

BUILDING SCIENCE

NOTE:

- (i) The principles of science which underlie the design, erection, preservation and use of building and civil engineering projects should be taught.
- (ii) Experimental work should be an essential feature of instruction. Suitable laboratory accommodation and equipment are therefore necessary.
- (iii) Students' notes and records of experiments should aim at the elucidation of the principles which the experiments are intended to illustrate or verify.
- (iv) It is essential to give a choice of questions in examinations to permit some latitude in the treatment of the various sections of the syllabus.

BUILDING SCIENCE N1

(with effect from 1 September 1979)

(One 3-hour paper)

1. Density and relative density of building materials; calculations involving density, volume and weight of a body. Structure of materials. Porosity, absorption of water; determination of moisture content; prevention of dampness in buildings; voids in granular materials; bulking of sand; grading of aggregate.
2. Timber: Structure and properties; moisture content; seasoning-natural and kiln; preservation of timber.
3. Measurement of atmospheric, gas and water pressure; (Boyle's and Charles's laws).
The application of the syphon to flushing cisterns; anti-syphonage lift, force and diaphragm pumps.
4. Physical measurement: Units of measurement; measurement of length, area, volume.
Mass, force and weight. Specific gravity.
5. Concrete; composition, properties and uses of Portland cement concrete. Grading and particle shape of aggregates; Proportions of material for various types of construction. Water-cement ratio.
Methods of mixing materials. Slump test. Transporting, placing and curing. Quantities of materials per cubic metre. Yield of concrete from given batch of materials for a specific mix.

6. Force: Definition of a force; representation of a force; action and reaction; effects, units. Force as a vector quantity; addition of vectors; definition of resultant, equilibrant and equilibrium; equilibrant and resultant of a system of forces. Parallelogram and triangle of forces and their application in solving simple problems. Resolution of a force into two components at right angles, graphically and by calculations.
7. Force polygon; conditions of equilibrium for concurrent, co-planar forces. Application to determine magnitude of the unknowns for systems of concurrent, co-planar forces. Conditions of equilibrium of a body under the action of three forces. Application to determine unknown reaction in direction and magnitude. Bow's notation.
8. Link polygon; use to determine resultant and reactions (parallel forces only); application to simply supported beams with vertical loads.

BOUWETENSKAP

LET WEL:

- (i) Die wetenskaplike beginsels wat die ontwerp, oprigting, verduursaming en benutting van bou- en siviele ingenieursprojekte ten grondslag lê, moet gedoseer word.
- (ii) Eksperimentele werk behoort 'n essensiële kenmerk van die onderrig te wees. Geskikte laboratoriumakkomodasie en -uitrusting is dus 'n vereiste.
- (iii) Studente se aantekeninge en rekords van eksperimente behoort as doelstelling te hê die verduideliking van die beginsels wat die eksperimente bedoel is om te illustreer of te bewys.
- (iv) Dit is essensieel dat 'n keuse van vrae by eksamens toegelaat word om sodoende vir 'n mate van vryheid voorsiening te maak by die behandeling van die verskillende afdelings van die leerplan.

BOUWETENSKAP N1

(met ingang van 1 September 1979)

(Een 3-uurvraestel)

1. Digtheid en relatiewe digtheid van boumateriale; berekeninge waarby digtheid, volume en gewig van 'n liggaam betrokke is. Die struktuur van materiale. Poreusheid, absorpsie van water; bepaling van voginhoud; voorkoming van vogdeurdringing in geboue; leegtes in korrelrige materiale; voguitsetting van sand; gradering van aggragaat.
2. Hout: Struktuur en eienskappe; voginhoud; droging - natuurlike en oonddroging; verduursaming van hout.
3. Meting van atmosferiese, gas- en waterdruk (die wette van Boyle en Charles). Die toepassing van hewelwerking met betrekking tot spoelbakke; nie-heweling; suig-, pers- en diafragmapompe.
4. Fisiese meting: Maateenhede; meting van lengte, oppervlakte en volume. Massa, krag en gewig. Soortlike gewig.
5. Beton; samestelling, eienskappe en gebruike van Portlandsementbeton. Gradering en fatsoen van aggregate. Verhoudings van materiale vir verskillende soorte konstruksie. Water-sementverhouding. Metodes vir die meng van materiale. Saktoets. Transportering. Blasing en nabehandeling. Hoeveelhede materiale per kubieke meter. Opbrengs van beton vir 'n gegewe lot materiale vir 'n bepaalde mengsel.

6. Krag: Definisie van n krag; voorstelling van n krag; werking en reaksie; effekte, eenhede. Krag as n vektorgrootheid; optel van vektore; definisie van resultante ewewigskrag en ewewig; ewewigskrag en resultante van n kragtestelsel. Parallelogram en driehoek van kragte en die toepassing daarvan by die oplossing van eenvoudige probleme. Ontbinding van n krag in twee reghoekige komponente, grafies en deur middel van berekeninge.
7. Kragteveelhoek: Ewewigstoestande vir konkurrente saamvlakkige kragte. Ewewigstoestande van n liggaam onder die werking van drie kragte. Toepassing om die rigting en grootte van die onbekende reaksie te bepaal. Bow se notasie.
8. Skakelveelhoek; die gebruik daarvan om resultante en reaksies te bepaal (slegs ewewydige kragte). Toepassing op eenvoudig gesteunde balke met vertikale belastings.

BOUWETENSKAP N2

(met ingang van 1 September 1979)

(Een 3-uurvraestel)

1. Warmte: Die aard van warmte; temperatuur en warmte; eenvoudige warmteberekeninge; uitsetting en inkrimping deur temperatuurverandering. Oordrag van warmte deur geleiding, konveksie en straling. Eenvoudige mengseleksprimente. Britse termiese eenhede en die kalorie. Eenvoudige faktore wat die warmte-isoleeringseienskappe van materiale en strukturele eenhede affekteer. Die uitsit van water by bevriesing; rypskade aan geboue. Konstruksieprobleme te wyte aan die uitwerking van uitsetting en inkrimping.
2. Oppervlakspanning. Kapillariteit; waterwerende middels. Eienskappe van absorberende en nie-absorberende vaste stowwe; vaste en hoopdigtheid, poreusheid, versadigingskoëffisiënt.
3. Die beginsel van Archimedes en flottasie. Bepaling van die soortlike gewig van onoplosbare vaste stowwe en van vloeistowwe; hidrometer; elementêre berekeninge.
4. Dakbedekkings: Die eienskappe van dakbedekkings van die volgende materiale gemaak: koper, lood, gegalvaniseerde ysterplaat, asbessementleie en gegolfde plate, natuurlike leie, houtspane, dekriet, "malthoid" (bitumineuse dekmateriaal).
5. Konkurrente kragte. Bepaling van die resultante en ewewigskrag vir 'n stelsel van enige getal konkurrente saamvlakkige kragte, grafies en deur middel van berekening.
6. Skakel- en stangeveelhoek. Grafiese bepaling van die ligging van die resultante en ewewigskrag van ewewydige en nie-ewewydige kragte wat op vaste liggame inwerk. Toepassing op eenvoudig gesteunde balke met vertikale belastings (met inbegrip van gelykmatig verspreide belastings) met en sonder oorhangente; bepaling van die ligging van sentroïede van plat reglynige profiele simmetries om een as.
7. Momente: Definisie en beginsel van momente; toepassing op eenvoudige hefboome; ligging van resultante van 'n stelsel van ewewydige kragte; 'n kragtepaar; bepaling van die reaksies van steunpunte van eenvoudig gesteunde balke onder vertikale en gelykmatig verspreide belastings - met en sonder oorhangente. Bepaling van die ligging van die sentroïed van plat reglynige profiele wat simmetries om een as is.
8. Raamwerke. Grafiese bepaling van die grootte en aard van die kragte in die onderdele van eenvoudige raamwerke. Dakkappe met spanwydte tot 10 meter, met simmetriese vertikale belasting.

BUILDING SCIENCE N2

(with effect from 1 September 1979)

(One 3-hour paper)

1. Heat: Nature of heat; temperature and heat; simple heat calculations; expansion and contraction by change of temperature. Transfer of heat by conduction, convection and radiation. Simple mixture experiments; British thermal units and the calorie. Simple factors affecting the heat insulating properties of materials and structural units. Expansion of water on freezing; frost damage to buildings; constructional problems due to the effects of expansion and contraction.
2. Surface tension. Capillarity; water repellants. Properties of absorptive and non-absorptive solids; solid and bulk density, porosity, saturation co-efficient.
3. Archimedes' Principle and flotation. Determination of the specific gravity of insoluble solids and of liquids; hydrometer; elementary calculations.
4. Roof coverings: The properties of roof coverings made of the following materials: copper, lead, galvanised iron sheeting, asbestos cement slates and corrugated sheets, natural slates, wood shingles, thatch, malthoid, (bitumastic sheeting) clay and concrete tiles, fibre glass sheets.
5. Concurrent forces. Determination of resultant and equilibrant for a system of any number of concurrent co-planar forces, graphically and by calculation.
6. Link and funicular polygon. Graphical determination of the position of the resultant and equilibrant of parallel and non-parallel forces acting on rigid bodies. Application to simply supported beams with vertical loads (including uniformly distributed loads) with and without overhanging ends; determination of position of centroids of plane rectilinear sections, symmetrical about one axis.
7. Moments: Definition and principle of moments; application to simple levers; position of resultant of system of parallel forces; a couple; determination of reactions of supports of simply supported beams under vertical and uniformly distributed loads - with and without overhanging ends. Determination of position of centroid of plane rectilinear sections symmetrical about one axis.
8. Frames: Graphical determination of the magnitude and nature of the forces in the members of simple frames. Roof trusses up to 10 metre span with symmetrical vertical loading.

BUILDING SCIENCE N3

(One 3-hour paper)

1. Voids in granular materials; theory of concrete mix design grading; workability; water/cement ratio. Methods of testing cements, aggregates and concrete. Moisture movement of concrete products. Lightweight concrete; production and characteristics.
2. Characteristics of chemical action; oxidation, calcination of limestone; slaking of lime. Solution; crystallisation; efflorescence. Setting and characteristic properties of lime and Portland cement; factors affecting their use in mortars, concrete and plasters.
3. Water: Effects of hard and soft waters on pipes; treatment of water for industrial and domestic purposes.
4. General nature of paints; paint failures. General introduction to plastics used in the construction industry.
5. Electricity: Voltage and current, units of measurement. Electric appliances, lighting, heating, motors. Difference between single and three-phase supply. Safety precautions, earth leakage and overload (elementary treatment).
6. Friction: Simple laws of static and sliding friction; definition of and experimental methods of determining coefficient of friction and angle of friction; motion of a particle under gravity; mass, momentum, force.
7. Work: Principle of work; mechanical advantage; velocity ratio; efficiency. Block and tackle. Winch and differential pulley block.
8. Moments: Definition of a moment of a force and couples; principle of moments for bodies in equilibrium. Application to problems on reactions of beams under inclined loads; position of centroid of plane non-symmetrical rectilinear sections, with or without portions removed (also by link polygon method).
9. Frames. Graphical determination of the magnitude and nature of the forces in the member of simple frames. Roof trusses up to 30 feet span with unsymmetrical vertical loading; cantilever frames under vertical loading.
10. Shear legs and tripods.
11. Shear force and bending moment. Introduction to the calculation of S. F. and B. M. in cantilevers and simply supported beams, including beams with overhanging ends, under uniformly distributed or point loads.

BOUWETENSKAP N3

(Een 3-uurvraestel)

1. Lengtes in korrelrigemateriale; teorie van gradering vir betonmengselontwerp; bewerkbaarheid; water/ sementverhouding. Metodes om sementsoorte, aggregate en beton te toets. Vogbeweging van betonprodukte. Ligte beton; produksie en kenmerke.
2. Die kenmerke van chemiese werking; oksidasie, kalsinasie van kalkklip; kalkblussing. Oplossing; kristallisasie; skimmel. Bindings- en kenmerkende eienskappe van kalk en Portlandsement; faktore wat die gebruik daarvan in mortelsoorte, beton en pleister-soorte affekteer.
3. Water: Die uitwerking van harde en sagte water of pype; die behandeling van water vir industriële en huishoudkundige doeleindes.
4. Algemene aard van verfsoorte; verfmislukkings. Algemene inleiding tot plastiekstowwe wat in die boubedryf gebruik word.
5. Elektrisiteit: Spanning en stroom, maateenhede. Elektriese toestelle, verligting, verwarming, motore. Die verskil tussen enkel- en driefasige toevoer. Veiligheidsmaatreëls aardlekkasie en oorbelasting (elementêre behandeling).
6. Wrywing: Eenvoudige wette van statiese en skuifwrywing; definisie van en eksperimentele metodes vir die bepaling van vrywingskoeffisiënt en wrywingshoek; beweging van 'n partikel onder swaartekrag; massa, momentum, krag.
7. Arbeid: Arbeidsbeginsel; meganiese hefvoordeel; snelheidsverhouding; rendement. Katrolstel. Wenas en differensiëlekatrol.
8. Momente: Definisie van 'n moment van 'n krag en kragtepare; beginsel van momente vir liggame wat in ewewig verkeer. Die toepassing op probleme oor reaksies van balke onder skuins belastings; ligging van sentroïed van plat nie-simmetriese reglynige profiele, met of sonder gedeeltes daarvan verwyder (ook deur middel van die skakelveelhoekmetode).
9. Raamwerke: Grafiese bepaling van die grootte en aard van die kragte en 'n onderdeel van 'n raamwerk. Dakkappe met spanwydte tot 30 voet, met onsimmetriese vertikale belasting; vrydraerrame onder vertikale belasting.
10. Katrolbokke en drievoete.
11. Skuifkrag en buigmoment. Inleiding tot die berekening van skuifkrag en buigmoment in vrydraers en eenvoudig gesteunde balke, met inbegrip van balke met oorhangente, onder gelykmatig-verspreide of puntbelastings.