a one-year period
	Architectural Drafting This course would benefit the student who seeks an insight into the fields of architecture and graphic representation as a part of his general education.	Division 2	One	60 hours over a one-year period
	Building Construction Practices A course designed for the student who wants an emphasis on actual building construction and a broad appreciation of the varied aspects involved.	Division 3	One	60 hours over a one-year period

Section	Topic	Element	Cross Reference	Technical Terms
11.1 Organization	**111.1 Ownership**	1111.1 Private .2 Corporate .3 Developing	112.1	charter, board of directors, stockholders, joint ventures, organizational charts, capital
	111.2 Regulations	1112.1 Authorities .2 Planning .3 Building .4 Safety	141.6 33.2	planning boards
	111.3 Designers	1113.1 Urban planners .2 Architects .3 Engineers	14.1 22.2	zoning
	111.4 Personnel	1114.1 Professional associations .2 Contractors' associations .3 Manufacturers' associations .4 Research .5 Standards .6 Trade Unions .7 Apprenticeship .8 Canada Manpower		project engineer, estimator, superintendent, inspector, designated trades
	111.5 Construction	1115.1 General contractor .2 Sub-contractor		expedite, consortium

Fundamentals	Suggestions for Student Activity	Discussion
Motives	• form a model company within the class with a president, board of directors, and shareholders with a view to expediting a class project. • make field trips to architects', consulting engineers' and manufacturers' offices to see different methods of ownership in operation.	The activities of Junior Achievement Clubs might be investigated. The teachers of commercial subjects could be involved to gain maximum benefit from this topic.
[redacted]ntrol		
Environmental control Basic structure requirements	• on a map of the city, locate the business, residential, and industrial areas. • locate the future zoning areas on the map.	A representative from the local planning board may be invited to outline the board's functions.
Collective strength Standards Ethics	• prepare a research topic on apprenticeship systems.	Professional associations bring together persons for the purpose of pooling knowledge, improving the product, and setting standards of quality control. Contractors' and manufacturers' associations provide new techniques for product improvement. Trade unions organize workers, according to skills, to improve working conditions, for salary negotiations, and to maintain standards of workmanship in the trade. The teacher may invite a representative from Canada Manpower to address the students and register them for social security.
Co-ordination	• research the legal responsibility of the sub-contractor and the general contractor on a construction project.	The general contractor co-ordinates and organizes the various functions involved in the building process. The responsibility of the sub-contractor is to produce only a specific portion of the building.

Section	Topic	Element	Cross Reference	Technical Terms
11.1 Organization (continued)	**111.6 Materials**	1116.1 Selection .2 Manufacturing .3 Distribution .4 Manufacturers' services .5 Availability .6 Maintenance	3.1 3.2	
11.2 Economics	**112.1 Owner and representatives**	1121.1 Project site .2 Mortgages .3 Leasing .4 Taxes .5 Fees	111.1	lien, amortization, lease back, assessment
	112.2 Contractors	1122.1 General overhead .2 Project overhead		job office, temporary services, equipment rental
11.3 Estimating	**113.1 Units**	1131.1 Mensuration .2 Material .3 Labour	12.3 1.6 3.1 3.2	
	113.2 Preliminary	1132.1 Linear .2 Area .3 Volume .4 Module	3.1 3.2	module
	113.3 Detail	1133.1 Take-off procedure .2 Materials .3 Labour .4 Profit and overhead	3.1 3.2	

Fundamentals	Suggestions for Student Activity	Discussion
Economy Value		Imagination and resourcefulness in quantity purchases of building materials are the key to profit. This topic deals with the economic aspects of materials only; physical properties are covered under Unit 1.3.
Investment Rights and responsibilities (mortgagee and mortgagor)	• examine and discuss the various aspects of a standard mortgage form. • using tables, calculate the cost of amortizing a mortgage over 30 years at the prevailing rates.	It should be pointed out that, depending on the type of structure, draws on the mortgage can be made at different times.
Costs Profit and loss	• list items of cost which are allocated to general overhead and those which are allocated to project overhead.	The teacher may decide to have the students visit a contractor and/or an architect's office to understand fixed and variable costs in construction.
Geometric principles Accuracy	• calculate volumes and areas of basic components. • prove the calculations through the use of geometric forms.	Although accuracy in estimating is essential, the competitive business world also considers speed important. This section provides an opportunity for correlation with the mathematics department.
Feasibility Units Comparisons Standardization	• estimate the total cost of a portion of a construction project from a set of plans which include specifications. • compare estimates.	It should be emphasized that accurate estimating can only be achieved with a thorough knowledge and experience in construction procedures and practices. Costing may be done on a basis of unit of construction based on past experience. Conversion to the metric system may be introduced.
Visualization Cost analysis	• tabulate unit costs with the aid of a calculator.	A calculator is an established media for reducing the possibility of error and/or exclusions in estimating.

Section	Topic	Element	Cross Reference	Technical Terms
11.3 Estimating (continued)	**113.4 Scheduling: Critical path, Bar graph**	1134.1 Methods .2 Material timing .3 Labour timing	12.2 12.3 1.6 3.1 3.2	bar chart, flow chart
11.4 Documents	**114.1 Contracts**	1141.1 Types .2 General conditions		stipulated sum, cost plus
	114.2 Tendering	1142.1 Invitations to bid .2 Procedures .3 Sub-trades	1.6	invited, public, builders' exchange
	114.3 Drawings and specifications	1143.1 Types .2 Standards .3 Legality .4 Format .5 Content (division of work) .6 Method of preparation	21.3 12.2	set of plans, working drawings, specifications
	114.4 Guarantees	1144.1 Manufacturers .2 Contractors .3 Bonds .4 Insurance		

Fundamentals	Suggestions for Student Activity	Discussion
Time and test control	• prepare a flow chart for a simple project.	Scheduling provides for proper planning of a project to forecast completion dates and to economize on material and labour.
Legality	• examine and discuss the various types of documents used for contracts, tendering, bids, sub-contracts, drawings and specifications, guarantees and schedules.	Documents provide a clear, legal understanding of the responsibilities of all parties engaged in producing a satisfactorily completed project.
Graphic communication		The teacher should emphasize the important role that this topic plays in the overall construction industry.
Protection		The teacher may decide to bring in someone from the commercial department or someone from industry to discuss the various aspects of this topic. A display of sample documents for this section would be appropriate.

Section	Topic	Element	Cross Reference	Technical Terms
12.1 Evaluation	**121.1 Preliminary investigation**	1211.1 Legal considerations		title, deed, covenant, lien, casement
		.2 Accessibility		right-of-way, orientation, ingress-egress
		.3 Features of adjacent property	12.3	topography
		.4 Surface features on site	1233.2	grade
		.5 Sub-surface features	1231.3	service line
		.6 Available services and utilities	1.6	
	121.2 Detail investigation	1212.1 Soil exploration	31.1 32.1	
		.2 Location of the building and services	1232.1	
	121.3 Soil mechanics	1213.1 Sampling		auger, wash, core boring
		.2 Testing		sounding rod, shelby tube, density
		.3 Identification		acid, alkaline, cohesive, non-cohes
		.4 Analysis		mechanical

Fundamentals	Suggestions for Student Activity	Discussion
Legality	• make a comparative study of legal documents. • investigate the procedures to search a title for a given property through the registry office.	From the laws of property regarding land has grown a distinctive branch of Common Law. Through these laws, a consistency and stability has emerged which outlines requirements both before and after development.
	• investigate the accessibility provided on a specific project to accommodate construction equipment and supplies.	
	• take a field trip and report on features of adjacent property on a specific site.	Limitations in excavating and restrictions on building heights should be considered with regard to adjacent properties.
	• prepare a research topic which investigates sub-surface services in the local area.	These activities could provide an excellent opportunity for correlation with the geography department.
Soil formation Accessibility		Information on the history of the site should be investigated, particularly for evidence of soil reclamation possibilities. It is important that the availability and capacities of the utilities be compatible with the building requirements.
Organic and inorganic soils	• examine a sample of in situ soil and identify its characteristics.	Load-bearing properties are determined by the compaction characteristics of soil.
	• carry out the simple Atterberg limits tests.	It may help the teacher to involve the geography and science departments in the investigation of soil stratification and testing.
Sensory recognition	• do sieve tests.	

Section	Topic	Element	Cross Reference	Technical Terms
12.2 Construction Surveys	**122.1 Instruments**	1221.1 Distance measurement		calibration, graduation, planes, chain pin, range pole, stadia, plumb, odometer
		.2 Angle measurement		quadrant, angle of depression and elevation, ratio, theodolite
		.3 Levelling		line level, spirit level, dumpy level, self-levelling, spirit vial, levelling rods
	122.2 Construction lines	1222.1 Plot boundaries	1223.3 1143.3	legal description, real property, property line, road allowance, frontage, flankage, lot, squatters' rights
		.2 Establishing construction lines	1223.3	datum point, corner stake, set-back pattern, offset, recess, batter board, ledger board, grade stake

Fundamentals	Suggestions for Student Activity	Discussion
Spatial relationships Gravity as a reference direction Stadia Principle	• pace a given distance to develop spatial estimation capabilities. • validate the use of the stadia with a 100 ft. tape. • check and correct for inaccuracies found in the surveying instruments.	The surface of the earth can be described in numbers of angular and linear standard units. The earth grid has evolved with the geographic poles as reference points. Plane surveys involve both geometry and trigonometry.
Circles as reference directions Cosine Law Sine Law Vernier Principle	• construct a compass card or protractor by folding a square piece of paper to make 16 points, unfold, cut to a circular pattern and locate the 16 compass points. • apply the Pythagorean Theorem through layouts using the shop wall and floor. • calculate the height of a building trigonometrically, using a base line and two elevation angles obtained with the aid of a transit.	Students should appreciate that linear measure can be obtained by indirect means. This topic could provide the opportunity to point out the application of the laser beam as a refinement to precision measurement.
Level Gravity as a reference direction	• locate various level points using a hose, spirit, line, and dumpy levels. • use a levelling rod to establish and compare a series of elevations.	Construction surveys could provide an excellent opportunity for correlation with the mathematics department in the school.
Delimitation of area Demarcation of area	• examine plot plans to determine their limitations and restrictions. • select a parcel of land and draw its plot plan. • determine road allowances, frontage, flankage, and rear dimensions from the plan. • divide the shop into as many areas as there are students and record by description the location of each in the room.	In establishing construction lines, the need for accuracy in property boundaries is paramount since the principle of Common Law and tenure of land is involved. It should be pointed out that legal boundaries are often located, described, and marked according to the topography of the land.
Temporary control Accuracy	• locate the position for a structure and establish its corners. • erect batter boards. • establish layout lines on ledger boards. • run stakes in line.	Practical exercises could be carried out either on the playing field or in the shop. Adjacent structures, trees, or range poles could be used as alternate control targets during the suggested activity.

Section	Topic	Element	Cross Reference	Technical Terms
12.2 Construction Surveys (continued)	**122.3 Elevation and grades**	1223.1 Bench marks	1223.3 1143.3	mean sea level, datum plane, elevation
		.2 Establishing grades	1223.3 1231.3	traverse, station, turning point, backsight, foresight, rod reading, profile staking, gridding or grilling, assumed datum plane
		.3 Recording methods	12.2	profile plot, mean grid elevation, interpolation, contour lines
12.3 Excavation	**123.1 General**	1231.1 Equipment	113.4	pull shovel, pneumatic drill, clamshell crane, dragline, scraper, backhoe, trencher
		.2 Clearing and grubbing		wrecking ball, grapple, salvage, stockpile, rough grading
		.3 Soil disposal	113.1 1211.5 1223.2 145.1	soil swell, angle of repose, slope cut, neat cut, disturbed soil, undisturbed soil, pay-line, spoil
		.4 Shoring and underpinning	121.1 123.2	free standing, soldier pile, sheet piling, sheeting, shores, settlement, load transfer, mud crib, needle beam
		.5 Backfilling	1233.2	fill, deleterious debris, tamping, rough grading, terracing

Fundamentals	Suggestions for Student Activity	Discussion
Permanent control Datum	• examine plans and records to locate existing bench marks. • inspect the locations of bench marks in the immediate area. • establish a new bench mark in the classroom or shop, located from an existing one.	It should be emphasized that for future reference, bench marks should be permanent and easily accessible.
Transfer of elevation	• conduct a number of differential and profile levelling exercises to establish grades. • lay out a grid for a contour plot plan.	Differential levelling and profile levelling are simple extensions of earlier levelling exercises. In this topic, co-operation with the school's mathematics department is possible.
Verification	• record data for differential and profile levelling exercises. • plot the profile using an exaggerated scale. • interpolate contour lines from a plot plan.	The use of standard field book forms is recommended during these activities.
Mechanical advantage Fluid power Pascal's Law	• prepare a research topic that explores the variety of excavation equipment available with specific reference to power train systems.	Types of earth-moving and processing equipment are classified by mounting, capacity, and working range. Major equipment companies have excellent illustrated material to show the working range of equipment in common use. Hydraulic pressure systems have improved the speed and control response of most modern equipment.
Forces of reaction	• observe and report on land clearing and demolition projects in the immediate area.	Demolition principles could be analysed to illustrate the potential and kinetic energy involved. Reclamation of land through disposal of wastes is becoming increasingly important.
	• estimate the excavating and haulage costs of soil disposal on a project selected by the class.	Excavation estimates provide greater financial risk than any other phase of construction. The serious consequences that may result in excavating below the designated depth should be emphasized.
Coulomb's Wedge Theory Equilibrium of forces Soil friction	• visit a pile-driving project to evaluate the elements involved.	A simplified explanation should be made to indicate how a wedge of earth applies a thrust against a gravity retaining-wall.
Reconstitution Restoration		

Section	Topic	Element	Cross Reference	Technical Terms
12.3 Excavation (continued)	**123.2 Special Techniques**	1232.1 Drilling and blasting	121.1 1212.2 1231.4 3.3	drilling rig, jackhammer, blasthole, safety fuse, blasting cap, loading, earth stemming, mudcapping, snakeholing
		.2 Pier excavating	1212.1	drilled in a caisson, caisson auger, kelly bar, open caisson, pneumatic caisson, working chamber, air lock cutting edge, cofferdem
		.3 Trenching	1231.4 3.3	bracing, tamping, service trench, soak-away
	123.3 Drainage	1233.1 Sub-surface	16.2	water table, porosity, soak-away area, dry well, sump backflow, weeping tile
		.2 Surface	1451.1 16.2	run-off, gullying, erosion, ponding, block grading, revised grade, gradient, swale

Fundamentals	Suggestions for Student Activity	Discussion
Conversion of energy Artificial environments	• prepare a research topic on drilling and blasting techniques with special emphasis on safety precautions used. • visit a trenching operation to reinforce the application of this technique in construction.	The limited use of explosives in built-up areas should be discussed. An explosives expert could be invited to address the students on the application of this technique in construction. The many hazards of working in a sub-surface chamber filled with compressed air should be discussed. Adequate shoring and ventilation are major concerns in any deep excavation work.
Suspension Transportation Deposition Hydrostatic pressure Gravitational forces	• carry out soil absorption tests. • prepare a research paper on the consequences of soil erosion.	The new light-weight materials used for sub-surface drainage in highway construction should be investigated. Specialists on drainage may be brought in from the Ontario Water Resources and/or the Ontario Department of Highways. Drainage depends upon the type of soil, vegetation, condition of the soil, the intensity of rainfall, and the differences in energy gradient. The geography department could help when dealing with erosion as a problem in surface drainage.

Section	Topic	Element	Cross Reference	Technical Terms
13.1 Concrete	**131.1 Cements**	1311.1 Types and purposes .2 Manufacture		slurry, clinker
	131.2 Aggregates	1312.1 Heavyweight .2 Lightweight .3 Grading and testing		fineness modulus, sieve analysis, unit weight
	131.3 Design and Control of mixes	1313.1 Proportioning .2 Water cement ratio .3 Compression testing .4 Consistency testing .5 Flexural testing .6 Additives .7 Curing	151.4 32.2	colorimetric test, silt test, slump test, workability, bleeding, efflorescence
13.2 Wood	**132.1 Structure and Classification**	1321.1 Anatomy of trees .2 Cell structure .3 Identification	151.4 3.1	cellulose lignin
	132.2 Manufacture of lumber	1322.1 Lumbering operations .2 Milling operations .3 Units of measurement	3.2	
	132.3 Wood diseases	1323.1 Types .2 Causes and control .3 Effects on lumber		hyphae fungus, incipient decay, creosote

Fundamentals	Suggestions for Student Activity	Discussion
Chemical reaction Hydration	• prepare a research paper on the manufacture and the many uses of cement.	The design, construction, and use of appropriate testing equipment would be a worthwhile undertaking for the students throughout this entire unit.
	• vary the mixtures and investigate the effects on concrete in both its plastic and hardened state.	
Optimization Plasticity Tension Compression Shear Thermal stress	• cure concrete under various conditions and compare the results. • assess the hardness of floor concrete using oxide additives. • test the effectiveness of plasticizers on the workability of concrete. • visit a laboratory where concrete samples are tested and analysed.	The resistance to freeze-thaw action of air-entrained concrete should be discussed.
Exogenous growth Cell structure Organic versus inorganic compounds	• test the structural characteristics of various types of wood. • measure the moisture content in woods with the aid of a moisture meter.	While the structure and classifications of wood may have been presented in an intermediate course, its relevance at this stage should be emphasized.
Optimization	• prepare a research paper on the economic aspects of the manufacturing process.	Students should realize the importance of careful harvesting and planned reforestation to ensure proper conservation and a continued supply of lumber and wood products.
Bacterial growth Prevention	• examine common wood diseases with a microscope.	Trees lend themselves to organic diseases under certain conditions. The use of preservatives on lumber however, to reduce the possibility of bacterial growth should be discussed.

Section	Topic	Element	Cross Reference	Technical Terms
13.2 Wood (continued)	**132.4 Seasoning of lumber**	1324.1 Purpose .2 Moisture content .3 Drying		air drying, kiln drying, hydroscopic water, free water
	132.5 Grading of lumber	1325.1 Purpose and types .2 Defects .3 Methods	1514.4	factory lumber, shop lumber, yard lumber
	132.6 Plywoods	1326.1 Characteristics and uses .2 Manufacture .3 Grades and surface textures		cross bands, core, face veneer
	132.7 Composition board	1327.1 Types .2 Manufacture .3 Uses		particle board
13.3 Masonry and Masonry Bonding Materials	**133.1 Blocks**	1331.1 Types .2 Manufacture .3 Testing	32.5	modular sizing, load bearing, non-load bearing, screen blocks, solar blocks
	133.2 Brick	1332.1 Types .2 Manufacture .3 Testing		modular co-ordination, calcareous clay, non-calcareous clay

Fundamentals	Suggestions for Student Activity	Discussion
Osmosis Density Evaporation	• use a moisture meter for charting dimensional changes in lumber as a result of seasoning.	
Standards Strengths of wood	• using destructive tests, show the effects of natural and manufacturer's defects on various grades of lumber.	
Lamination	• compare the strengths of plywood, lumber, and composition board under a variety of load conditions.	The cross graining of wood by lamination greatly increases its strength, impact resistance, and reduces shrinkage.
Reconstitution of waste		
Modular Composition ratio Geometrical shapes	• test the compressive strength of load bearing and non-load bearing blocks. • investigate the insulating qualities of various types of blocks. • take a field trip to a concrete block factory and report on the processes involved.	The sound reduction values and thermal insulation qualities of concrete block walls are affected by the type of construction, the kind of wall finish, the type of aggregate used, and the fill inserted in the air spaces. Wood as an aggregate in the manufacture of concrete blocks is an innovation that should be discussed.
Curing	• undertake a comparative study of brick, tile, and stone as used in the construction industry. • test for water absorption qualities of various masonry units.	Brick has now changed in many locations from a structural to a decorative material in construction.

Section	Topic	Element	Cross Reference	Technical Terms
13.3 Masonry and Masonry Bonding Materials (continued)	**133.3 Tile**	1333.1 Types .2 Manufacture .3 Testing		structural, partition, back-up, furring, fireproof, glazed
	133.4 Stone	1334.1 Classification .2 Composition		sedimentary, igneous, metamorphic rubble, cleavage line
	133.5 Mortars	1335.1 Types .2 Additives .3 Proportioning		cement, lime, slaking, bond, water retentivity, water penetration, efflorescence
13.4 Metals	**134.1 Ferrous**	1341.1 Types and shapes .2 Production .3 Characteristics .4 Applications	151.4	high carbon steel, low carbon steel, alloy steel, rolled steel, cast iron, wrought iron
	134.2 Non-Ferrous	1342.1 Types .2 Production .3 Characteristics .4 Applications		Extrusion

Fundamentals	Suggestions for Student Activity	Discussion
		It should be emphasized that concrete products have replaced various types of tiles as building material.
Strength Shrinkage Plasticity Calcination Bonding	• carry out a comparative analysis on various mortar mix combinations.	Stucco, grout, and parging materials could also be introduced under this topic. To make a comparative analysis more meaningful, the fabrication of a wall section would be appropriate.
Alloying Standards	• prepare a research paper on the shapes and sizes of structural members used in general construction. • take a plant tour to observe the various steps in the manufacture of steel.	Steel manufacture may be illustrated through the use of films and other visual media.
Malleability Oxidation	• investigate both the structural and decorative uses of aluminum and other non-ferrous metals in residential and commercial building projects.	

Section	Topic	Element	Cross Reference	Technical Terms
13.5 Insulators	**135.1 Acoustical**	1351.1 Purpose .2 Types	152.4	cycle, frequency, amplitude, acoustics, reverberation
	135.2 Thermal	1352.1 Purpose .2 Types	152.2	BTU, conductivity, conductance, resistance, total transmission
	135.3 Vapour	1353.1 Purpose .2 Types	152.1	humidity, vapour barrier, dew point
13.6 Protective and Decorative Materials	**136.1 Paints and varnishes**	1361.1 Types .2 Uses		alkyd, laytex, urethane, silicon
	136.2 Glass	1362.1 Types .2 Manufacture .3 Uses	152.3	armoured, plate, float, sheet, textured, structural, insulating, wired, solar
	136.3 Plastics	1363.1 Types and properties .2 Fabrication .3 Uses	152.7	laminates, fibre glass, vinyls

Fundamentals	Suggestions for Student Activity	Discussion
Audible frequency range Energy transmission and absorption Damping	• test and compare the sound transmission qualities of various types of materials.	When considering the insulation of a building, the economics, the physical comfort, and the protection of the structure should be discussed.
Heat transfer Conduction Radiation Convection	• compare various materials for their thermal insulating properties.	
Condensation	• observe the effect of condensation by placing insulation, with and without a vapour barrier, over steam. • make a study of the types of vapour barriers and their location relative to thermal insulation and temperature differentiation.	The relation between insulation and adequate ventilation should be stressed.
Preservation Decoration	• investigate the effects of weathering on coated surfaces.	The construction of a weather simulation box is suggested to carry out a number of tests.
Transparency Translucency Transduction	• test the thermal conductivity of glass. • compare the types of glass and their uses in the construction industry.	
Chemically inert materials	• research present practices and future possibilities for plastics as a building material.	Plastics as a building material is changing many concepts of construction and long standing construction techniques.

Section	Topic	Element	Cross Reference	Technical Terms
14.1 Community Planning	**141.1 Shelter**	1411.1 Domestic .2 Education .3 Commercial .4 Industrial		zoning, population density, a complex, sector patterns, concentric zone patterns, multiple nuclei patterns
	141.2 Recreation	1412.1 Local .2 Municipal	111.3	conservation area, green belt
	141.3 Landscape	1413.1 Public	145.1	landforms, water shed, erosion
	141.4 Services	1414.1 Water .2 Sewage .3 Electricity .4 Gas .5 Communications	111.3 1.6	improved lot, serviced lot, potability, filtration, septic systems, substation, incineration
	141.5 Circulation	1415.1 Roads .2 Transportation .3 Walks	111.3	toll roads, access roads, service roads, rapid transit
	141.6 Zoning	1416.1 Types and purpose .2 Regulatory bodies	111.2 111.3	by-law, planning board

Fundamentals	Suggestions for Student Activity	Discussion
Controlled environment Spatial patterns	• investigate people's basic and ancillary requirements for shelter and protection. • prepare a colour code map of the immediate area to indicate existing and developing patterns.	The topics in this section may be covered best by an orientation period followed by discussions with local planning personnel. It should be emphasized that municipal by-laws and National Building Codes are created to protect the investment the owner has in his home. This topic should provide an opportunity for correlation with the geography department.
Physical fitness Leisure time	• investigate the diversity of recreational programs and facilities servicing the local area. • do a feasibility study for future recreational requirements.	
Drainage Aesthetics	• research the responsibilities of public works in maintaining public lands in the area.	It should be stressed that landscaping is the responsibility of the subdivider, the owner, and the municipality. Parks and green belts are an important part of community planning.
Purification Pressure Bacterial action Gravitational flow Evaporation Communications	• summarize local services provided by public utilities in your area.	
Transportation media	• investigate and discuss possible changes to improve local circulation.	
Control		

Section	Topic	Element	Cross Reference	Technical Terms
14.2 Requirements of a Building	**142.1 Accommodation**	1421.1 Activity	144.2 151.1	Traffic patterns
	142.2 Internal environment	1422.1 Heat .2 Light .3 Colour and texture .4 Air .5 Sound .6 Aesthetics .7 Psychological effects	1.6 15.2 13.5	BTU, conduction, convection, radiation, complementary colours, supplementary colours, ionization, humidification, decibel, symmetry
	142.3 Resistance to loads imposed on the building	1423.1 Use and occupancy .2 Snow .3 Wind .4 Earth and water .5 Earthquakes .6 Temperature and moisture	15.1	forces,live loads, movement joints
	142.4 Resistance to loads imposed by the structure	1424.1 Dead loads		potential energy
	142.5 External environment	1425.1 Aesthetic and psychological effects		

Fundamentals	Suggestions for Student Activity	Discussion
Conveniences Maintenance	• discuss the features that would have to be considered for good design in specific areas of a building.	Appropriateness for the intended activity of specific areas of a building is the first criterion of good design.
Stability Sensory reaction Aesthetics		The psychological and sociological effects of room environment must be considered in its design. The home economics department could help present this topic.
Equilibrium of forces Aerodynamics Hydrostatic pressure Vibration	• with the aid of the building code, calculate the real and optimum loads that could be applied to floors in the student's home, • determine the hydrostatic pressure exerted on a basement floor slab. • calculate the dead load on a wood joist floor system. • prepare a graph which shows the effects of varying wind velocities on a building.	The foundation of the Tokyo Imperial Hotel provides an interesting study in resistance to loads.
Density		
Form	• compare buildings in the local area to justify the basic reasons for their specific design.	Natural setting and the surrounding community should generally dictate building styles.

Section	Topic	Element	Cross Reference	Technical Terms
14.3 Structural Elements of a Building	**143.1 Vertical elements**	1431.1 Bearing walls .2 Columns .3 Shear walls	15.1 326.1	ultimate stress, allowable stress, unit stress, factor of safety, radius of gyration
	143.2 Horizontal elements	1432.1 Slabs .2 Beams .3 Trusses	311.3 15.1	tension, compression, shear, lateral bending, deflection, flat, arched
	143.3 Special elements	1433.1 Arches .2 Shells and domes .3 Air supported domes		corbelled, gauged, bonded, rowlock
14.4 Non-Structural Elements of a Building	**144.1 Space enclosing elements**	1441.1 Curtain walls .2 Partitions .3 Doors .4 Windows	152.5 31.5	
	144.2 Vertical circulation elements	1442.1 Stairs .2 Ramps .3 Escalators .4 Elevators	1421.1	
	144.3 Service elements	1443.1 Climatic control .2 Sanitation and water .3 Illumination .4 Power	1.6	solar screen

Fundamentals	Suggestions for Student Activity	Discussion
Compression Slenderness ratio	• apply constant loads to various shapes and sizes of wood columns and compare the results obtained. • construct and test model trusses of not less than one-quarter scale for their reaction to various kinds of loads.	This section provides an excellent opportunity for the application of some of the testing equipment of an industrial physics laboratory.
Bending Shear		A foam rubber slab may be useful to demonstrate the neutral axis and the tension and compression surfaces of a beam under a horizontal load.
Keystone Principle Force dissipation Equalization of air pressure	• do a comparative study of the advantages of arches and domes in construction.	The geodesic dome uses a minimum of material for maximum space and forces are equally distributed throughout the structure.
	• compare the applications of masonry veneer curtain wall and metal curtain wall in construction.	Basic sizes of building components may be obtained through the building code.
Pace uniformity Proportions Inclined plane Mechanical advantage Pascal's Law	• examine shop drawings of an overhead sheave-type elevator and a hydraulic piston-type elevator to show the differences in design.	Stair design deals with pace uniformity and riser-tread proportioning, while an escalator is a travelling inclined plane. A visit to an elevator or escalator installation would be useful to observe the mechanics involved.
Stability Pressure equalization Energy conversion	• examine and discuss heating, electrical, and plumbing system plans and specifications. • interpret schematic plan layouts for the building service elements. • visit the heating plant and the transformer vault in the school to become familiar with industrial control mechanisms.	

Section	Topic	Element	Cross Reference	Technical Terms
14.5 External Elements	**145.1 Landscaping**	1451.1 Grading .2 Plants .3 Ground cover	1233.2 141.3	original grade, existing grade, terrace, datum point
	145.2 Pavement	1452.1 Walks .2 Steps, ramps .3 Roadways	123.3	asphalt, bituminus
	145.3 Fencing	1453.1 Types .2 Purposes		chain link, split rail, basket weave, louvred

Fundamentals	Suggestions for Student Activity	Discussion
Control Aesthetics		An overview of external elements will contribute to the general education of future home owners.
Circulation control Chemical reaction Cost	• compare the costs of the various types of materials used for walks and driveways in a housing development.	
Privacy Enclosure Aesthetics		The fact that fencing may or may not be the responsibility of the contractor should be discussed.

Section	Topic	Element	Cross Reference	Technical Terms
15.1 Structural	**151.1 Requirements**	1511.1 Equilibrium .2 Stability .3 Strength .4 Safety factors .5 Function .6 Economy .7 Aesthetics	14.2 33.1	centroids, axis, moments, inertia, deformation, stress, strain, forces, vectors, force polygon
	151.2 Materials	1512.1 Elasticity .2 Material constants .3 Durability		yield point, ultimate strength, modulus of elasticity, elastic limit, allowable load, factor of safety
	151.3 Deformation of materials	1513.1 Tension .2 Compression .3 Simple shear .4 Simple bending	142.3	unit stress, axial load, concentrated load, uniformly distributed load, moments, fulcrum, reaction, magnitude, cantilever, foot-pounds, inch-pounds
	151.4 Design	1514.1 Footings .2 Walls .3 Slabs .4 Columns .5 Beams .6 Roof	311.1 32.1 1.3	live load, dead load, screeds, slenderness ratio, ledger, stirrups, split-ring connector
	151.5 Sizing and joining	1515.1 Modular .2 Manufacture tolerances .3 Erection tolerances .4 Types of joints		module, modular size, manufacturing size, deviation, space grid, reference planes, modular range

Fundamentals	Suggestions for Student Activity	Discussion
Vector analysis Hooke's Law Equilibrium of forces	• solve centroidal, inertia, and parallelograms of force problems. • investigate modern methods used for assembly in construction such as high tensile bolts, riveting, welding, and adhesives.	A study of strength of materials is the basis for all structural design. The fact that aesthetic values may be gained by exposing certain structural components should be discussed.
Limitations Change	• solve tension and compression problems. • examine building codes to understand the physical properties of various structural materials.	Wood, steel, and concrete are prime building materials which have specific applications due to fire endurance, weathering, costs, and thermal conductivity. Alloys should also be considered in the study of structural materials.
Unit stress Law of levers	• solve shear and bending problems. • prepare accurate shear and bending moment diagrams. • calculate structural loads. • carry out destructive testing on various materials by tensile, compressive, and shear forces.	The construction and analysis of shear and bending moment diagrams will help to emphasize the point of maximum bending and the point of zero shear.
Design loads Design formulae Support Stress analysis	• design simple structural members in concrete, steel, and wood. • prepare a research paper on the application of structural design relevant to all aspects of the construction of a building complex. • do tests to compare load-carrying characteristics between plain and reinforced shapes made of concrete, steel, and wood.	The design of structural members depends upon the correct use of concrete, steel, and wood design manuals. The pros and cons of prefabrication should be considered before a structural component is designed.
Module Efficiency through standardization	• establish modular sizes for building components. • compare modular designs. • show building components within a space grid. • investigate the use of a 12" dimension for sizes of building components.	The advantages of modular construction lie in the repetitive nature of machines and the effectiveness of standard operations. The problems in communicating dimensions in design, manufacture, and erection of components should be stressed.

Section	Topic	Element	Cross Reference	Technical Terms
15.2 Non-Structural	**152.1 Moisture control**	1521.1 Roofing .2 Flashings .3 Waterproofings .4 Dampproofings .5 Vapour flow and vapour barriers	135.3	bitumens, polythene, dew point, permeance
	152.2 Temperature control	1522.1 Heat flow and insulation .2 Weather stripping	16.4 135.2 142.2	conduction, convection, radiati thermal conductance, thermal resistance
	152.3 Light Control	1523.1 Window .2 Solar .3 Artificial	136.2 161.3	single, double hung, casement, hopper, skylights, clerestory, rheostat
	152.4 Sound Control	1524.1 Acoustical surfacing .2 Construction materials .3 Room geometry	135.1	absorption, reflection, reverberation time

Fundamentals	Suggestions for Student Activity	Discussion
Capillary action Kinetic force Permeability Pressure equalization	• compare the resistance to moisture of various waterproof materials.	The presence of moisture in the atmosphere necessitates a thorough study of its movement when considering materials and their application. The effects of the expansion of frozen water in moisture control should be discussed. The resistance of water-vapour flow is controlled by the permeability of the material.
Conduction Convection Radiation	• examine and compare the heat flow through materials of various composition and colours. • explore types of heat bridges.	The advantages and disadvantages of heat, light, sound, and air passing through windows should be discussed. Various media to retard the transfer of heat through the control of radiation, conduction, and convection should be considered.
Regulation Diffusion Seasonal variation		
Transmission Energy conversion Control	• compare sound transmission and reverberation time in various teaching areas in the school. • investigate the relationship between the shape of a room and sound control.	Both acoustically and non-acoustically treated rooms should be considered in any comparison. If a decibel meter is available, the sound attenuation and reverberation time could easily be measured.

Section	Topic	Element	Cross Reference	Technical Terms
15.2 Non-Structural (continued)	**152.5 Space and circulation control**	1525.1 Geometry of the structure	31.5	
		.2 Halls and stairs	2131.2	
		.3 Doors	314.2	
		.4 Movable partitions	1441.2	
	152.6 Surfaces	1526.1 Exposed non-structural materials	14.3 31.4	curtain wall, framework, metal lath, gypsum core, lime, joining compound, underlay
		.2 Lath and plaster	32.6	
		.3 Dry wall		
		.4 Panelling		
		.5 Suspended ceilings		
		.6 Floors		
	152.7 Fitments	1527.1 Cabinets	136.3	
		.2 Counters		

Fundamentals	Suggestions for Student Activity	Discussion
Traffic control Regulations	• indicate traffic pattern lines on the floor plans of both a residence and a school. • establish trouble spots and discuss their possible solutions.	
Aesthetics Insulation Compartment Maintenance	• select surface materials for specified areas in the school and discuss the advantages/disadvantages of the various materials chosen.	The selection of surface materials is determined by initial cost, maintenance, durability, colour, texture, life, comfort, acoustical properties, ease of application, and ease of repair.
Ergonomics	• design custom fitments for a specific area in the school.	Both space available and function play an important role in the design of fitments. This topic could provide an excellent opportunity for correlation with the home economics department.

Section	Topic	Element	Cross Reference	Technical Terms
16.1 Electrical	**161.1 Sources and distribution**	1611.1 High voltage .2 Low voltage		phase, cycle, frequency, circuit protection, branch circuit, circuit breaker
	161.2 Power	1612.1 Wiring systems .2 Machines	144.2	service entrance, transformer vault, live conductor, neutral conductor, ground conductor, transformer, primary, secondary, induced voltage, turns ratio, induction motor, centrifugal mechanism, split-phase
	161.3 Lighting	1613.1 Wiring .2 Fixtures	142.2 152.3	demand factor, heat and flame-retarding wire, footcandles, lumens, incandescent, fluorescent

Fundamentals	Suggestions for Student Activity	Discussion
Energy conversion Voltage transformation Phase relationship	• prepare a sketch of a distribution panel to show voltages, protection devices, and power and lighting circuits.	Students should be familiar with the Ontario Electrical Code and its jurisdiction within the building industry. If time-tabling permits, this part of the course should be taught in the electricity room where students could obtain a "hands on" approach to the appropriate equipment.
Power Demand factor Energy conversion Motor principle 1 h.p. = 746 watts	• on a floor plan, locate the receptacles, outlets, and switches. Show the branch circuits and calculate the size of service required. • design an elementary circuit to establish the nomenclature and function of conductors. • use non-metallic sheathed cable, armoured cable, conduit, and other duct systems on simple wiring projects. • investigate the operation of a transformer. • compare the starting characteristics of single-phase and three-phase motors. • refer to the Ontario Electrical Code to determine the overload protection requirements for a motor.	It is important that students are aware of live, neutral, and ground conductors. The function of the "U" prong on portable electrical equipment should also be emphasized. It should be stressed that symbols used on electrical drawings should conform to the standards of the Canadian Government Specification Board.
Level of illumination Coefficient of utilization Luminous efficiency, lumens/watt	• do experiments to show the operation of circuit breakers under overloaded conditions. • compare fluorescent and incandescent lamps from the standpoint of over-all efficiency. • measure to compare the variations in intensity of illumination throughout the technical department in the school. • calculate the lighting wattage and branch circuit requirements for one of the instruction areas in the school.	Students could be given an overview of an electrical distribution system through an investigation from the transformer vault to the splitters, panels, and sub-panels in the school. The efficiency of fluorescent lamps may be four times greater than incandescent lamps. They have a distributed light and operate at a very low temperature. In air-conditioned buildings, the size of the cooling unit can be reduced considerably through the use of fluorescent rather than incandescent lamps.

Section	Topic	Element	Cross Reference	Technical Terms
16.1 Electrical (Continued)	**161.4 Communication**	1614.1 Signal devices .2 Communication systems .3 Television		extra low potential, rectifier, modulated d.c., open circuit,
	161.5 Heating	1615.1 Water	142.2 152.2 164.4	British thermal unit, calorie, thermostat, flip-flop thermostat
16.2 Water Supply and Disposal Systems	**162.1 Sources**	1621.1 Site water .2 Potable water .3 Industrial water	141.4	steam flow, water table, reservoir, hydrostatic, artesian
	162.2 Potable water distribution	1622.1 Municipal piping .2 Domestic piping .3 Domestic fixtures	141.4	intake, pumping station, pressure head, suction head, main, meters, water hammer,
	162.3 Sewage	1623.1 Domestic .2 Municipal .3 Industrial	141.4	stack, trap, vent, septic tank, collector, catchbasin, grade, invert elevation
	162.4 Water disposal	1624.1 Site water .2 Sewage water		drain tile, sump, disposal field, effluent disposal

Fundamentals	Suggestions for Student Activity	Discussion
Energy conversion Contact connections Programming	• prepare a technical report on the school's communication system.	It should be stressed that conductors of different systems should not be installed in the same conduit, cabinet, or box. Systems such as fire alarms are normally designed to have open contacts in parallel, and burglar alarms with closed contacts in series.
Psychrometrics	• investigate and compare the BTU potential and unit costs of various fuels.	This topic deals only with potable water heating. The various methods of heating public buildings and private homes are covered in Section 16.4.
Hydrological cycle Ground storage Precipitation Control	• use rain gauges, barometers, and hygrometers to check and record precipitation. • investigate the various systems of water purification used in both rural and urban settings. • prepare a research paper on programs to divert and store water.	A representative from the Ontario Water Resources Commission could speak on the various topics in this section. Water supply and disposal systems could also be explored in conjunction with the science department.
Equation of continuity Pressure requirements Energy losses	• interpret standard piping symbols on a set of working drawings. • sketch an elementary distribution system.	
Gravity flow Equation of continuity Limiting velocity	• sketch a sewage-collector system and study the function of the component parts. • prepare an isometric drawing of the drainage system as found in a typical home.	It should be pointed out that much of the natural nitrogen is destroyed through the chemical treatment used in modern sewage disposal systems.
Bacterial action Soil properties	• compare the differences in design between pressure and non-pressure pipes; include in the investigation the different coupling methods used.	The main emphasis in this topic should centre around private rather than municipal systems. It should encompass the areas of bedding, pipe design, inspection, maintenance, and contracting as they relate to the private application.

Section	Topic	Element	Cross Reference	Technical Terms
16.3 Gas Systems	**163.1 Sources**	1631.1 Natural .2 Manufactured		propane
	163.2 Distribution	1632.1 Piping		
	163.3 Uses	1633.1 Heating and cooling		
16.4 Heating Systems	**164.1 Water**	1641.1 Piping systems .2 Boilers, radiators, controls .3 Fuels	142.2	
	164.2 Steam	1642.1 Piping systems .2 Controls, boilers, radiators .3 Fuels	142.2	reducing valve, relief valve, condensation, temperature gradient
	164.3 Air	1643.1 Ductwork, heat-exchanger, registers, controls .2 Fuels	142.2	
	164.4 Electrical resistance	1644.1 Wiring .2 Heat-exchangers .3 Elements	142.2	

Fundamentals	Suggestions for Student Activity	Discussion
Calorific value	• compare gas with oil as a medium for providing a variety of services to the home owner today.	The basic equipment differs very little between gas and oil in today's homes.
Control		Any study of gas equipment should include ventilation and pipe size requirements.
Function		
Conduction Convection Radiation Heat exchange	• calculate the heat loss in a moderate sized home. • make the necessary calculations to determine the correct size of a radiator for a specific application. • compare water and steam systems from the standpoint of efficiency. • evaluate the heating system used in the school. • prepare a sketch and a report on the heating system in your home.	The study of heating systems should include a study of types of fuels and their application. The examination of the heating system in the school should include a discussion with the stationary engineer to ascertain job responsibilities and qualifications.
Specific heat Condensation Evaporation Expansion		
Balance Convection		
Energy conversion 1 KWH = 3413 BTU's		It should be stressed that where buildings are heated by electricity, the construction standards must meet the triple seal of quality as specified by the Ontario Electrical League. A representative from Ontario Hydro could be invited to expand upon electrical heating in the home.
Semiconductor		

Section	Topic	Element	Cross Reference	Technical Terms
16.5 Air Conditioning	**165.1 Ventilating**	1651.1 Local Units .2 Central Units	142.2	negative air pressure
	165.2 Conditioning	1652.1 Cleansed .2 Humidity controlled .3 Temperature controlled	142.2	sensible heat, latent heat, absolute humidity, relative humidity, psychrometer, barometer, damper

Fundamentals	Suggestions for Student Activity	Discussion
Physiological needs Quantity control	• examine the school's ventilation system with a view to discovering the methods of moving both fresh and stale air.	Both the psychological and the physiological aspects of working in a controlled environment could be discussed.
Quality control	• compare an air conditioning unit with a refrigeration unit from the standpoint of over-all operation. • check and compare the relative humidity in various locations in the school. • compare room humidity readings as temperatures vary outside.	

Section	Topic	Element	Cross Reference	Technical Terms
21.1 Instruments and Materials	**211.1 Instruments**	2111.1 Traditional .2 Drafting machines .3 Computers		parallel
	211.2 Surfaces	2112.1 Drawing .2 Tracing .3 Illustration		bristol board, laminated film, bond, art board, vellum, sepia, linen, mylar
	211.3 Reproduction	2113.1 Prints .2 Diazo .3 Photo	114.3	white print, blue print, ammonia, wet and dry process, negative, positive, micro film
21.2 Methods	**212.1 Basic techniques**	2121.1 Linework .2 Lettering .3 Dimensioning .4 Symbols		transfers, templates
	212.2 Orthographic Projection	2122.1 Plans .2 Elevations .3 Sections .4 Details		top view, front view, side view

Fundamentals	Suggestions for Student Activity	Discussion
Accuracy Grid Efficiency		The correct use and care of instruments should be stressed throughout the course. The fact that new materials, methods, and equipment have increased the speed and accuracy of graphic communication should be discussed. The introduction of computers has eliminated some traditional operations. The course should be constantly revised to accommodate advances in computer drafting techniques. The use of a variety of materials is to be encouraged as media for students' projects.
Opaque Transparent Translucent		
Chemical reaction	• compare the processes of various types of reproduction methods.	
Communication Symbols	• make part drawings to emphasize the various basic drafting techniques.	
Drawing to scale Two dimensional	• prepare both freehand and instrumental drawings to reinforce this basic third angle projection principle.	It should be emphasized that orthographic projection helps to communicate ideas among technically trained personnel. Axonometric projection is more appropriate for the non-technically trained.

Section	Topic	Element	Cross Reference	Technical Terms
21.2 Methods (continued)	**212.3 Axonometric projection**	2123.1 Oblique .2 Isometric	142.5	cabinet, cavalier, receding axis
	212.4 Perspective	2124.1 One-point .2 Two-point .3 Three-point .4 Short methods		vanishing point, station point, horizon line, picture plane, visual ray, ground line
	212.5 Rendering	2125.1 Materials .2 Shades and shadows .3 Entourage	142.5	umbra, montage
	212.6 Modular Drafting	2126.1 Three dimensional space grid .2 Two dimensional component and planning grid .3 Modular sizes .4 Conventions		standard module, dimensional module, reference space grid, co-ordinates, planning grid
	212.7 Models	2127.1 Representative .2 Detail		mass form, topographic, entourage, contours

Fundamentals	Suggestions for Student Activity	Discussion
Three dimensional	• study industrial and commercial drawings so that the application of axonometric projection techniques may be fully appreciated.	Students should be made aware that axonometric methods are more closely related to mechanical services drawings.
Realism Three dimensional	• make a drawing using perspective templates. • prepare one-,two-,and three-point perspective drawings. • experiment with a variety of templates and stencils.	Perspective drawings provide a realistic quality to interior or exterior views of a structure. To provide an individualized approach on a project, each student could take a different location for his station point.
Seasonal light variation Realism Three dimensional	• develop shades and shadows using mechanical templates. • experiment with the change of effects with variations in direction of light.	Colour is an important aspect in rendering. This topic could provide an excellent opportunity for correlation with the art department.
Mass production Modular integration Standardization	• develop a modular building design and specify joint locations.	Modular drafting is a relatively new concept which has resulted in a reduction in building costs.
Scaled representation	• construct a simple model from a presentation drawing.	

Section	Topic	Element	Cross Reference	Technical Terms
21.3 Drawings	**213.1 Preliminary**	2131.1 Pre-design .2 Flow diagram .3 Freehand sketches .4 Presentation	114.3 152.5	traffic flow, activity areas, site plan
	213.2 Working and detail	2132.1 Architectural .2 Structural .3 Mechanical	14.3 1.6	specifications
	213.3 Shop	2133.1 Architectural .2 Structural .3 Mechanical .4 Electrical	1.6 15.2	schematic, diagramatic

Fundamentals	Suggestions for Student Activity	Discussion
Communication of ideas Design to meet man's requirements	• make a complete set of preliminary sketches and drawings of a building project.	The drawings suggested for this section could be for a major building project undertaken in the construction shop.
Control	• continue in progressive steps through the necessary working and detail drawings.	
Fabrication and erection	• make a set of shop drawings based on the project previously selected.	Shop drawings provide a form of communication between the contractor and the sub-trades. Students should be made aware of the necessity of co-operation between the contractor and the various sub-trades to ensure satisfactory completion of a project.

Section	Topic	Element	Cross Reference	Technical Terms
22.1 Periods	**221.1 Ancient**	2211.1 Primitive .2 Mesopotamian .3 Egyptian .4 Minoan .5 Greek .6 Roman		pylon, column, obelisk, frieze, relief sculpture, Architectural Orders, facade, architrave, entablature, colonnade, vaulting
	221.2 Mediaeval	2212.1 Early Christian .2 Byzantine .3 Romanesque .4 Gothic .5 Renaissance		nave, atrium, apse, narthex, cloister, spandrel, buttress, arcade, voussoir, keystone, tracery
	221.3 Modern	2213.1 European .2 American .3 Canadian		curtain wall, cantilever, geodesic, curvilinear, concourse, art nouveau, folded plate
22.2 Personages	**222.1 Architects**	2221.1 20th Century .2 19th Century .3 Earlier	111.3 142.5	
	222.2 Engineers	2222.1 20th Century .2 19th Century .3 Earlier	111.3	

Fundamentals	Suggestions for Student Activity	Discussion
Structure suitability Stability and permanence of the structure Communication through form	• research man's efforts down through the ages for answers to the problem of shelter and for development of recognizable styles by various civilizations. • investigate the effects of the development of specific materials such as brick and concrete on construction techniques. • research the application of historic principles of construction on the modern building industry. • with the aid of sketches, compare and contrast periods of architecture. • identify different periods of architecture from photographs and sketches of well know structures. • visit the Royal Ontario Museum for research on the various eras.	This section aims to develop an appreciation of building design and construction as it has evolved. Correlation with the history and art departments would be desirable in the teaching of this unit. Present architecture has emerged from geographic, religious, and social influences in three historical periods: ancient, mediaeval, and modern. Students should be made aware of the motivational forces and the contributions of each period. The concept of the skyscraper started about 1880 with the Montauk Building in Chicago, a ten-storey structure designed by by D. H. Burnham.
	• prepare a report on major contributions to the construction industry by one or more famous architects or engineers.	

Section	Topic	Element	Cross Reference	Technical Terms
31.1 Foundations	**311.1 Footings**	3111.1 Types .2 Layout .3 Forms	11.3 114.5 1212.1 13.2 1221.3 1514.6	live load, dead load, step footing, spread footing, integral footing, projection, water stop, pier, keyway, disturbed soil, undisturbed soil
	311.2 Walls	3112.1 Types .2 Formwork connections .3 Waterproofing .4 Dampproofing	143.1	wales, spreader, bulkhead, pilaster, construction joint, control joint, sleeve, cove, tie, buck, parge, rate-of-pour
	311.3 Slabs	3113.1 Waterproofing .2 Sub-base .3 Drainage	143.2	water table, screed, butterfly, darby, membrane
31.2 Framing	**312.1 Wall types**	3121.1 Platform .2 Balloon, braced frame .3 Post and beam .4 Rigid frame .5 Prefabrication	11.3 114.5 13.2	ribbon, firestop, lintel, hunch gusset, crown gusset, arch anchor
	312.2 Floors	3122.1 Sills .2 Beams .3 Joists .4 Sub-floors .5 Bridging .6 Openings .7 Prefabrication	143.2	girder, header, ledger, tail joist, hanger, trimmer, bridging

Fundamentals	Suggestions for Student Activity	Discussion
Support Design of forms	• construct a full-sized section of a typical footing form and pour a portion with concrete.	Central Mortgage and Housing Corporation standards for footing and wall thickness must be observed for National Housing financing approval. In form design, ease of assembly, stripping, and re-use should be discussed. Scheduling should be stressed as an important factor in the study of topics under this section.
Forces imposed by plastic concrete Hydrostatic pressure Capillary action Hydration Shrinkage	• construct a full-sized portion of a wall form which includes sleeves and bucks.	
	• pour and test slab sections of different concrete mixes. • compare the strengths of reinforced and non-reinforced slab sections.	
Vector forces	• construct a full-scale project which incorporates the framing of floors, walls, ceilings, and roof. The roof design should include hip and valley rafters.	The similarities among floor, wall, and roof framing should be emphasized. In framing, high structural stength can be obtained by using small members and good design. In most instances, in residential construction, the soffit and facia portion of the roof is constructed before wall erection.

Section	Topic	Element	Cross Reference	Technical Terms
31.2 Framing (continued)	**312.3 Walls**	3123.1 Members .2 Rough openings .3 Sheathing .4 Prefabrication	143.1	cripple, load bearing, non-load bearing, trimmers, lintels, truss members, braces, plates
	312.4 Roofs	3124.1 Types .2 Terminology and calculations .3 Common rafters .4 Hip and valley .5 Jack rafters .6 Roof openings .7 Sheathing .8 Prefabrication	14.3	gable, hip, gambrel, mansard, run, thrust, collar ties, birdsmouth, side cut, truss, gusset plate, split ring, gang nail, interesecting, single slope, overhang, ridge, lookout, gable, dormer
31.3 Masonary	**313.1 Solid**	3131.1 Materials .2 Bonds .3 Advantages and disadvantages	13.3	wythe, bond, mortar, back up, stretcher, header, soldier, rowlock, drip cap
	313.2 Veneer	3132.1 Materials .2 Construction methods .3 Advantages and disadvantages	13.3	running bond, lead, tooled joints, closure, trip, course, space rule
31.4 Finishing	**314.1 Exterior**	3141.1 Wall .2 Roof	13.6 13.2	cladding, batten, frieze, facia, soffit, plancier, return, saddle, drip cap, rake
	314.2 Interior	3142.1 Floor .2 Wall .3 Ceiling .4 Trim	13.2 13.6 152.6	resilient, parquet, underlay, casing, base, shoe, cove, coping, scribing, plastic laminates

Fundamentals	Suggestions for Student Activity	Discussion
Rigidity of a triangle	• compare various types of sheathing for strength, insulating qualities, and economy. • compare sheathing to cross bracing for structural rigidity.	
Pitch = $\frac{\text{Rise}}{\text{Span}}$ Rise per ft. run = Pitch x Unit of Span Pythagorean Theorem Proportional comparison of triangles	• calculate the line length of a rafter using tables, the step-off method, and the Pythagorean Theorem. • lay out and cut the top, seat, and tail cuts on a rafter. • determine the length of the ridge board for different types of roofs. • frame portions of a gable, hip, and intersecting roof. • construct various types of trusses and compare their strengths. • compare truss roof and conventional roof designs from the stand-point of strength and rigidity.	It should be stressed that one of the important criteria in roof design is its aesthetic quality. Roof trusses offer special advantages. They speed up site erection, conserve lumber, and can provide a greater unobstructed span than the conventional joist and rafter construction techniques.
Preservation	• compare different bond designs and consider the advantages and disadvantages of each. • lay a section of a solid and a veneer masonry wall.	Mortar, bricks, and blocks constitute a large segment of residential building materials. If masonry is taught in another area of the school, an interchange of classes would be beneficial for this part of the course.
Precision Selection		This section deals with the fabrication of exterior and interior finishing materials that could be a part of the major building project.
Function Aesthetics	• mitre and cope various designs of moldings at the intersection of regular and irregular planes. • scribe members to an irregular surface.	

Section	Topic	Element	Cross Reference	Technical Terms
31.5 Millwork	**315.1 Doors**	3151.1 Types .2 Hardware .3 Installation	13.2	threshold, jamb, lead, kalamein, swage, mortise, strike plate, door jack, hinge gain
	315.2 Windows	3152.1 Types .2 Hardware .3 Installation	1523.1	Sash, stile, stops, mullion, muntin, sashless, sill, sill horn, drip groove, check rail, jambs
	315.3 Stairs	3153.1 Types .2 Terms and calculations .3 Construction .4 Installation	1525.2 1442.1	tread, riser, stringer, nosing, stair rod, line of travel, pitch board, volute

Fundamentals	Suggestions for Student Activity	Discussion
Control of traffic	• compare the various types and applications of doors and windows. • hang a door. • set a window.	
Control of light and ventilation		
Safety in design Proportion	• layout and construct common stair types.	It should be pointed out, that for economic reasons, metal has replaced wood in stair-rail construction.

Section	Topic	Element	Cross Reference	Technical Terms
32.1 Foundations	**321.1 Simple**	3211.1 Footings .2 Walls .3 Pilasters and piers .4 Waterproofing	1514.1 1212.1 13.2	keyway, stepped, live load, dead load, parging
	321.2 Special	3212.1 Pilings .2 Piers .3 Caissons .4 Retaining structures .5 Floating slabs .6 Grade beams .7 Rock anchors	1212.1 121.3 151.4	friction piles, bearing piles, water table, box caisson, open caisson, pneumatic caisso cofferdam, cohesive soil, non-cohesive soil
32.2 Structural Concrete	**322.1 In situ**	3221.1 Advantages and disadvantages .2 Pouring or placing methods	151.4 1442.1 13.1	slump tests, floating, aggregate segregation
	322.2 Formwork	3222.1 General considerations .2 Column forms .3 Wall forms .4 Slab forms .5 Beam forms .6 Stair forms .7 Bulkheads and keyways .8 Special forming materials .9 Special forming methods	13.2 3.3	walers, ties, kicker, shoring, bucks, beam hangers, slab pans, ledger, brace, bulkhead, joints, spreaders, rock anchors, cleats, column clamp, inserts
	322.3 Reinforcing	3223.1 Stresses .2 Positioning .3 Materials .4 Fabricating	14.3	lateral ties, spiral, stirrups, dowels, cantilever, temperature bars

Fundamentals	Suggestions for Student Activity	Discussion
Equilibrium of forces Stresses	• design and build a simple form. • prepare a research topic on special types of foundations. • study plans of industrial construction that include unique foundation arrangements.	Architects could be invited to address the students on this section of the course. The study of concrete foundations should include pouring and curing under winter conditions.
Friction Hydrostatic pressures	• investigate the use of wood as a foundation medium in present building techniques. • carry out experiments to show the differences in soils regarding their capacity to bear specified loads.	Comparisons should be made between reinforced concrete and wood-steel construction. Students should be made aware that foundation designs will vary considerably because of local environmental conditions.
Chemical reaction Hydration Plasticity	• from a set of plans choose a section that contains a variety of formwork shapes and either individually or in groups, design and build the forms selected.	
Fluidity Tension Compression Shear Diagonal tension Friction bonds	• assess the form design by actual concrete placement. • investigate form designs that can be easily assembled and stripped.	
	• investigate the types and the placement of reinforcing steel in concrete structures. • perform simple tests on model beams to show the effectiveness of correct positioning of reinforcing on the beam's strength.	The importance of the correct sizing and placing of reinforcement should be stressed in all formwork covered under this topic.

Section	Topic	Element	Cross Reference	Technical Terms
32.2 Structural Concrete (continued)	**322.4 Precast Concrete**	3224.1 Advantages and disadvantages .2 Common members .3 Erection procedures .4 Special systems	14.3	
	322.5 Pre-stressed	3225.1 Purpose and theory .2 Pre-tensioning .3 Post-tensioning	14.3	tendons
32.3 Structural Metals	**323.1 Steel products**	3231.1 Grades, sizes, and shapes .2 Built-up units .3 Fabrication .4 Erection	13.4	
	323.2 Aluminum	3232.1 Uses and advantages .2 Erection	13.4	lally column, open-web joist
32.4 Structural Timber	**324.1 Solid units**	3241.1 Species, grade-suitability .2 Fastening and connecting .3 Advantages and disadvantages	13.2	shoe, shear plate, vents
	324.2 Laminated Units	3242.1 Types .2 Materials .3 Manufacture .4 Quality control and testing		scarfe joints, finger joints, glue-line, hinge connector

Fundamentals	Suggestions for Student Activity	Discussion
Stresses Prefabrication	• investigate the applications of the various types of precast shapes used in construction. • research the various methods of fastening precast units. • visit a precast concrete factory to observe and report on the techniques used in the operation.	
Pre-conditioning Elastic limits		
Selection of materials Classification		The fact that the fire endurance of steel structures is much lower than either wood or concrete should be emphasized.
		It should be pointed out that lightweight metals now play a major role in both the structural and the decorative aspects of construction projects.
Compression Tension Bending moments Classification Elastic limit	• make test pieces of different types of wood and subject them to various load conditions.	
Structure Bonding	• from architects' plans, construct sections of laminated arches and test their strength.	Lumber used in the manufacture of laminated timbers should have parallel grain structure and an absence of natural wood defects.

Section	Topic	Element	Cross Reference	Technical Terms
32.5 Structural and Veneer Masonry	**325.1 Structural**	3251.1 Types .2 Materials .3 Installation	13.3	bonds, pilaster, buttresses, joints, ties, cavity wall, grout
	325.2 Facing Units	3252.1 Types .2 Materials .3 Installation	31.3	brick anchors, stone anchors
	325.3 Ancillary	3253.1 Types .2 Materials .3 Installation		coping, sills, lintels
32.6 Components, Exterior and Interior	**326.1 Walls**	3261.1 Load bearing .2 Curtain .3 Rain screens .4 Windows .5 Doors	151.4 15.2	curtain wall grid, tilt-up panels, rain screen, furring, plaster grounds, solid, hollow metal
	326.2 Finish floor	3262.1 Poured toppings .2 Wood on concrete .3 Resilient .4 Clay and ceramic		slurry, metallic aggregate, sleepers, mastic, tile, terra cotta, terazzo

Fundamentals	Suggestions for Student Activity	Discussion
Selection Modular co-ordination	• investigate the types of masonry and mortars used in heavy construction for load and non-load bearing walls.	It should be emphasized that allowable height and minimum thickness of block-bearing walls are specified in the National Building Code. The aesthetic potential of structural masonry should not be overlooked in presenting this topic.
Expansion rate Durability Maintenance Aesthetics	• research the various types of facing materials used in construction and consider the methods of anchoring employed.	The reasons for the necessary clearance between the wythe and the framing members should be discussed. The various flashing methods should also be investigated.
Compressive strength Selection of materials Modular sizing	• investigate and compare the various types of doors and windows available for use in heavy construction.	Regardless of the type of construction, vapour barriers and insulation are vital considerations in any building. Students should be made aware of functional form as well as the aesthetics in the consideration of doors and windows.
Durability Vibration Maintenance	• install wood and tile sections of a floor and compare their inherent qualities.	The durability and maintenance factors should clarify the need for the various types of floor surfaces used in commercial buildings.

Section	Topic	Element	Cross Reference	Technical Terms
32.6 Components, Exterior and Interior (continued)	**326.3 Roofs**	3263.1 Types .2 Structural aspects	1514.6	saw-tooth, hyperbolic, parabolic, flat, thin, shell, trussed, arched
	326.4 Roof coverings	3264.1 Shingle .2 Sheet type .3 Built-up, cold, hot applications .4 Flashings		roof deck, roofing felt paper, membrane
32.7 Cold Weather Procedures	**327.1 Personal protection**	3271.1 Wearing apparel .2 Special equipment and procedures		salamander heater
	327.2 Building protection	3272.1 Reasons .2 Enclosure systems .3 Special precautions		
	327.3 Materials handling	3273.1 Adverse effects		flash set, carbon monoxide

Fundamentals	Suggestions for Student Activity	Discussion
Loading	• research local roof designs and the materials used in their construction. • carry out an analysis of the roof design used on the school.	
Protection	• examine an architects' specifications for roof coverings.	It should be emphasized that roof coverings should provide a vapour barrier, insulation, weather proofing, and accommodate for temperature variations.
Environmental control Frost Hydration	• visit a construction site to observe personal and building protection procedures.	Considerations in cold weather construction may be summed up as follows: – the effect of frost under the foundation – concrete strength before it may be exposed to frost – the effect of temperature on the hydration rate of concrete – the avoidance of carbon dioxide when heating freshly poured concrete – the effects of oily film deposits from heaters.

Section	Topic	Element	Cross Reference	Technical Terms
33.1 Engineering	**331.1 Design**	3311.1 Temporary structures .2 Equipment	15.1 322.2	scaffolding, barricades, shoring, boom, swing stage
	331.2 Layout	3312.1 Physical restrictions: utilities, pedestrian, vehicles .2 Temporary facilities .3 Storage		
	331.3 Construction	3313.1 Precautionary methods .2 Emergency equipment .3 Protective equipment	322.2	flash point, volatile, toxic, respirator
33.2 Enforcement	**332.1 Legislated**	3321.1 Inspectors: provincial, municipal		
	332.2 Non-legislated	3322.1 Supervisors .2 Individuals .3 Unions		
	332.3 Liability	3323.1 Compensation .2 Public opinion		lost time

Fundamentals	Suggestions for Student Activity	Discussion
Value of human life Safety factor Stability	• make an on-site inspection of a project and report on safety practices observed.	This section should not be taught as a separate entity, but should be stressed at appropriate times throughout the course.
Efficiency		
Safety inspection Economics	• assisted by the construction safety supervisor, carry out a survey of protective equipment used on a local construction site. • discuss "safety is an attitude" with a construction safety supervisor.	
Minimum standards		The students should be made aware of the various kinds of inspectors involved in any construction project.
Responsibility: legal, moral, personal		
Insurance		A representative from the Workmen's Compensation Board could address the class concerning this aspect of the course.

Section	Topic	Element	Cross Reference	Technical Terms
33.3 Education	**333.1 Accident prevention associations**	3331.1 Industrial Accident Prevention Association .2 Construction Safety Association		
	333.2 Mangement	3332.1 Safety promotion .2 Training programs .3 First aid		
	333.3 Labour	3333.1 Safety promotion .2 Training programs .3 First aid		

Fundamentals	Suggestions for Student Activity	Discussion
"We worry"	• establish a safety committee to promote safety consciousness in activities in the school. • initiate an Industrial Accident Prevention Association inspection of the technical wing in the school.	

Resource Material
Films

The following films, listed alphabetically, might prove useful to the teachers of Elements of Construction Technology to supplement various aspects of the course. Most are available from Learning Materials Service Unit, Ontario Department of Education, 559 Jarvis Street, Toronto. For those areas however, that have their own film resource centres, procurement sources are identified.

A is for Architecture
Learning Materials Service Unit, Department of Education. Made by National Film Board, 1959. (30 min.) colour.
This film shows the changing concepts in architecture through the ages and how each style reflects the sentiments and values of the time.

Another Choice
Made by Bramalea Construction Limited, Peel County. Distributed by Modern Talking Picture Service, 1815 Leslie Street, Don Mills, Ontario. (27 min.) colour.
This film gives a description of a planned satellite city as opposed to urban development within a city. The attempt is to show a balanced community independent from the large metropolitan area of Toronto. This film might be used in conjunction with the film *Suburban Living – Six Solutions* (available at Learning Materials Service Unit, Department of Education) which deals with six approaches to urbanization.

Art and Industry of Precast
Learning Materials Service Unit, Department of Education. Made by Portland Cement, 160 Bloor Street East, Toronto, 1964. (24 min.) colour.
This film illustrates the methods of making and installing precast mullions and panels for construction.

Buying Your New House
Learning Materials Service Unit, Department of Education. Made by Central Mortgage and Housing Corporation, 1960. (15 min.) black and white.

Choosing a House Design
Learning Materials Service Unit, Department of Education. Made by Central Mortgage and Housing Corporation, 1960. (15 min.) black and white.

Choosing Your Neighbourhood and Lot
Learning Materials Service Unit, Department of Education. Made by Central Mortgage and Housing Corporation, 1960. (15 min.) black and white.
In these three films, a young married couple specifies the main points of buying a new house, choosing a design and selecting a neighbourhood through a discussion with a Central Mortgage and Housing Corporation representative to whom they direct a series of pertinent questions. The answers are frequently illustrated by photographs or animation and reflect the judgements of housing experts.

Concrete in Canada
Learning Materials Service Unit, Department of Education. Made by Portland Cement, 160 Bloor Street East, Toronto, 1964. (20 min.) colour.
This is a good general film as an introduction to precast concrete design. The film shows a forty-seven-storey reinforced concrete structure in Montreal, the Toronto City Hall, and other projects of Canadian interest, where concrete is used.

Critical Path
Learning Materials Service Unit, Department of Education. Also distributed by Educational Film Distributors, 191 Eglinton Avenue East, 1968. (16 min.) colour.
In planning a new undertaking, a chart is made to show each move as a separate step in an integral plan. This technique helps to solve many problems on paper before they occur in practice. The film shows the drawing up, after discussion, of a Critical Path Analysis for work on a major project. The advantages of the system for all units are emphasized.

Designing a Better Tomorrow – A Career in Architecture
Made by American Institute of Architects. Distributed by Canadian Film Institute, 1762 Carling Avenue, Ottawa. (14 min.) colour.
This film was produced as a vocational guidance aid for showing to high school students. The film provides a graphic short course on the meaning of architecture in general. The film explains the attitudes, interests, and educational preparation desirable for the study of architecture as a career.

Engineering With Glass
Learning Materials Service Unit, Department of Education. Made by Photomedia Department, Corning Glass Works, Main Plant, Corning, New York 14830. colour.
This film deals with the uses and application of glass along with its properties. The context of the film is presented in an up-to-date, interesting and scientific manner. Chet Huntley is the narrator.

How to Transport, Place, Finish and Cure Quality Concrete
Learning Materials Service Unit, Department of Education. Made by Portland Cement, 160 Bloor Street East, Toronto, 1954. (32 min.) colour.
This film shows approved methods for placing concrete in horizontal and vertical forms, proper finishing techniques for slabs and for vertical walls, and a variety of curing methods with particular emphasis on winter protection.

Mountains to Microns
Learning Materials Service Unit, Department of Education. Made by Portland Cement, 160 Bloor Street East, Toronto, 1959. (24½ min.) colour.
This film shows production of portland cement from raw material to the finished product. It includes outstanding examples of concrete construction and the use of cement in making concrete.

Principles of Architectural Composition
Learning Materials Service Unit, Department of Education. Made by Canadian Structural Clay Association, 4824 Yonge Street, Willowdale, Ontario. colour.
A detailed analysis of architecture covers the following headings: style, character, unity, sequence, proportion, rhythm, and scale.

Principles of Quality Concrete
Learning Materials Service Unit, Department of Education. Made by Portland Cement, 160 Bloor Street East, Toronto, 1969. (23 min.) colour.
Describes the essential steps in making quality concrete from the design of the mix to the time the concrete comes from the mixer.

Regent Park
Made by National Film Board. Distributed by Mr. E. D. Brennan, Central Mortgage and Housing Corporation, 650 Lawrence Avenue West, Toronto, on a long term loan basis. (12 min.) black and white.
Shows how the Regent Park South district of downtown Toronto was successfully re-developed. It vividly portrays the slum conditions prior to re-development, the financial responsibilities which municipal, provincial, and federal governments accepted to re-develop the area.

Sewer Construction
Learning Materials Service Unit, Department of Education. Made by Portland Cement, 160 Bloor Street East, Toronto, 1965. (18½ min.) colour.
Illustrates batter board construction, the equipment used in levelling and trenching techniques, methods of shoring, pipe bedding, and pipe joining.

Steel in Space
Made by Pacific Car and Foundry, Structural Steel Division. Distributed by Association Industrial Films, 333 Adelaide Street West, Toronto. (30 min.) colour.
This film shows construction of the space-needle tower for the Seattle World's Fair. It also shows foundation footings and steel erection.

Successful Street Paving
Learning Materials Service Unit, Department of Education. Made by Portland Cement, 160 Bloor Street East, Toronto, 1961. (13½ min.) colour.
The film shows methods of preparing the base for concrete, pouring and screeding of concrete, also joints in continuous concrete slabs.

The Changing City
Learning Materials Service Unit, Department of Education. Made by National Film Board. (28 min.) colour.
A clear interpretation of how, under the National Housing Act, the resources of the federal government are made available to help meet the housing needs of a growing Canada. The film illustrates, with examples, some applications of the Act.

The City and the Future (The City, Part 6)
Learning Materials Service Unit, Department of Education. Made by National Film Board (28 min.) black and white.

The Mechanism of Moisture Movement in Wood
Learning Materials Service Unit, Department of Education. Made by Byron Motion Pictures, 95 K Street, Northeast, Washington, D.C. 20002. colour.
This film deals in depth with moisture in wood, covering methods of drying, cell structure, equilibrium, capillary action, analysis of how wood loses moisture, and the reasons for defects when losing moisture.

Trees — Our Plant Giants
Learning Materials Service Unit, Department of Education. Also distributed by Canadian Film Institute, 1762 Carling Avenue, Ottawa, 1960. colour.
This film portrays, in a simple manner, analysis of trees and the structure of wood. It is basically for the Intermediate Division.