

Education for Industry and Commerce

# BUILDING CRAFTS

6

---

T9D1:84.3

T9D1:84.3  
H5  
034952



PRINTING OFFICE \* PRICE 1s.0d.NET

1945

374

EDUCATION FOR INDUSTRY AND  
COMMERCE

# BUILDING CRAFTS

---

MINISTRY OF EDUCATION  
PAMPHLET No. 4

---

LONDON  
HIS MAJESTY'S STATIONERY OFFICE

1945

# CONTENTS

	PARAGRAPHS
INTRODUCTION .. .. .	1-7
I. ORGANISATION OF PART-TIME DAY AND EVENING	
CRAFT COURSES	
Types of Courses .. .. .	8-10
Design of Craft Courses .. .. .	11-14
Organisation of Part-time Day Classes .. .. .	15-17
Examinations and Certificates .. .. .	18
II. THE CRAFT COURSES—SYLLABUSES IN TECHNOLOGY	
AND PRACTICAL WORK	
Technology: General Notes .. .. .	19-24
Practical Work: General Notes .. .. .	25-30
Brickwork .. .. .	31-39
Masonry .. .. .	40-48
Plastering .. .. .	49-57
Carpentry and Joinery .. .. .	58-66
Woodcutting Machine Work .. .. .	67-75
Painting and Decorating .. .. .	76-84
Plumbing .. .. .	85-93
Slating and Tiling .. .. .	94-98
Mastic Asphalt Work .. .. .	99-104
III. THE CRAFT COURSES—SYLLABUSES IN THE ASSOCIATED	
SUBJECTS	
Associated Subjects—General Notes .. .. .	105
Calculations .. .. .	106-08
Geometry .. .. .	109-11
Geometry and Drawing .. .. .	112-14
Science for the Crafts .. .. .	115-20
Building Construction .. .. .	121

# EDUCATION FOR INDUSTRY AND COMMERCE

## BUILDING CRAFTS

### INTRODUCTION

1. In the years immediately prior to the war about 30,000 apprentices and others attended part-time classes in building subjects in technical schools and colleges in England and Wales. Of these about two-thirds attended courses planned to serve particular building crafts. The remainder attended general building courses of a more comprehensive character.
2. Only about one-tenth of these students were released by their employers to enable them to attend part-time day classes. The remainder, about 27,000, attended in the evenings in their own time. The majority of these evening courses called for attendance on three evenings a week, together with additional time for homework. Thus it was not surprising that many apprentices found this a heavy load to carry, in addition to a full working week, and that some failed to persevere and achieve some measure of success. Others again did not attend such classes during their apprenticeship and therefore could derive no benefit from this provision of instruction. It was known that increased daytime attendance would have introduced marked improvements into this situation. Increases were in fact taking place, but development was slow and the distribution was uneven.
3. The revival of interest in apprenticeship in the building crafts, the initiation of new apprenticeship schemes and the strengthening of existing schemes, coupled with the influence of the newly established Building Apprenticeship and Training Council, have tended to focus attention on this problem. Apprenticeship schemes without exception now include clauses in the apprenticeship conditions calling for daytime attendance at technical classes. Although the application of these clauses is as yet far from being universally effective, the demand for the provision of part-time day classes has already increased to a marked degree. It seems likely therefore that, in the future, a very high proportion of the apprentices in this industry will be required to attend part-time day classes.
4. As has been announced from time to time, it is the view of the Government that, in order to cope with the great post-war demands for building, the building industry must be considerably expanded.

This increase will call for corresponding increases in the numbers of young persons entering the several crafts as apprentices. It will also call for improved facilities for training and education if the new demands in building are to be satisfied with skill and efficiency by the craftsmen of the future.

5. The considerable increase in the number of apprentices who will be employed, together with the general requirement that they shall attend part-time day classes, should lead to a great extension in the provision of courses of craft instruction in the daytime as soon as the present difficulties affecting the supply of teachers and the provision of accommodation can be overcome. The apprentices should thus be enabled to study their crafts under the most advantageous conditions and with greater assurance of success than in the past. In addition, as will presently be seen, it should be possible to extend, or improve, the instruction given in a number of the smaller crafts, in which the difficulties associated with evening attendance have so far seriously hindered the provision of proper facilities.

6. Since the establishment of part-time day classes on a greatly increased scale and the general desire for improvements in the provision of technical education for the building crafts, will give rise to special educational problems, the Ministry has decided to issue this set of model courses and syllabuses in order to facilitate the task of those who will be responsible for the organisation and conduct of such courses in the future. The syllabuses have been largely based upon existing syllabuses, some of which have been subject to recent revisions, but the opportunity has been taken to modify some of the existing material and to incorporate new material, so as to bring the syllabuses into line with modern developments in craft technology.

7. This pamphlet has been prepared by a number of H.M. Inspectors who have expert knowledge in this section of technical education. In this they have been assisted both by a number of people engaged in the industry and concerned with apprenticeship, and also by a number of experienced principals, heads of departments and teachers concerned with building education in the technical colleges. The Ministry desires to express its thanks to all who have in this way rendered valuable assistance in the production of the pamphlet. It is hoped that its issue will constitute a substantial contribution to the development of technical education in the building crafts.

# I. ORGANISATION OF PART-TIME DAY AND EVENING CRAFT COURSES

## TYPES OF COURSES

8. The scheme of part-time education for apprentices and others engaged in the building industry, or in associated occupations, comprises broadly three types of courses :

(a) *Junior or Preparatory Courses* : these are planned to give preparatory instruction in Calculations, Drawing, Elementary Science and English to those who have not reached the educational standards required on entry to one or the other of the two types of technical courses described in (b) and (c) below.

(b) *Building Craft Courses* : these provide instruction in the building crafts. With few exceptions they prepare students for the examinations of the City and Guilds of London Institute (see para. 18). This is the type of course with which this pamphlet is concerned.

(c) *General Building Courses* : these courses are of a more comprehensive character than the Craft Courses and call for a higher standard of general education on entry. They are intended to provide for a broad technical study of the industry as a whole while, in their advanced stages, they offer specialised instruction suitable for those preparing to occupy positions of responsibility in the industry or in one or other of the associated professions. The majority of these Courses are approved for the award of National Certificates in Building, under the scheme jointly administered by the Institute of Builders and the Ministry of Education.

## STANDARD OF ENTRY TO CRAFT COURSES

9. This pamphlet is devoted to the problems of providing suitably devised Craft Courses and no attempt will be made to discuss in detail the types (a) and (c) described above. It must be noted, however, that in order to ensure effective instruction and a satisfactory measure of progress during the Craft Courses a suitable standard of entry must be maintained. While it is to be recognised that the educational developments now in prospect in the secondary field, together with the marked increase which has already taken place in the number of Junior Technical Schools of Building, is likely to reduce the number of those needing instruction of the Junior Preparatory Course type, there will still be some for whom such courses should be provided on entry to apprenticeship.

## TRANSFER TO GENERAL BUILDING COURSES

10. Craft apprentices who show marked ability and who desire to take the more comprehensive General Building Course, following the completion of the whole or a substantial part of their Craft Course,

should be enabled to do so. Some adjustment of the Craft Courses may be necessary to facilitate such transfers at suitable stages. Preferably these adjustments should be made as required in individual cases. If it is considered that more general adjustments are desirable then care must be taken to see that they are not so substantial as to alter the character of the Craft Courses. The proposals now put forward assume that the majority of the apprentices will remain in their Craft Course until they have reached the highest stage of certification of which they are capable. Only in the case of students of exceptional ability should transfer to the General Building Course be encouraged before the completion of their Craft Course.

#### DESIGN OF CRAFT COURSES

11. Evening courses have generally been planned to occupy three evenings in each week. This has led to a threefold division of the work which has been almost universally adopted. This division will not be so essential in the part-time day courses, where more time will be available and greater freedom regarding the time given to each subject week by week will be possible. The threefold division is, however, both convenient and familiar, practically all existing course and examination arrangements are based upon it, and it is a method of division which is likely to persist so long as the provision of evening courses continues to be an important factor. The subject matter of the Courses dealt with in this pamphlet has therefore been arranged under the following three main headings :

- I. Technology.
- II. Practical Work.
- III. Associated Subjects, including :
  - (i) Craft Calculations,
  - (ii) Craft Geometry and Drawing,
  - (iii) Craft Science, and
  - (iv) Building Construction.

These headings are explained below and in paras. 19 to 30, but it may be briefly stated here that the term *Technology* is used to cover a methodical study of the materials, processes and usages of each craft, while the term *Practical Work* covers all forms of workshop activity and other practical processes of the craft which can be carried out in or in association with the school. The *Associated Subjects* listed above are considered essential for the proper study of the technology of the craft and the right appreciation of the experiences gained in the workshop. It is of course intended that at each stage all these aspects will be so treated as to constitute a comprehensive and properly co-ordinated study of the Craft.

#### DIVISION INTO YEARS OR GRADES

12. With few exceptions the normal duration of existing part-time craft courses has been four years. The use of the term "years" has reference to the almost universal practice of spreading each "year" of the course over a complete winter evening session, commencing

usually in September and concluding in the following April or May, when the yearly examinations are taken. It must now be noted, however, that since in the not very distant future a large number of apprentices may be released by their employers to attend for technical instruction on one day per week, conditions will arise which must markedly affect the present yearly organisation of the courses. Apprentices will presumably be released for attendance at, or soon after, the date of their entry into employment and it may thus not be possible to group them all in classes starting at the commencement of the winter session. It may therefore be necessary to start new classes at two or more distinct dates during the year, according to the dates when the larger groups of apprentices are taken into employment and to hold the necessary examinations more than once in each calendar year to suit this plan. While it is not possible to discuss here all the effects which such changes may have upon the organisation of these courses, it has been decided, while retaining the present convenient fourfold division, to arrange for the references to these divisions to be made either by "years" or "grades" as may be found to be most convenient. Both terms have therefore been used in this pamphlet.

#### DISTRIBUTION OF ASSOCIATED SUBJECTS

13. While the subjects of Technology and Practical Work will appear in each year or grade of a course, the Associated Subjects must be distributed over the whole course according to some carefully considered scheme. At the same time it will be found to assist in the organisation of these Courses, if undue diversity in the distribution of the Associated Subjects can be avoided from craft to craft. Thus students of different crafts should be able to take certain Associated Subjects in common, especially in the early Grades, thus economising in the number of classes which have to be provided. This is subject to the proviso that, whenever the number of students in a particular craft and grade is sufficient to justify a separate class, it should be formed. To avoid complexity such an arrangement of common Associated Subject classes has been assumed in drawing up the syllabuses in this pamphlet. There are, however, differences in the emphasis to be placed upon the Associated Subjects between the different crafts; these must be safeguarded. Thus the Masons and the Carpenters and Joiners will require to carry their study of Geometry to a somewhat higher stage than will the other crafts, while the Painters and Decorators will need to give greater attention to all forms of free drawing and work in colour, and so on. These variations, however, affect mainly the later stages of the courses, so that it ought to be possible to draw up schemes which allow of a considerable measure of joint instruction in the earlier grades, with a measure of choice in the later grades which should not involve too great a multiplication of classes. Such an arrangement is set out in the Scheme below; paragraph references are given to the syllabuses of the Associated Subjects in order to explain the intention of the Scheme in concise form. The Scheme is intended to apply alike to Part-time Day Courses and to Evening Courses.



## 14. SUGGESTED SCHEME for the Arrangement of Subjects, Grade by Grade, in Part-time Day or Evening Courses.

GRADE I	GRADE II	GRADE III	GRADE IV
Technology	Technology	Technology	Technology
Practical Work	Practical Work	Practical Work	Practical Work
Associated Subjects.			
Calculations (See para. 107)	<i>Either</i> *Calculations (See para. 108)	One subject from: *Science (See paras 117 to 120),	One subject not taken in Grade III from: *Science (See paras. 117 to 120),
<i>and</i> Geometry (See paras. 110 or 113)	<i>or</i> *Geometry (See paras. 111 or 114)	*Geometry (See paras. 111 or 114)	*Geometry (See paras. 111 or 114)
	<i>and</i> Craft Science (See para. 116)	<i>or</i> Building Construction (See para. 121)	<i>or</i> Building Construction (See para. 121)

\* All the marked subjects represent a second stage of study.

## THE ORGANISATION OF PART-TIME DAY CLASSES

15. Provided there are sufficient students to justify the formation of all the classes called for by the various crafts, organisation along the lines indicated in the above Scheme in Part-time Day Classes should not be difficult. This should certainly be the case in all the larger centres of population, where the endeavour should be to provide a complete scheme of craft courses. This complete provision at the larger schools and colleges should enable them to make substantial contributions in the solution of some of the problems of the smaller centres and crafts, which are dealt with in the next paragraph. The release of apprentices in the daytime should facilitate such developments. In all cases it ought to be possible to provide better facilities for craft instruction than was the case when the courses had to be conducted so largely in the evening.

## ORGANISATION IN SMALL CENTRES AND FOR THE SMALLER CRAFTS

16. In all except the largest centres, however, certain difficulties will arise in arranging a complete scheme of craft instruction. It is expected that these difficulties will be substantial in all centres which draw students from a total population of less than 50,000 persons. For some of the smaller crafts also, such as Slating and Tiling, the provision of separate courses is likely to be difficult even in the larger centres of population. To meet these difficulties special measures will have to be worked out. In the simplest cases these may take the form of some kind of concentration of the instruction, such as the provision of the

associated subjects in common for several crafts and the reduction of the number of days in the week on which an institution may offer to provide the instruction. Where greater concentration is called for more than one grade of a craft may have to be taken together for Technology and for Practical Work. In very small centres much of the Technology, especially where a considerable amount of drawing is required, may have to be taken in a common class, in which there should be much simple drawing of craft details, note-taking and individual guidance. It is already clear that there will be some very small centres, in rural areas or in small isolated towns and villages, where even these measures will fall short of a satisfactory solution. This will also be the case in several of the smaller crafts, in some of which shortened Courses may have to be adopted to meet these difficulties, *e.g.*, see the two-year Courses in Slating and Tiling (paras. 94 to 98) and Mastic Asphalt Work (paras. 99 to 104). Such difficulties may also call for measures of a regional or even a national character of a type which it is not the purpose of this pamphlet to discuss. It is hoped, however, that the foregoing notes, on some of the more outstanding problems of organisation, will be of assistance to all concerned in these matters.

#### ALLOCATION OF TIME

17. In the past about 150 hours of instruction have been available in each year of such courses when held in the evenings. Part-time day attendance, which is usually spread over forty or more weeks in the year, allows of a much higher total of hours in each year or grade. While the total of 150 hours must be considered as an absolute minimum, where evening courses have to be continued, a higher total should be attainable in the part-time day courses. It should thus be possible to cover the work adequately without calling for additional attendance in the evenings. Evening attendance should be reserved for voluntary attendance at classes which interest the student, or for additional work which the student may desire or need to take. The time available in the day courses should also be sufficient for the inclusion of physical training and certain general subjects where such are desired. It should be pointed out, however, that, if properly dealt with, much of the work covered by these courses should be of considerable educational value, thus it ought not to be necessary to add much to the subjects already included. Finally it is suggested that in each year of a course, day or evening, the total time devoted to the Craft Course should be divided approximately into three equal parts, in each of which one of the three main divisions set out above will be taken. Technology and Practical Work will thus occur in each year or grade, while the Associated Subjects will be distributed according to a considered plan as already explained.

#### EXAMINATIONS AND CERTIFICATES

18. As with the majority of existing courses, all those described in this pamphlet are intended to offer suitable preparation for the examinations of the City and Guilds of London Institute. It has been

usual for the Intermediate Examination of the Institute to be reached at the end of the Second Year or Grade, and the Final Examination at the end of the Fourth Year or Grade. If, as is hoped, these courses are eventually taken by nearly every apprentice in these crafts, it would be unreasonable to expect that all should reach the Final Examinations. It is suggested, however, that practically every apprentice should be able to take and pass the Intermediate Examinations, as a minimum qualification. Some apprentices may require more than two years to achieve this award, but it is clearly desirable that they should reach a definite stage of certification in this way, even if it may prove necessary eventually, and on general grounds, to adjust the work of the earlier Grades in order to make this possible. Only the more able apprentices would then be expected to reach and pass the Final Examinations. Of those who reach this stage a good proportion should be able to qualify for the award of the Full Technological Certificate in their Craft, by reason of the fact that their studies will have included suitable associated studies in Calculations, Geometry, Science and Building Construction. Such awards are of course subject to the approval of the arrangements by the Institute. Courses would therefore have to be submitted to the Institute by technical schools and colleges and by regional examining bodies, for the purpose of the award of Full Technological Certificates in conjunction with the Final Examinations. Full Technological Certificates are not at present available in all the building crafts; where they are, however, they should come to be recognised as an essential qualification of the first class craftsman and also of those aiming to hold responsible positions in their craft as chargehands, foremen or craft managers.

---

## II. THE CRAFT COURSES— SYLLABUSES IN TECHNOLOGY AND PRACTICAL WORK

### TECHNOLOGY—GENERAL NOTES

19. The broad problems of organisation having been dealt with, the remainder of the pamphlet will deal in greater detail with the actual contents of the Courses and with the conditions and methods which are likely to make for efficient instruction and satisfactory achievement by the students. The following notes and the corresponding General Notes on Practical Work, are intended to be read in conjunction with each of the Courses and references will be made to them at suitable points.

20. *New Developments.* In preparing the following syllabuses full use has been made of existing syllabuses, especially of those which have been the subject of recent revisions. The opportunity has also been

taken to ensure that the syllabuses conform to modern developments in craft technology, including those changes consequent on the introduction of new materials or new processes into these crafts. In this connection attention should be drawn to the considerable volume of technical literature, dealing with recent and prospective developments in building practice, issued by several of the Government Departments, and to the literature of the various Research and Development Associations. In varying ways these will affect craft practices. Both teachers and students should, therefore, endeavour to make use of this literature. These suggestions apply with particular force in the Fourth Year of these courses. At this stage the students should be encouraged to acquire knowledge of new developments which are taking place either within their craft or in other sections having some relation to their own work. A progressive outlook on the part of the students should in fact be encouraged at every stage in these courses. This may also be assisted by the arrangement of visits to works, factories and buildings in process of erection and by the holding of special lectures.

21. *Order of Treatment.* A special feature has been made in these syllabuses of the orderly arrangement of the sections in each Grade. This should facilitate the methodical arrangement of the instruction and also make it possible to follow particular sections through the several grades so as to ensure that the sequence, grade by grade, is satisfactory and that the ideas are developed progressively.

22. *Geometrical Drawing and Sketching.* No special mention has been made of Drawing in the syllabuses for Technology because it has been assumed, first that the students will enter these courses already in possession of an elementary knowledge of the methods of geometrical drawing and projection, and second, that the methods of drawing will not only be properly developed in the associated subject of Geometry but will also be extensively used throughout the courses as the chief method of instruction in the technology classes. This work should include plane geometrical drawing, sketching, the projection of related views by geometrical methods, the reading of plans and working details drawn full-size or to scale. Whenever appropriate, these drawings should conform to the requirements of the British Standards Institution in B.S.1192: 1944, "Architectural and Drawing Office Practice."

23. *Use of the Knowledge of Calculations, Science and Building Construction.* Though instruction in these subjects will be given under the head of Associated Subjects, it is intended that references to and utilisation of such knowledge will be brought in frequently throughout the Courses and at suitable stages. This close co-ordination of the instruction under the several subject headings should be a valuable feature of these courses. The attention of the students should certainly be drawn from time to time to the importance of this linking up. In this way not only will their interest be aroused in the whole work of the Course, but they will be brought to appreciate the value of basing their technical studies on a broad basis of related knowledge.

24. *Knowledge of Building Regulations, Byelaws, Codes of Practice, etc.* Craft students should early be made aware of the existence of certain legal, government, professional or technical regulations and publications which affect their crafts directly at certain points. This is particularly important in respect of safety and welfare measures, which will be affected by the Building Regulations, and also in respect of certain technical details affected by the Building Byelaws. (*Note.* While the London County Council Byelaws may be used in London and the Home Counties, the Model Building Byelaws will probably serve at this stage for the remainder of the country.) Similar remarks apply to the Codes of Building Practice which are now being issued, some of which may apply to or markedly affect some of the crafts here considered. The British Standard Specifications should also be referred to in all cases where they are of direct importance in a craft.

#### PRACTICAL WORK—GENERAL NOTES

25. *Daytime Classes in Practical Work.* A steady increase in the number of Craft Courses conducted in the daytime should lead to improvements, in conditions and methods, of a character which was hardly possible in the conditions under which evening classes have had to be conducted. This applies particularly to the provision of workshop accommodation. This should soon be of a more extensive character, more generously equipped and more spacious than has been possible in the past. In addition it may now be possible to carry out some of the practical work, either wholly or partially, in the open air, and with other improvements which will make for more realistic conditions. The following syllabuses explain how to exploit such advantages to the full, although, in a number of cases and by reason of prevailing conditions, it may not be possible for these suggestions to be adopted fully for some time to come.

26. *Workshop Accommodation and Storage.* In general the aim should be to provide this accommodation on as generous a scale as possible. Space rather than elaboration of planning is what is needed. A minimum unit figure of 60 sq. ft. per working space should be adopted. In the case of the crafts of Brickwork, Masonry and Plastering, however, this figure should be raised to 100 sq. ft. per working space, since it will often be necessary to erect work in these shops which will occupy some space during a number of class periods. In some cases it may be found convenient to combine these shops in one large Building Erection Shop. In such a shop several crafts may co-operate to erect complete examples of building work. In addition space should be made available for the erection of full-scale doors, windows, frames, window dressings, fireplaces, sanitary equipment, and portions of roof work suitable for receiving examples of slating and tiling, mastic asphalt work, and finishings in lead, copper and zinc. Such co-operative working will not only add to the general interest of the students of all the crafts, but should accustom them to a full measure of co-operative working with other crafts; this should be of great value to them as craftsmen. All this practical work will call for

considerable storage space. This should be provided additional to and at the rate of at least one-fifth of the floor area of the workshops.

27. *Workshop Equipment.* Except in the case of the Woodcutting Machinists' Shop, elaborate or expensive workshop equipment will not generally be necessary. There should, of course, be an ample provision of tools in all cases; these should include a number of the smaller mechanical tools now in general use, such as drills, saws, and paint-spraying machines. All crafts should acquire some familiarity with the erection of scaffolding and the use of lifting tackle. Suitable units should therefore be installed in one or other of the larger shops.

28. *Methods of Fixing.* Owing to the great variety of materials now used for the construction and covering of walls, floors, and ceilings, it is essential that all crafts should acquire some knowledge of how fittings and appliances may be fixed to these surfaces. For this purpose some wall space should be available in one of the workshops where, at convenient stages in the courses, students from the various crafts may carry out exercises in fixing. These wall surfaces should include a variety of finishes; the surfaces will require renewal from time to time as they become worn down.

29. *Co-ordination of Practical Work and the Use of Working Drawings.* The design of the work carried out in the shops should be controlled as far as possible by the issue of working drawings prepared departmentally. In this way it should be possible throughout these courses to lay emphasis on the need for correct, accurate and acceptable designs for all craft work. The arrangements for doing this will vary from school to school, but the methods should call for a full measure of co-operation from all concerned. Thus, while the workshop exercises will usually be carried out from straightforward working drawings and simple specifications, it should be possible in most cases to follow these details back to some more complete set of drawings, prepared either in the advanced craft classes or in the architectural or general building classes forming a part of the Department. In this way the students will gradually become familiar with plans and specifications such as are prepared by the architect, and the methods by which they are interpreted for practical purposes by the builder and craftsman.

30. *Prefabrication and the Need for Dimensional Accuracy.* A point to which particular importance should now be attached in all practical work is the necessity which will arise for practical accuracy, especially where prefabricated units have to be fitted in. The students should be familiarised from an early stage with the methods for ensuring accuracy in measurements and in setting out work in their craft, and for the co-ordination of measurements and limits of error between standardised parts which have to be fitted together. It may be possible with a number of the items of practical work to carry out combined exercises, in which co-ordination of the measurements in the work of several crafts is necessary.

## COURSE IN BRICKWORK

### 31. GENERAL NOTES

(a) This Course in Brickwork is arranged as a Four Year Course under the following main divisions :

- I. Technology.
- II. Practical Work.
- III. Associated Subjects :
  - (i) Craft Calculations.
  - (ii) Geometry and Drawing.
  - (iii) Craft Science, and
  - (iv) Building Construction.

(b) The distribution of the Associated Subjects, grade by grade, is explained in paras. 13 and 14. (See also the General Notes on Technology and Practical Work, paras. 19 to 30.)

(c) The treatment of the Craft under several subject headings, all closely related, should be explained early in the Course. Emphasis should be laid upon the way in which this method increases the practical value of the Course, by ensuring that it is broadly based upon a wide knowledge of craft practices and of the technical and scientific reasons underlying their adoption.

(d) While instruction in the Associated Subjects will be given mainly in the special classes provided for that purpose, it is intended that there should be frequent references to and utilisation of all this related knowledge throughout the Course, in both Technology and Practical Work.

(e) It is assumed that the methods of geometrical and free drawing will be used and developed during the Course to the full extent and in the manner required by the craft. They should include plane geometry, sketching and free drawing, the projection of related views by geometrical methods, the preparation of detail drawings, full-size and to scale, and the reading of architect's plans and working drawings.

(f) Some introductory talks of a general character should be given in the First Year or Grade. These should cover in a simple and interesting manner the work of the craft, its relation to other crafts and to building generally.

### BRICKWORK (TECHNOLOGY)

#### 32. FIRST YEAR OR GRADE

(1) *Tools.* The tools commonly used by the bricklayer. Trowels, chisels, hammers, mallets. Simple setting-out and measurement ; rules, levels, plumb rule, line and pins.

(2) *Materials.* Introduction to the materials of the bricklayer and contractor ; brick, sand, lime and cement. Simple practical tests of strength and soundness ; methods of storage. The principal types of brick in use.

(3) *Bonding.* Wall construction ; brick dimensions ; terms used in

bonding. Bonding of straight brick walls, with stopped and returned ends, in English and Flemish bonds up to  $1\frac{1}{2}$  bricks in thickness. Isolated and attached brick piers.

(4) *Foundations and Footings.* Purpose and construction of foundations; width, depth and thickness of concrete foundations; spread and bonding of brick footings; sleeper walls. The mixing and placing of foundation and surface concrete.

(5) *Damp-resisting Construction.* Purpose and placing of horizontal damp-proof courses; materials used; precautions to be adopted. Construction of simple cavity walls; use of wall tiers.

(6) *Openings in Walls.* Bondings at openings in brick walls with square and recessed jambs. Quoin stones. Simple stone dressings to door and window openings; heads, thresholds, cills. Use of wood lintels.

(7) *Arches.* Construction of small arches in brick and stone; terms used. Setting-out to scale of segmental, semi-circular arches and rough relieving arches. Use of turning pieces and wood centres.

### 33. SECOND YEAR OR GRADE

(1) *Tools.* Special cutting and testing tools of the bricklayer. The use of the lever, crowbar and simple lifting tackle. Introduction to the use of timber and steel scaffolding, planks, trestles and ladders.

(2) *Materials.* Outlines of the manufacture of lime, cement and bricks. Proportioning and mixing mortars (including lime-cement mixes) and concretes; use of gauge boxes; shrinkage in volume on mixing.

(3) *Bonding.* Further bonding of walls in English and Flemish bond, including junctions between main, party, partition and gable walls. Racking-back and toothing; oversailings and corbelling. Gables. Beam filling to roofs. Garden wall bonds. Cutting for other trades. Jointing and pointing brickwork.

(4) *Foundations and Footings.* Foundations and footings to thicker walls and piers; requirements of the Model Byelaws. Setting out and levelling foundations. Excavation and timbering of shallow trenches in various soil.

(5) *Damp-resisting Construction.* Purpose and construction of dry areas. Ventilation of timber ground floors. Damp-proof layers, horizontal and vertical. Copings to brick boundary walls and gables. Copings to and damp-proofing of parapet walls.

(6) *Openings and Arches.* Setting-out of openings in brick walls to maintain unbroken bond. Bonding square and recessed jambs. Treatment of broken bond. Use of reinforced concrete lintels. The bonding of arches in brick and stone, including straight brick lintels. Purpose-made and rubbed brick arches. The construction, support and removal of large wood centres.

(7) *Dressings and Fixings.* Brick, stone and other dressings to quoins and to door and window openings. String courses, cornices and plinths in brick and stone. Breeze and other partition blocks. Internal and



external domestic paving in brick, tile, stone and concrete. Methods of fixing equipment and fittings to brick, stone, tile and concrete.

(8) *Flues and Fireplaces.* Dimensions, forms and construction of flues, fireplaces and stacks for detached two-storey dwellings. Hearth construction at ground and first-floor levels. Flues for gas fires, air inlets. Requirements of the Model Byelaws.

(9) *Drainage.* The lay-out and construction of simple systems of house drainage. Essentials of good drain ware; pipes and gullies; precautions in laying and jointing.

#### 34. THIRD YEAR OR GRADE

(1) *Scaffolding and Machines.* Scaffolding in timber and steel for domestic buildings. Machine-mixing and placing of concrete. Use of small cranes and lifts for brickwork and masonry materials. Use of pulley blocks for heavier lifts. Safety precautions.

(2) *Materials.* Damp resisting qualities of brickwork, mortar joints and concrete. Effect of variations of proportioning and of amount of water on strength and porosity of concrete and mortar. The selection and use of bricks for decorative purposes and for colour. Practical tests for freedom from efflorescence.

(3) *Bonding.* Bonding generally in walls at right, acute and obtuse angles. Brick walls curved on plan, junctions with straight walls. Gate piers and buttresses to boundary walls. Brick weatherings to external flues. Plinths.

(4) *Heavy Brick Construction.* Construction of buttresses, small retaining walls, brick piers and the necessary footings. Timbering deep trenches. Introduction to reinforced brickwork.

(5) *Foundations.* Spread of foundations to carry stated loads; safe pressure on different soils; trial holes and tests; treatment of foundations on made ground or ground of uneven bearing capacity. Treatment of sloping sites; stepped foundations and footings.

(6) *Basements.* Construction of basements and sub-basements in brick. Methods of damp-proofing and ventilating basements; asphalt linings and damp-proof layers; "tanking" on wet sites. Simple cases of underpinning. Timbering to deep foundation and basement excavations.

(7) *Arches and Lintels.* Setting-out and construction of all forms of arches straight on plan up to 20 ft. span. Pre-cast or *in situ* concrete lintels, hearths and thresholds; formwork; steel reinforcement.

(8) *Stone and Other Dressings.* Composition walls in brick and stone, ashlar facings. Dressings to brickwork in stone, artificial stone and terra cotta. Stone and concrete stairs built into brickwork.

(9) *Flues and Fireplaces.* Fireplace, flue and stack construction for semi-detached houses and for large buildings; internal and external stacks; dual stacks with party wall. Bonding and finishing stacks above roof level.

(10) *Drainage*. Lay-out of house drainage systems; construction of air-inlets; inspection and disconnecting chambers. Construction of small brick sewers. Mechanical methods of consolidating returned earth in trenches. Requirements of the Model Byelaws.

### 35. FOURTH YEAR OR GRADE

(1) *Site Organisation*. Organisation of brickwork jobs on large sites. Lay-out of stores, workshops, offices and other hutments. Water supply. Relations with other trades. Safety and welfare provision; the Building Regulations.

(2) *Retaining Walls and Basements*. Construction and erection of large retaining walls, battered walls, buttresses and basements. Simple tunnelling. Underpinning with the necessary shoring and strutting. Introduction to special foundation methods; piling; sheet piling. Treatment of sub-soil water, during building operations and permanently. Safety measures in deep excavations.

(3) *Arches and Vaulting*. Bonding and erection of large span brick arches. Lay-out and cutting to skew arches. Barrel vaulting with intersections. Brick niches. Brick arches curved on plan.

(4) *Combined Brick and Steel Constructions*. Use of reinforced brickwork in walls, and over openings. The construction of reinforced concrete stairways in brick buildings. General brickwork construction in association with steel and reinforced concrete framed buildings; casings and panel fillings. Hollow block floors. Partitions and casings.

(5) *Fire Resistant Construction*. Requirements of the Model Byelaws in respect of fire protection of steel, etc. Tall chimney construction in brick. Use and setting of fire bricks. Setting of small boilers and special ranges. Heat and sound resisting qualities of brickwork.

(6) *Setting-out Brick Buildings*. Setting-out of brick buildings from architects' plans; fixing building lines and levels; use of bench marks and dumpy level; determining gradients; setting-out angles and curves; use of sighting rails and profiles; boning rods. Methods of preparing quantities for brickwork; measuring completed work against original quantities.

(7) *Strength of Brickwork*. Elementary discussion of the strength and stability of walls, piers, retaining walls and beams. Requirements of B.S. Specifications which cover brickwork materials.

## BRICKWORK (PRACTICAL WORK)

### 36. FIRST YEAR OR GRADE

(1) *Tools and Materials*. The handling of the common tools. Use of line, level and plumb rule. Mixing of mortar and foundation concrete. Care and storage of materials.

(2) *Bonding*. Bonding and building straight lengths of wall, up to  $1\frac{1}{2}$  bricks in thickness and in English and Flemish bonds, with stopped and returned ends. Simple cavity walls. Small isolated and attached piers.

(3) *Footings and Foundations.* Construction of footings and concrete foundations to the above walls. Placing simple damp-proof courses.

(4) *Openings and Arches.* Bonding to small openings, with square and recessed jambs. Plain stone dressings to ends and openings. Setting-out and building simple arches. Placing copings, padstones and corbels.

### 37. SECOND YEAR OR GRADE

(1) *Bonding.* Bonding and building straight walls up to  $2\frac{1}{2}$  bricks in thickness and in English and Flemish bonds, junctions of partition with main walls; right-angle and squint junctions. Garden wall bonds. Footings. Oversailings. Methods of pointing.

(2) *Damp Resistant Construction.* Bonding cavity walls; treatment at top, base and openings. Dry areas. Building parapet walls; treatment of copings. Placing vertical and horizontal damp-proof layers.

(3) *Arches and Openings.* Square and recessed jambs to openings. Setting-out and erection of large arches in brick and stone. Purpose made and rubbed brick arches. Use of centres.

(4) *Stone and Other Dressings.* Bonding-in of brick, stone and other dressings. Ashlar facings to brick walls. Fixing equipment and fittings to brick, tile and stone wall surfaces.

(5) *Flues and Fireplaces.* Construction of simple fireplaces with hearths and flues.

### 38. THIRD YEAR OR GRADE

(1) *Scaffolds and Lifting Tackle.* Erection of small scaffolds in timber and steel. Use of lifting tackle.

(2) *Construction of Walls.* Bonding at squint quoins and between walls straight and curved on plan. Bay window openings. Fixing all types of frames, floors and linings to brickwork. Buttresses. Weatherings in brick. Use of asphalt linings and layers for damp-proofing.

(3) *Arches and Dressings.* Gauged and purpose-made arches. Bonding stone and other dressings to brick walls. Decorative brickwork. Casting thresholds, cills, lintels, and hearth stones in plain and reinforced concrete.

(4) *Flues and Fireplaces.* Back-to-back fireplace construction, flues and stack. Setting fireplaces and ranges.

(5) *Drainage.* Construction of a simple house drainage system. Fixing levels and gradients. Testing drains. Construction of a small brick sewer.

(6) *Setting-out.* Setting-out brick walls, including openings, from architects' plans.

### 39. FOURTH YEAR OR GRADE

(1) *General Brickwork.* More advanced practical work in all sections dealt with in earlier grades, including also the construction of inverted and skew arches.

- (2) *Brick Facings to Framed Buildings.* Brick facings, casings, and panel fillings to steel and reinforced concrete framed buildings.
- (3) *Chimney and Furnace Construction.* Tall chimney construction. Setting special ranges and small boilers.
- (4) *Heavy Constructions.* Demonstration of practical methods of underpinning and shoring; foundation piling; treatment of large excavations and sub-soil drainage.
- (5) *Setting-out.* Setting-out brick buildings or intricate portions of buildings from architects' plans.

## COURSE IN MASONRY

### 40. GENERAL NOTES

(a) This Course in Masonry is arranged as a Four Year Course under the following main divisions :

- I. Technology.
- II. Practical Work.
- III. Associated Subjects :
  - (i) Craft Calculations.
  - (ii) Geometry and Drawing.
  - (iii) Craft Science, and
  - (iv) Building Construction.

(b) The distribution of the Associated Subjects, grade by grade, is explained in paras. 13 and 14. (See also the General Notes on Technology and Practical Work, paras. 19 to 30.)

(c) The treatment of the Craft under several subject headings, all closely related, should be explained early in the Course. Emphasis should be laid upon the way in which this method increases the practical value of the Course, by ensuring that it is broadly based upon a wide knowledge of craft practices and of the technical and scientific reasons underlying their adoption.

(d) While instruction in the Associated Subjects will be given mainly in the special classes provided for that purpose, it is intended that there should be frequent references to and utilisation of all this related knowledge throughout the Course, in both Technology and Practical Work.

(e) It is assumed that the methods of geometrical and free drawing will be used and developed during the Course to the full extent and in the manner required by the craft. They should include plane geometry, sketching and free drawing, the projection of related views by geometrical methods, the preparation of detail drawings, full-size and to scale, and the reading of architects' plans and working drawings.

(f) Some introductory talks of a general character should be given in the First Year or Grade. These should cover in a simple and interesting manner the work of the craft, its relation to other crafts and to building generally.

## MASONRY (TECHNOLOGY)

## 41. FIRST YEAR OR GRADE

(1) *Tools.* Description of the tools commonly used by the mason for working and setting stonework. Methods of measuring and setting-out masonry and description of the tools and instruments used.

(2) *Materials.* Introduction to the principal materials of the mason. The broad grouping of building stones as sandstones, limestones, marbles and granites. Outline of the main processes in quarrying, conversion and preparation of stonework for fixing. Other materials used: lime, cement, sand and brick, with simple practical tests for soundness; methods of storage.

(3) *Bonding.* Types of masonry walling; rubble, coursed and uncoursed; compound walls in brick and stone; simple ashlar facings. Introduction to bonding of stone walling and compound brick and stone walling; terms used in building.

(4) *Foundations.* The purpose and construction of foundations in stone and brick. The width, depth and thickness of concrete foundations. Spread and bonding of brick footings. Provision for ventilation under floors. Foundations in stone for boundary walling. The proportion, mixing and placing of foundation and surface concrete.

(5) *Damp-resisting Construction.* The purpose and placing of horizontal damp-proof courses. Purpose and construction of cavity walls; use of wall ties.

(6) *Joints and Labours.* The principal joints used in masonry; dowels, plugs, cramps and joggles. Mortar for stone walls and stone facings; grouting, pointing. Labours to stonework.

(7) *Openings.* Bonding of squared and returned ends and simple openings in stone walls. The bonding of quoin and jamb stones. Simple stone dressings to door and window openings; heads, cills, thresholds.

(8) *Arches.* Construction of small stone arches; terms used; small segmental, camber and semi-circular arches. Rough relieving arches and wood lintels. Use of wood centres.

(9) *Stairs.* Stone stairs in simple straight flights with landings; steps rectangular in section and built-in at both ends.

## 42. SECOND YEAR OR GRADE

(1) *Tools and Lifting Tackle.* The more special tools of the mason. Lifting tackle of a simple nature; levers, crowbars, use of rollers, nippers, lises, pulley blocks. Simple timber scaffolding for low walls.

(2) *Materials.* General properties of the principal building stones; stone quarrying and the selection of stone. Outline of the manufacture of limes and cements and the principal types available. Proportioning and mixing mortar and concrete; use of gauge boxes; voids in loose materials and the shrinkage in total volume on mixing. Introduction to the manufacture of artificial stone.

- (3) *Walls*. Large compound walls in brick and stone. Setting out plain ashlar facings; bonding stone and brick. Rough relieving arches and reinforced concrete lintels over wide openings. Methods of fixing fittings to stone walls.
- (4) *Copings, Weatherings, etc.* Copings to horizontal walls, parapets and gables; throatings, weatherings. Use of foot stones or springers, kneelers and apex stones. String courses, plinths and cornices. Saddled joints. Top protection of stonework by asphalt or lead. Treatment of hollow wall construction at openings.
- (5) *Openings*. Stone dressings to quoins, door and window openings; cills, heads, thresholds, simple mullions and transoms. Stone fronts including pilasters and entablature, showing jointing and construction. Square and octagonal bay windows. Setting-out simple tracery.
- (6) *Arches*. Setting-out and construction of stone arches up to 10 ft. span, segmental, semi-circular and elliptical. The construction, support and removal of timber centres.
- (7) *Stairs*. Stone staircases with steps of plain and moulded sections, built-in at one or both ends. Setting out of winders and landings.

#### 43. THIRD YEAR OR GRADE

- (1) *Machinery and Scaffolding*. Introduction to masonry machinery and machine processes. Lay-out of stone-working shops, for hand and machine working. Cranes and hoists. Hoisting and fixing stonework. Scaffolding in timber and steel. Safety precautions.
- (2) *Materials*. Characteristics and detailed properties of the principal building stones. Geological nature of these stones and its relation to their use for building. Outline of tests for strength and weathering. General knowledge of the strength and stability of stone construction.
- (3) *Stonework on Framed Buildings*. Stone lintels and cornices; notching and securing to steelwork and reinforced concrete framework; methods of jointing and fixing. Built-up cornices involving the use of ties and supports.
- (4) *Arches*. Setting-out, cutting and setting large segmental and elliptical arches. Skew arches.
- (5) *Window and Other Finishings*. Window and door openings with moulded cill, architrave and pediment. The setting of pilasters and columns with entasis, flutings and moulded caps and bases. Curved pediment and cornices with modillions.
- (6) *Curved Work*. Walls curved on plan. Plain circle-on-circle work (without mouldings) to openings in stone-faced buildings. Small niches and domes.
- (7) *Marble and Granite*. The varieties and uses of marble and granite. Methods of working and fixing floors, wall linings, stanchion casings, plinths, etc.
- (8) *Heavy Construction. Restoration*. Shoring, needling and underpinning to heavy stone buildings. Conditions of stability and the

construction of buttresses and retaining walls in stone. Restoration and reinforcement of ancient buildings.

(9) *Artificial Stone*. Methods of preparation, construction and design of moulds. *In situ* casting of lintels, etc.

(10) *Working Methods*. Shed methods; preparation of moulds from full-size details; bed, face and joint moulds. Use of "fixing" sketches and numbering of individual stones.

#### 44. FOURTH YEAR OR GRADE

(1) *Machinery. Organisation*. The use of machinery in the preparation of masonry; sawing, planing, turning and moulding. The organisation of masonry contracts in the shops and on the site. The measurement and costing of stone and labours. The Building Regulations.

(2) *Preservation. Restoration*. The selection of stone for particular purposes and important buildings. Inspection and testing for defects. Methods of restoration and preservation. Weather protection of parapets, cornices, plinths, etc.

(3) *Stonework on Framed Buildings*. Advanced study of work in stone-encased steel and reinforced concrete construction.

(4) *Masonry Details*. Scale drawings for architectural details in facings, cornices, window and door openings, etc., including porticos, columns and pediments and entablatures.

(5) *Stairs*. Geometrical stairs in stone. Ramp and twist to stone balustrade. Setting out of volutes and scrolls.

(6) *Tracery and Vaulting*. Outline of the types and construction of tracery and vaulting. Lanterns.

(7) *Work of Double Curvature*. More advanced work in domes and circle-on-circle construction, including mouldings.

(8) *Working Drawings*. The preparation of working drawings and lay-outs from architects' drawings. Numbering for shop and for fixing; fixing sketches. The preparation of quantities for stonework.

### MASONRY (PRACTICAL WORK)

#### 45. FIRST YEAR OR GRADE

(1) *Tools and Working Methods*. The correct and efficient handling of masonry tools. Squaring stones; working chisel drafts to produce plane surfaces. Squared ends and sides, plain beds and joints.

(2) *Walls*. The bonding of stonework in walling, dry and in mortar; coursed rubble, squared rubble and simpler ashlar, with and without brick backing. Footings and concrete foundations. Placing damp-proof courses.

(3) *Stone Dressings*. Quoin and jamb stones; lintels and heads; tooled, boasted and ribbed surfaces. Preparation and use of simple face and bed moulds.

(4) *Moulded Work*. Simple moulded work, with internal and external mitres and returned ends. Sunk and moulded work in panels. Pier caps, etc.

## 46 SECOND YEAR OR GRADE

- (1) *Stone Dressings*. Dressings to small window openings, weathered cill with seatings, splayed jambs, mullion and head. Preparation of copings in stone.
- (2) *Arches*. Voussoirs and keystone for small arches.
- (3) *Stairs*. Overhanging spandrel steps with rounded nosing and returned end.
- (4) *Ashlar Walling*. Building portion of a compound wall, with stopped end and simple opening, in ashlar facings with brick backing.
- (5) *Artificial Stonework*. Casting a dressing for a window or door opening in concrete, including suitable preparation of exposed faces and introduction of reinforcement.

## 47. THIRD YEAR OR GRADE

- (1) *Scaffolding and Lifting Tackle*. Erection of small scaffolds in timber and steel. The setting up and use of lifting tackle and appliances.
- (2) *Moulded Work*. Springing stone and apex stone to moulded pediment. Intersection of raking and circular mouldings with horizontal members. Circular work on moulded cap or base. Simple tracery.
- (3) *Facings to a Framed Building*. Construction and fixing of facings or a cornice to a portion of a steel frame.
- (4) *Moulded Fireplace*. Construction of small moulded fireplace surround, either in cut stone or in pre-cast concrete with stone chippings in exposed surfaces.
- (5) *Window or Niche*. Construction of stone finishings to a small window opening, with semi-circular or segmental head in a wall curved on plan, or construction of a small niche semi-circular on plan and in elevation.
- (6) *Setting-out*. Setting-out from architects' drawings and the preparation of working drawings and moulds for any of the foregoing work.

## 48 FOURTH YEAR OR GRADE

- (1) *Masonry*. More advanced examples from the sections dealt with in earlier grades, including moulded work, stone facings to framed buildings, circle-on-circle work, staircase work, tracery, vaulting and domes.
- (2) *Machinery and Methods*. Demonstrations of stone working machinery. Demonstrations illustrating the lay-out of masonry shops and sheds. Organisation of large masonry contracts. Methods of lifting and fixing stonework. Obtaining levels and maintaining heights.
- (3) *Working Drawings and Moulds*. The preparation of stone working and stone fixing details, from architects' drawings, of more intricate portions of stone buildings.



## COURSE IN PLASTERING

### 49. GENERAL NOTES

(a) This Course in Plastering is arranged as a Four Year Course under the following main divisions :

- I. Technology.
- II. Practical Work.
- III. Associated Subjects :
  - (i) Craft Calculations.
  - (ii) Geometry and Drawing.
  - (iii) Craft Science, and
  - (iv) Building Construction.

(b) The distribution of the Associated Subjects, grade by grade, is explained in paras. 13 and 14. (See also the General Notes on Technology and Practical Work, paras. 19 to 30.)

(c) The treatment of the Craft under several subject headings, all closely related, should be explained early in the Course. Emphasis should be laid upon the way in which this method increases the practical value of the Course, by ensuring that it is broadly based upon a wide knowledge of craft practices and of the technical and scientific reasons underlying their adoption.

(d) While instruction in the Associated Subjects will be given mainly in the special classes provided for that purpose, it is intended that there should be frequent references to and utilisation of all this related knowledge throughout the Course, in both Technology and Practical Work.

(e) It is assumed that the methods of geometrical and free drawing will be used and developed during the Course to the full extent and in the manner required by the craft. They should include plane geometry, sketching and free drawing, the projection of related views by geometrical methods, the preparation of detail drawings, full-size and to scale, and the reading of architects' plans and working drawings.

(f) Some introductory talks of a general character should be given in the First Year or Grade. These should cover in a simple and interesting manner the work of the craft, its relation to other crafts and to building generally.

### PLASTERING (TECHNOLOGY)

#### 50. FIRST YEAR OR GRADE

(1) *Tools.* Description of the tools commonly used by the plasterers for plain work and run mouldings. Methods of testing plane surfaces and the corners formed between them.

(2) *Materials.* Introduction to the materials commonly used by the plasterer ; limes, plaster of Paris, cement and sand ; simple practical tests for soundness and suitability ; methods of storage in the shop and on buildings. Wood laths.

(3) *Plaster on Solid Walls.* Methods of applying and finishing plaster on brick walls and slab partitions ; two- and three-coat work ; preparation of slaked lime and lime putty ; preparation of stuff for each

coat; use of gauged stuff. Preparation of brick walls and slab partitions to receive plaster; treatment at tangles, door and window openings, with or without wood finishings.

(4) *Plaster on Framed Walls and Ceilings.* Methods of applying and finishing plaster on ceilings and stud partitions; two- and three-coat work. Preparations for plastering. Methods of fixing wood laths; counter lathing and brandering. Metal lathing. Use of plaster boards.

(5) *Run Mouldings.* Introduction to solid run mouldings; shop methods and methods used on buildings. Setting out simple panels; working mitres to small panels and to mouldings run in position.

#### 51. SECOND YEAR OR GRADE

(1) *Tools and Scaffolding.* Tools used by the plasterer for larger moulded work and for curved mouldings and other decorative work. The use of trammels, gig sticks, templates and peg moulds. Simple interior scaffolding in timber and steel.

(2) *Materials.* Further work on the materials of the plasterer; proprietary plasters; comparison of hydraulic and non-hydraulic limes; the nature and uses of hydrated limes; Portland cement. Plaster slabs and boards. Types of metal lathing. Elementary knowledge of the building materials to which plaster is commonly applied.

(3) *Internal Plastering.* Plastering to walls and ceilings; treatment of external angles in special cements. Special finishes to internal plaster surfaces; smooth, rough and "plastic" finishes. Plastering on metal lathing. Plastering to curved surfaces.

(4) *External Plastering.* Application of plaster to external walls; lime and cement stucco; rough cast, pebble dash and other methods of exterior surface finishes, including introduction to mechanical application. Use of lime stucco.

(5) *Run Mouldings.* Running larger bracketed cornices. Forming breaks and returns in plain and moulded surfaces. Setting out panelled surfaces and simple pediments, including intersections between straight and curved mouldings. Setting out and running simple arch finishes of circular or elliptical outline. Running curved mouldings on the bench and in position.

(6) *Fibrous Plaster Work.* Introduction of fibrous plaster work; preparation of gelatine moulds for simple strap work, bosses and medallions; methods of casting and fixing.

(7) *Moulds for Concrete Casting.* Preparation of plaster moulds for castings of moulded work in concrete and for thresholds, cills and heads in reconstructed stone.

#### 52. THIRD YEAR OR GRADE

(1) *Equipment and Scaffolding.* Use of the cement gun and other mechanical means of applying plaster or cement finishes or of producing special surface finishes. Scaffolds in timber and steel for plasterers' work. Safety measures on plasterers' work.

(2) *Classification of Plasters.* Comparison of plasters and cements derived from gypsum; characteristics and uses of anhydrous and hemi-hydrate products; use of accelerators and retarders; classification of trade makes.

(3) *Plaster and Damp Walls.* Effect of moisture in walls on internal and external plastered surfaces; methods of excluding dampness from walls which are to be plastered; types of protection at base, top and the external faces; treatment of damp walls. Waterproofing compounds. Effect of new plasterwork on oil paints.

(4) *Plaster for Fire-Resistance and Sound Insulation.* Use of plaster slabs and plaster on metal lathing for fire-resisting purposes, to ceilings, beams, partitions and columns. Sound insulation using plaster bedded or covered cork and other slabs; nature and use of acoustic plasters; sound deadening insulation in floors. Keying plaster ceilings to concrete.

(5) *Large Modelled Surfaces.* Methods of preparing and fixing fibrous plaster casings to beams and columns and to form suspended ceilings. Setting out panelled walls and ceilings in solid and fibrous plaster work, including cylindrical surfaces with mouldings.

(6) *Fibrous Plaster Work.* Further work on the preparation of moulds in gelatine and plaster; piece moulds; trimming, keying, jointing and fixing large cast work in plaster.

### 53. FOURTH YEAR OR GRADE

(1) *Plant and Equipment.* General plant, scaffolding and appliances for plasterers' work. The Building Regulations.

(2) *Organisation of Plasterers' Work.* The organisation of plasterers' work in the shop and on buildings. The supervision and checking of plasterers' work; the preparation of working instructions and drawings from architects' details.

(3) *Measurement of Plasterers' Work.* The measurement of plasterers' work; quantities of material and labour involved. The supply and storage of materials. Ordering and specifying materials.

(4) *Materials.* Use of white and coloured cements. Magnesite cement in wall slabs and floors. Corrosive effects of plaster on iron; precautions which may be taken. Granolithic finishes to steps and floors.

(5) *Production of Decorative Work.* Knowledge of the common architectural terms, forms and proportions in decorative architectural features. Setting-out and producing, in solid and cast plaster work, such features as brackets, consoles, caps, pilasters and columns; methods of running diminished flutes and mouldings.

(6) *Cast and Modelled Surfaces.* The preparation of large fibrous plaster mouldings and features. Plaster moulds for concrete and reinforced concrete work. Plaster work in vaulting and domes. Plaster work of double curvature, solid and fibrous, in openings, niches and domes.

## PLASTERING (PRACTICAL WORK)

## 54. FIRST YEAR OR GRADE

- (1) *Use of Tools.* The correct and efficient handling of plasterers' tools.
- (2) *Preparation of Materials.* The preparation of slaked lime and lime putty, of coarse stuff, of gauged stuff and of setting stuff. The care and storage of plasterers' materials in use.
- (3) *Plaster on Solid Walls.* The plastering of small wall surfaces and vertical angles on brickwork; testing surfaces and external and internal angles. Two- and three-coat work.
- (4) *Plaster on Framed Partitions.* The plastering of small surfaces to partitions on wood and metal lathing. Two- and three-coat work.
- (5) *Bench Work.* Running small plaster moulds on the bench; preparation of zinc moulds and templates; mitering and fixing to form small panels on walls and ceilings.
- (6) *Run Mouldings.* Running a small solid cornice and forming internal and external mitres.

## 55. SECOND YEAR OR GRADE

- (1) *Working from Scaffolds.* Working from small movable scaffolds and trestles. Safety precautions.
- (2) *Preparations for Plastering.* Fixing wood and metal lathing. Preparation of brickwork for plastering. Fixing working points and levels. Checking wood grounds and angle beads.
- (3) *Work on Walls and Ceilings.* The plastering of wall and ceiling surfaces on brick, clay, tile, plaster board, wood lath, metal lath and concrete; these should include both larger surfaces and surfaces broken into small units.
- (4) *External Work.* External plastering on brick walls and framed walls, rough cast, pebble dash and other types of surface finishes.
- (5) *Run Mouldings.* Running and mitering larger bracketed cornices in position. Intersection of straight and curved mouldings; determination of mould profiles.
- (6) *Bench Work.* Preparation of gelatine moulds and the casting of simple straps and bosses in plaster. More difficult work on moulded panels.

## 56. THIRD YEAR OR GRADE

- (1) *Working from Scaffolds.* Working from larger scaffolding for exterior and interior work and in the covering of large areas.
- (2) *Solid Curved Work.* Setting out and plastering panelled walls and ceilings, with solid run mouldings on flat and cylindrical surfaces; preparation, fixing and mitering of the mouldings. Running mouldings in position to curved outline. Intersections between straight and curved mouldings; determination of profiles.
- (3) *Preparing and Fixing Fibrous Work.* Preparing and fixing moulded

plaster ceilings for a ceiling beam, a column or a pier, including the necessary gelatine moulds.

(4) *Cast Work*. Preparation and use of a mould for casting a moulded concrete cill, head or quoin stone or for an isolated decorative feature.

#### 57. FOURTH YEAR OR GRADE

(1) *Advanced Practical Work*. More advanced examples in all the work mentioned in earlier grades. The production of large surfaces, with details, to acquire speed in execution.

(2) *Preparation of Working Instructions and Details*. Setting out intricate plaster work from architects' drawings. Preparation of workshop and job drawings and instructions. The design, preparation and application of templates and special moulds.

(3) *Decorative Work*. Preparation of moulds required for a fluted pilaster, a column, a moulded vault or a pediment with curved and straight intersecting mouldings.

(4)  *Casting*. The preparation and use of moulds for casting more elaborate features in plaster and in reconstructed stone.

(5) *Work of Double Curvature*. Preparation and use of drawings, templates and working equipment for the production of fibrous and solid work of double curvature.

## COURSE IN CARPENTRY AND JOINERY

#### 58. GENERAL NOTES

(a) This Course in Carpentry and Joinery is arranged as a Four Year Course under the following main divisions :

- I. Technology.
- II. Practical Work.
- III. Associated Subjects :
  - (i) Craft Calculations.
  - (ii) Geometry and Drawing.
  - (iii) Craft Science, and
  - (iv) Building Construction.

(b) The distribution of the Associated Subjects, grade by grade, is explained in paras 13 and 14. (See also the General Notes on Technology and Practical Work, paras. 19 to 30.)

(c) The treatment of the Craft under several subject headings, all closely related, should be explained early in the Course. Emphasis should be laid upon the way in which this method increases the practical value of the Course, by ensuring that it is broadly based upon a wide knowledge of craft practices and of the technical and scientific reasons underlying their adoption.

(d) While instruction in the Associated Subjects will be given mainly in the special classes provided for that purpose, it is intended that

there should be frequent references to and utilisation of all this related knowledge throughout the Course, in both Technology and Practical Work.

- (e) It is assumed that the methods of geometrical and free drawing will be used and developed during the Course to the full extent and in the manner required by the craft. They should include plane geometry, sketching and free drawing, the projection of related views by geometrical methods, the preparation of detail drawings, full-size and to scale, and the reading of architects' plans and working drawings.
- (f) Some introductory talks of a general character should be given in the First Year or Grade. These should cover in a simple and interesting manner the work of the craft, its relation to other crafts and to building generally.

## CARPENTRY AND JOINERY (TECHNOLOGY)

### 59 FIRST YEAR OR GRADE

- (1) *Tools.* The principal wood-working hand tools; methods of sharpening and setting. Methods of measuring, setting-out and testing prepared wood members and complete framings. Use of the plumb rule and level.
- (2) *Timber.* Characteristics of timbers commonly used in carpentry and joinery; white deal or spruce, red deal, Columbian pine, white pine, American whitewood, oak, mahogany, teak. Introduction to the methods of seasoning timber; effect of moisture contents on the size and shape of timber. Market sizes of common timbers.
- (3) *Woodwork Joints and Fixings.* Methods of connecting wood members; nails, dowels, screws, bolts, wedges and glues. Use of machined materials; floor boarding, match boarding, mouldings and plywood. Woodwork joints; housing, halving, bridle, mortice and tenon; trenching; mitreing and scribing. Common methods of fixing woodwork to brickwork, fixing blocks, wood grounds and wall plugs.
- (4) *Floors and Partitions.* Preparing and fixing lintels and wall plates. Ground and upper floors and flat roofs, with trimming round openings and fireplaces. Laying floor boards; use of cramps. Erection of stud partitions. Preparation of plasterwork. Construction of small centres.
- (5) *Roofwork.* Ordinary roof work; lengths and bevels for common rafters to lean-to and double-pitch roofs (without hips); fixing ridges, purlins and wall plates; fixing collars, ties and ceiling joists; fixing roof boarding, fascias, tilting fillets and soffit boarding. Preparations for lead work on flats and in parallel and tapering gutters.
- (6) *Doors and Framing.* Construction of ledged and braced external doors, with solid frames; fixing solid frames; hanging external doors. Panel framing; construction of panelled doors. Fixing plain jamb linings and architraves.
- (7) *Windows.* Solid casement frames with single hanging casement.

Use of throatings, capillary grooves and weather bars. Glazing. Window furniture.

#### 60. SECOND YEAR OR GRADE

(1) *Tools and Appliances.* Construction and use of woodwork benches, vices and cramps. Mechanical principles underlying the use of nails, screws, crowbars, vices, cramps, and pulley blocks. The setting and sharpening of hand saws.

(2) *Woodworking Machines.* The general arrangement and uses of the woodworking machines; circular saw, band saw, surface planer, thicknessing machine, hand and power mortising machines. Safety precautions and regulations.

(3) *Timber.* The conversion, stacking and seasoning of timber for carpentry and joinery. Methods of kiln seasoning. "Second seasoning" after framing. Common defects in timber. Detection and prevention of dry rot. Methods of preservation. Use of Empire timbers.

(4) *Framed Construction.* Open frame construction with struts, ties, iron straps and bolts. Formwork for concrete lintels, cills and pillars. Construction of arch centres up to 15 ft. span; provision for easing. Simple framed partitions. Dead shoring.

(5) *Floors.* Framing openings in floors, trimming at hearths and landings. Construction of double floors with timber or steel binders. Methods of sound-proofing timber floors and partitions.

(6) *Roofwork.* Construction of complete roofs over small buildings rectangular on plan, including the construction of a king post roof truss and latticed trusses, fixing of purlins, ridge, hip rafters and common and jack rafters. Finding the cutting bevels. Framing openings in roofs, preparation for leadwork at chimneys.

(7) *Doors.* Framed and braced doors. Glazed and multi-panel door construction. Outline of manufacture of plywood and blocked doors. Construction and fixing of framed door linings. Hanging external and internal doors; fitting hinges, locks and door furniture.

(8) *Windows.* The construction of box frames and double-hung sashes. Metal casements in wood frames. Skylights and lay-lights.

(9) *Stairs.* Construction of single straight flights of stairs with closed strings. Proportion of rise to tread. Construction of landings. Preparation and fixing of wall handrails.

(10) *Setting-out.* The use of setting-out rods and cutting lists.

#### 61. THIRD YEAR OR GRADE

(1) *Tools and Machines.* Workshop relations between the carpenter and joiner, sawyer and wood-cutting machinist in the preparation and assembly joinery. Setting out for wood machine work. Arrangement and uses of spindle, moulding and tenoning machines. Use of small power tools; drills and saws. Factory regulations.

- (2) *Timber*. Selection and conversion of timber for constructional and decorative purposes. Types of kiln drying plant. Veneers, plywoods, resin-bonded plywoods and other built-up boards.
- (3) *Shoring and Formwork*. Raking, flying and dead shores. Construction of arch centres up to 25 ft. span; method of supporting and striking. Formwork to piers, floors and walls in reinforced concrete, including curved surfaces.
- (4) *Roofwork*. Timber roofs, including the queen post truss, open timber roofs, collar beam and hammer beam roofs and laminated timber trusses. Lengths and bevels for timbers to roofs over irregular plans. Use of the steel square.
- (5) *Floors and Framed Construction*. Floor loads; calculation of joist sections. Built-up and trussed beams. Half-timber construction. Timber framed and timber constructed buildings, including pre-fabricated panel construction. Methods of belting down, strutting and tying to resist wind pressure; use of continuous or pier foundations. Roof coverings.
- (6) *Doors; Panellings and Finishes*. Finishings to door and window openings; panelled jamb linings with square, splayed or segmented heads; obtaining bevels and face moulds. Wall panellings of various kinds; skirtings, dadoes, etc. Use of plywood and other boards. Flush doors. Entrance and vestibule doors. Gate construction.
- (7) *Windows*. Solid and boxed window frames with transom and several sashes. Pivoted sashes. French casements. Construction of solid bay windows and dormer windows. Louvred frames.
- (8) *Stairs*. Planning of straight, dog-legged and open newel stairs, including solid and cut strings. Construction of winders and of bull-nose and round-end steps. Handrails, balustrades, bends, knees and scrolls.
- (9) *Wood Fitments*. Internal fittings; cupboard and drawer construction; counters and office fittings. Kitchen fitments. Methods of secret fixing.

## 62. FOURTH YEAR OR GRADE

- (1) *Organisation*. The planning and organisation of joinery workshops. Use and storage of drawings, rods and templets. Relations between joiners and machinists. The general lay-out of the joiners, sawyers and machinists' shops, timber storage spaces and seasoning plant. Site arrangements in the case of large contracts. Duties of inside and outside foremen. The Building Regulations.
- (2) *Heavy Construction*. Construction of large timber structures; gantries, derrick towers, spectators' stands. Design of joints in heavy framing, using bolts (with or without connectors).
- (3) *Timber Roofs*. Open timber roofs, up to 60 ft. span, including all details of construction. Large modern laminated timber roofs. Dormers, turrets and spires in timber.



- (4) *Windows*. Solid door and window frames of double curvature, preparation of face and soffit moulds.
- (5) *Fittings and Finishings*. Treatment of entrances and vestibules. Panelling to walls, piers, cornices and beams. Fittings for banks, churches, etc. General methods of shop front and show case construction.
- (6) *Stairs*. Planning and construction of open newel and geometrical stairs. Development and construction of continuous strings. Development of face moulds and bevels for handrailing; workshop methods of working and jointing.
- (7) *Measurement of Work*. Methods of preparing quantities for woodwork. Measuring completed work. B.S. Specifications.

### CARPENTRY AND JOINERY (PRACTICAL)

#### 63. FIRST YEAR OR GRADE

- (1) *Tools*. The use and care of the principal woodworking tools.
- (2) *Joints*. Construction, full-size, of the following joints, trenching, halving, bridle, housing, trenching, mortise and tenon. Mitreing and scribing with a simple moulding. Fixing with nails, screws and bolts; glues and other adhesives; painting joints of exterior work. Fixing woodwork to brick walls; wall plugs. Concrete gauging boxes.
- (3) *Floors*. Cutting, jointing and fixing wall plates, floor joists and floor boards. Simple trimming round openings in floors and roofs.
- (4) *Roofs*. Construction of lean-to and double-pitched roofs, without hips. Determining lengths and bevels for rafters. Fixing collars, ties and ceiling joists. Preparation for lead work.
- (5) *Doors*. Construction of ledged and braced doors. Solid door frames. Panelled doors. Fitting and hanging doors. Simple panelling.
- (6) *Windows*. Solid window frame with single casement.

#### 64. SECOND YEAR OR GRADE

- (1) *Tools*. Sharpening and setting planes. Setting and sharpening saws. Some hardwood may be introduced into the exercises and more machined materials may be used in this grade.
- (2) *Joints*. Glued butt-edged joints, both dowelled and screw-slotted. Scarfings and lengthening joints for large timber members. Fixing woodwork to all types of wall surfaces.
- (3) *Temporary Work and Partitions*. Construction of wood centres to 10 ft. span. Formwork for concrete pillars, heads and cills. Brick-nogged and simple framed partitions.
- (4) *Roofwork*. Collar beam and king post roof trusses. Fixing purlins and rafters. Bevels and lengths for rafters over rectangular plans, including hip rafters; use of steel square and other methods.
- (5) *Doors*. Glazed doors. Framed door linings. Fixing locks and furniture.

- (6) *Windows.* Box window frame and double-hung sashes.
- (7) *Stairs.* Straight flights of stairs with closed strings; landing and wall handrail construction and fixing.
- (8) *Setting-out.* Preparation of rods and cutting lists for the foregoing work.

#### 65. THIRD YEAR OR GRADE

- (1) *Temporary Work.* Large arch centre construction. Formwork to floors, beams and piers for reinforced concrete buildings, including curved surfaces.
- (2) *Roofwork.* Construction of open timber roof truss with details of general construction. Cutting hips and rafters for roofs over irregular plans; use of steel square and other methods.
- (3) *Framed Construction.* Portions of framed timber buildings, including prefabricated panels.
- (4) *Doors.* Panel finishings to door and window openings; square and splayed linings. Gate construction.
- (5) *Windows.* Construction of pivoted sashes and hinged fanlights. Solid bay window frames. Lantern lights.
- (6) *Stairs.* Portions of a stair, either dog-legged or open newel, with bull-nose step and winders.
- (7) *Fitments and Panelling.* Cupboards or other internal fittings. Portions of room panelling, including treatment at openings.

#### 66. FOURTH YEAR OR GRADE

- (1) *Heavy Construction.* Portions of heavy timber framing, including the design of joints using bolts (with or without connectors).
- (2) *Roofwork.* Open timber roof, with turret or spire. Joints in laminated timber trusses.
- (3) *Doors and Windows.* Solid door or window frames of double curvature.
- (4) *Wood Finishings.* Examples of treatment in wood of entrances and vestibules. Wood panelling to walls with treatment at door or window opening.
- (5) *Fitments.* Examples of commercial, domestic, ecclesiastical and educational fitments.
- (6) *Stairs.* Portions of open newel and geometrical stair with handrails.
- (7) *Setting-out.* Preparation of rods and cutting lists from architects' drawings. Preparation of material for bench and machine work.

## COURSE IN WOODCUTTING MACHINE WORK

### 67 GENERAL NOTES

(a) This Course in Woodcutting Machine Work is arranged as a Four Year Course under the following main divisions :

- I. Technology.
- II. Practical Work.
- III. Associated Subjects :
  - (i) Craft Calculations.
  - (ii) Geometry and Drawing.
  - (iii) Craft Science, and
  - (iv) Building Construction.

(b) The distribution of the Associated Subjects, grade by grade, is explained in paras. 13 and 14. (See also the General Notes on Technology and Practical Work, paras. 19 to 30.)

(c) The treatment of the Craft under several subject headings, all closely related, should be explained early in the Course. Emphasis should be laid upon the way in which this method increases the practical value of the Course, by ensuring that it is broadly based upon a wide knowledge of craft practices and of the technical and scientific reasons underlying their adoption.

(d) While instruction in the Associated Subjects will be given mainly in the special classes provided for that purpose, it is intended that there should be frequent references to and utilisation of all this related knowledge throughout the Course, in both Technology and Practical Work.

(e) It is assumed that the methods of geometrical and free drawing will be used and developed during the Course to the full extent and in the manner required by the craft. They should include plane geometry, sketching and free drawing, the projection of related views by geometrical methods, the preparation of detail drawings, full-size and to scale, and the reading of architects' plans and working drawings.

(f) Some introductory talks of a general character should be given in the First Year or Grade. These should cover in a simple and interesting manner the work of the craft, its relation to other crafts and to building generally.

(g) To carry out this Course a full range of the principal machines should be available for demonstration and use. For lecture purposes there should also be an ample supply of photographs, drawings and diagrams showing some of the machines in section.

(h) Woodcutting machinery is used in a variety of trades and industries, some of which have no very close relations with building. The machine processes are more or less common to them all and it is suggested that, wherever these classes include students from these other trades, the attempt should be made to meet their special needs by some variations in the work dealt with in the classes.

## WOODCUTTING MACHINE WORK (TECHNOLOGY)

## 68. FIRST YEAR OR GRADE

(1) *The Machinist and other Woodworking Crafts.* Brief outline of the processes through which wood passes from the timber sheds, through the saw mill, machine shop and joiners' or assembly shop and then to its permanent place in the completed building. Relations of the work of the machinist to that of other crafts.

(2) *Saws.* Circular sawing machines and their use for ripping and cross-cutting. The use of rising and falling tables and spindles. Band and jig saws and their use in curved work. The principal types of circular saws and circular saw teeth; introduction to the methods of gulletting, setting and sharpening. Safety devices on these machines; need for care in the use of all machines.

(3) *Machines in General Use.* The construction and use of the surface planer, the thicknesser and of combined machines. Boring machines. Hollow chisel and chain mortising machines. Small power wood-working tools. Safety devices on woodworking machines.

(4) *Care of Machines and Cutters.* General maintenance of machines in use. Lubrication and inspection of machines and shafting. Introduction to the methods of grinding and sharpening cutters. Natural grindstones and other abrasive wheels, files, oilstones.

(5) *Methods of Jointing and Fixing Woodwork.* Details of woodwork joints; housing, halving, bridle, mortise and tenon, tonguing and grooving, mitreing and scribing, dovetailing. Nailing, screwing, bolting, gluing. Use of fixing blocks, wood grounds and wallplugs.

(6) *Methods of Wood Construction.* Introduction to the construction of wood floors and roofs, the joints used and the determination of lengths and bevels in simple cases. Construction of simple external door frames and doors (not panelled).

(7) *Machine Shop Work.* Machine workshop methods involved in the cutting out, planing and moulding of material for the construction of floors, roofs (without hips), and external door frames and doors (not panelled). The preparation and use of cutting lists. Marking-off work for the machines at the setting-out bench.

(8) *Timber.* Characteristics of the timbers commonly used in buildings; white deal or spruce, red deal, Columbian pine, American whitewood, mahogany and teak. Market sizes of softwoods. Common measures of timber.

## 69. SECOND YEAR OR GRADE

(1) *The Machine Shop.* Typical lay-out of a machine shop of moderate capacity. Principal machines; sequence of work, relation of machines, care and storage of tools, workshop methods and control for systematic production.

(2) *Machine Saws.* The dimension saw; the canting table or canting spindle; the adjustable swivel fence. Cross cut sawing machines sliding table and sliding carriage; arrangements for bevel cut.

Safety devices on these machines. Automatic machines for setting and sharpening circular and band saws; brazing machines for band saws.

(3) *Woodcutting Machines.* The construction and use of the following machines: panel planing and thicknessing machines, vertical spindle moulding machines. Types of cutter blocks. Trenching and recessing machines; use of expanding grooving and trenching heads. Tenoning machines. Safety devices on all these machines. Precision methods in setting planing cutters.

(4) *Preparation and Use of Cutters, Machines, Saws, etc.* Methods of grinding cutters; geometrical work in determining the profiles of cutters for producing mouldings of given section; cutter projection scales and the preparation of setting templets. Grinding angles to obtain clearance; cutting angles for woods of varying degree of hardness and quality.

(5) *Power Drives.* Introduction to the methods of belt and direct drive; types of belting in use; shift-gear devices; electrical power control devices; joining belts and the use of belt fasteners; belt guards and other safety measures.

(6) *Wood Construction.* Constructional details of panelled framing; panelled doors; plain and panelled jamb linings, architraves. Solid wood casement frames with single sash; use of throatings, capillary gooves and weather bars; glazing. Names and shapes of the common mouldings.

(7) *Machine Shop Work.* Machine workshop methods involved in the cutting-out and preparation of material for all the forms of construction outlined in the preceding paragraph, including the operations of sawing (square and bevel), planing, thicknessing, dimensioning, tonguing and grooving, moulding, recessing, mortising and tenoning. The use of architects' details and of setting-out rods; the setting-out of work for the machinist.

#### 70. THIRD YEAR OR GRADE

(1) *The Machine Shop.* Machines and methods suited to the large workshop planned for general contractors' work or as a machine joinery works; typical lay-out, including tool-room; methods of processing work, general control of stores and records.

(2) *Machine Saws.* Circular saws with mechanical feeds; rates of cutting for soft, hard, wet or dry timbers. Types of saw blades and saw teeth. Types of safety devices.

(3) *Woodcutting Machines.* General consideration of more specialised or complex machines; three- and four-cutter planing and moulding machines; tenoning and scribing machines; dovetailing, overhead recessing, high speed routers, corner-locking machines; sanding machines of various types; wood turning lathes. Special types of cutter blocks. The use of jigs, saddles and templets for special operations.

(4) *Preparation and Care of Cutters, etc.* Suitable feeding and periphery

speeds for the various machines and for the different kinds and qualities of timber. Cutting angles and clearances for saw teeth, surfacing and moulding cutters, including cutters for French spindle heads, mortising chains, boring tools, the methods of shaping cutters for tenoning and scribing machines. Automatic machines for grinding long planing cutters. The hardening and tempering of steel and alloy steels; use of alloy steels in cutters.

(5) *Wood Construction.* The construction of double-hung sashes and box window frames; sky lights and lay lights; single flights of straight stairs with closed strings; proportion of tread and rise; methods of fixing. Internal fittings; cupboard and drawer construction; kitchen fitments. Roof framework for hipped roofs, including lengths and bevels for the hips and rafters. Methods of producing veneers; slicing and peeling machines.

(6) *Machine Shop Work.* Machine workshop methods involved in the cutting-out and preparation of material for all the forms of construction outlined in the preceding paragraph, including the making of compound bevel cuts in roof work.

(7) *Timber.* The conversion, stacking and seasoning of timber; natural and kiln seasoning methods; "second seasoning" after framing. Common defects in timber. Methods of preservation. Market forms and measurement of hardwoods.

#### 71. FOURTH YEAR OR GRADE

(1) *Supervision and Management of Wood Machine Shops.* The planning and control of machine shops (a) for general machine joinery, (b) for building and contracting and (c) for large mills, including both the timber conversion and machine working for general purposes. Layout of machines in relation to each other; requirements as to space; methods of timber transport from sheds to machines and from machine to machine. Detailed consideration of safety and welfare arrangements; the Woodworking Machinery Regulations. Methods for supply and transmission of motive power. Collection and utilisation of wood waste; power from wood waste. Exhaust and blower systems for the removal of wood waste and cleaning of machines.

(2) *The Saw Mill.* Log-sawing machines; vertical and horizontal log-band sawing machines. Log carriages and feeds. Re-sawing machines; the band re-saw.

(3) *The Machine Shop.* General consideration of high-speed wood-cutting machines. Detailed consideration of planing and matching machines, combined rotary and fixed-knife planers, double-ended chain feed tenoning machines, multiple boring and mortising machines, special and combination machines. Methods of reducing vibration and friction. Periphery speeds for cutters with several varieties of timber; methods for varying cutting and clearance angles; rates of feed in relation to finish required. Calculations relating to power transmission, power, production and output costs. Introduction to the costing of machine work.

(4) *The Tool Room.* General organisation and equipment of the tool room. Storing and maintenance of saws and cutters; tensioning circular saws and wide band saws; swage setting of teeth to wide band saws. Range of saw sharpening and setting machines and of grinding, hardening and tempering and balancing cutters. Storage of spares for particular machines. Belt jointing equipment. Saw brazing machines. Relations between tool room staff, the machine operators and the general control of production.

(5) *Wood Construction and Related Machine Shop Work.* Consideration of general procedure in the execution of a contract; preparation of "setting-out rods" in the joinery shop, preparation of cutting and machining lists; passage through saw mill and machine shop; final assembly, gluing-up and sanding; methods for checking dimensions at all stages; controls for ensuring suitable moisture content at all stages. More advanced study of the details of carpentry and joinery work outlined in previous grades, including the setting-out of splayed and curved work for window frames and sashes. Detailed consideration of the machine shop work required in all this work, including the assembly of frame and panelled work by mass production methods. Consideration of the methods adopted in the manufacture of plywoods and of flush doors.

## WOODCUTTING MACHINE WORK (PRACTICAL WORK)

### 72. FIRST YEAR OR GRADE

- (1) Examination, dismantling, assembly, cleaning and lubrication of the machines in common use: circular saw, band saw, surfacing and thicknessing planers, boring and mortising machines.
- (2) The preparation and setting-up of these machines for simple work. Safety devices and need for care in use. Introduction to the setting and sharpening of saws and the grinding of planing cutters. Practice in setting cutters on spare cutter blocks.
- (3) The sawing and planing of material to length, width and thickness as given in cutting lists.
- (4) Examples of the common woodwork joints carried out on the machines. (*Note.* This work should include mortising but not tenoning, which may, however, be done by Grade II students.)
- (5) Preparation of the woodwork ready for assembly of some of the following woodwork constructions: simple floor, roof, external door and external door frame. In each case a setting-out rod to be prepared from drawings in the first place.

### 73. SECOND YEAR OR GRADE

- (1) Preparation and setting up for various kinds of work on dimension saw machines, including rise and fall table and canting spindle or table.
- (2) The preparation and setting-up of cross-cut sawing machines:
  - (a) for cross-cutting and (b) for grooving and trenching. Safety devices.

- (3) Use of machines for setting and sharpening band saws and circular saws. Brazing narrow band saw blades. Setting and sharpening circular saws by hand.
- (4) Preparation and setting up for simple work on the following machines: surface planer and thicknesser, spindle moulding machine, tenoning machine. Grinding and sharpening of straight planing cutters and small moulding cutters.
- (5) Preparation of a setting-out rod and cutting lists from drawings, together with the necessary machine work ready for assembly, of some of the following woodwork constructions: mouldings, solid window frame and casement sashes, panelled door.

#### 74. THIRD YEAR OR GRADE

- (1) Setting up and preparation of cutters for the three- and four-cutter planing and moulding machines; use of accessories on various examples of work, effects of rates of feed on finish for soft and hard woods.
- (2) Setting up and preparation of the cutters for the tenoning and scribing machine.
- (3) Setting up and preparation of the cutters for a spindle moulding machine with both square and French cutter block.
- (4) Preparation and setting up of one or more special machines as these may be available, including lathes.
- (5) Preparation from setting-out rods of the material, and machining ready for assembly, of some of the following woodwork constructions: double-hung sashes and frame; panelled door with linings and architraves; short flights of stairs; roof timbers for a hipped roof.

#### 75. FOURTH YEAR OR GRADE

- (1) Preparation of all types of machines for (a) high production methods and (b) intricate or complex work. Preparation and use of templates, jigs and saddles. Fixing safety guards on all machines.
- (2) More advanced work on the maintenance, grinding and sharpening of saws and cutters for all types of work. The use of automatic and semi-automatic machines for grinding and sharpening. Use of precision setting appliances and for balancing cutters. Preparation of wide band saws for use on band re-saws and log band-mills.
- (3) Preparation of advanced examples of carpentry and joinery in co-operation with the advanced carpentry and joinery students, to include suitable selections from doors, windows, panelling frames, stairs and internal fittings.



## COURSE IN PAINTING AND DECORATING\*

### 76. GENERAL NOTES

(a) This Course in Painting and Decorating is arranged as a Four Year Course under the following main divisions :

- I. Technology.
- II. Practical Work.
- III. Associated Subjects :
  - (i) Craft Calculations.
  - (ii) Geometry and Drawing.
  - (iii) Craft Science, and
  - (iv) Building Construction.

(b) The distribution of the Associated Subjects, grade by grade, is explained in paras. 13 and 14. (See also the General Notes on Technology and Practical Work, paras. 19 to 30.)

(c) The treatment of the Craft under several subject headings, all closely related, should be explained early in the Course. Emphasis should be laid upon the way in which this method increases the practical value of the Course, by ensuring that it is broadly based upon a wide knowledge of craft practices and of the technical and scientific reasons underlying their adoption.

(d) While instruction in the Associated Subjects will be given mainly in the special classes provided for that purpose, it is intended that there should be frequent references to and utilisation of all this related knowledge throughout the Course, in both Technology and Practical Work.

(e) It is assumed that the methods of geometrical and free drawing will be used and developed during the Course to the full extent and in the manner required by the craft. They should include plane geometry, sketching and free drawing, the projection of related views by geometrical methods, the preparation of detail drawings, full-size and to scale, and the reading of architects' plans and working drawings.

(f) Some introductory talks of a general character should be given in the First Year or Grade. These should cover in a simple and interesting manner the work of the craft, its relation to other crafts and to building generally.

### PAINTING AND DECORATING (TECHNOLOGY)

#### 77. FIRST YEAR OR GRADE

(1) *Tools.* The names, uses, preparation and care of the ordinary painters' tools, brushes and appliances. The painter's kit.

(2) *Materials.* The composition of paint ; pigments, binders, thinners and driers. Classification of the common pigments by colour and

\*With the kind permission of the National Painters' and Decorators' Joint Education Committee of England and Wales, these syllabuses have been based upon the " Scheme of Part Time Education for the Painting Craft," recently issued by them.

origin. The nature and use of white lead, the linseed oils, turpentine and driers.

(3) *Paint Technique*. The principles underlying the use of paints; the importance of cleanliness and method to protect the health of the craftsman and to avoid waste; terms used in painting.

(4) *Oil Media*. The elementary processes of painting in oil; preparation of old and new surfaces; priming, stopping, knotting. The mixing and application of paint. Procedure in painting plain surfaces, walls, ceilings, doors, windows, etc.

(5) *Water Media*. The use of water media; preparation of new and old surfaces; materials and tools; pigments, media, binders, etc.; mixing and application of distempers. Undercoat and finishing coats.

(6) *Colour and Design*. Use of the terms tint, hue, shade and monochrome in painter's work. Simple effects in broken colour; elementary use of stiplers and combs. Introduction to the use and preparation of stencils.

(7) *Lettering*. Origin and development of block lettering; the alphabet; capitals, small letters, punctuation and numerals; legibility, proportions, spacing and lay-out.

(8) *Paper-hanging*. The elementary processes of paper-hanging; preparation of surfaces; tools and appliances; mixing and application of paste; hanging and matching.

#### 78. SECOND YEAR OR GRADE

(1) *Tools and Scaffolding*. Special tools for decorative work. Manipulation and care of the blow lamp. Arrangement and use of simple scaffoldings in timber and steel; planks, trestles and ladders.

(2) *Materials*. Classification of painters' materials according to derivation, composition and manufacture. The physical properties of oils, thinners, driers, pigments and varnishes. Abrasive materials; dry and wet rubbing down. Use of lead paints; statutory regulations.

(3) *Paint Technique*. The preservative, hygienic and decorative values of painting. Types of painting finishes and their preservation. Common defects and their avoidance. The treatment of damp surfaces; effect of absorbed moisture on paint finishes. Prevention of dampness in walls.

(4) *Oil Media*. Necessary qualities in paint; fluidity, covering power, opacity, adhesiveness, drying, hardening, elasticity. Simple practical tests. Mixing oil paints, procedure with dry and paste materials. Methods of applying oil paints. Filling, surfacing, sequence of coats, varnishing, enamelling. Paint removal.

(5) *Water Media*. Description and use of washable distempers. Comparison between oil painting and distemper. Under coatings.

(6) *Colour and Design*. Colour in decoration; simple colour theory, prismatic and chromatic. Simple effects in broken colour; manipulation of combs and other tools. Scumbling, combing and glazing,

multiple combing. Decorative values of wood and marble surfaces ; simple forms of graining and marbling. Development of original methods of treatment.

(7) *Lettering*. Origin and development of the Roman alphabet. Spacing and lay-out.

(8) *Paper-hanging*. Methods adopted in hanging various types of papers ; borders, friezes, pulps, grounds, water and oil printed papers. Preparation of surfaces to be varnished.

#### 79. THIRD YEAR OR GRADE

(1) *Equipment and Scaffolding*. The selection, testing and care of brushes, tools and plant. The protection and care of furniture and fittings during the decoration of interiors. Scaffolding for interior and exterior work in timber and steel ; connections, stability and storage. The use of travelling cradles. Safety measures.

(2) *Materials*. General chemical and physical properties of paint materials ; effects of exposure and weather during painting and afterwards ; reactions between paint materials and between paints and the grounds to which they are applied. Other paint defects. Painting over plaster and cement surfaces, new and repaired.

(3) *Oil Media*. The selection of paints for interior and exterior use. Flattening ; flat oil paint. Gloss and other surface finishes. Introduction to the use of spray painting.

(4) *Water Media*. Decorative effects in water media. Survey of methods of tempera decoration ; suitability for certain classes of work.

(5) *Colour and Design*. Pigmental modifications ; juxtaposition ; harmonising. Colour schemes in contrast to or harmonised with existing surroundings ; contrasts in tone and colour.

(6) *Various Surface Treatments*. Decorative effects in broken colour and textures. Graining, marbling and similar finishes. Gilding. Wood staining. Polishing.

(7) *Lettering and Heraldry*. Lettering as decoration. Lettering in gold and metals. Pen lettering. Lay-out. Introduction to the decorative use of heraldry ; the principal terms, tinctures and metals used.

(8) *Paper-hanging*. The hanging of relief materials and fabrics.

#### 80. FOURTH YEAR OR GRADE

(1) *Equipment and Scaffolding*. The design of scaffolding for special jobs, in timber and in steel. The Building Regulations as they affect painters' work.

(2) *Materials*. Practical and physical tests of oils, pigments, media, paints, enamels and varnishes. Methods of exposure tests. Heat-resisting paints. Treatment of mould growths. Synthetic paints and paint materials. Use of B.S. specifications in ordinary work.

(3) *Business Procedure*. The elements of job management. Taking out quantities for painting and decorating. Technical terms used for

painted items in buildings. Introduction to costing and estimating. Selection, purchase and storage of painters' materials.

(4) *Spray Painting*. Practical methods and design. Construction, use and care of spray painting plant of all types. Painting of new and old work; comparison of methods and processes.

(5) *Colour and Design*. Painting ornament in relief. The treatment of relief materials after hanging. Plastic paints and similar materials.

(6) *Lettering and Heraldry*. Outline of the basic conventions and practices of heraldry, with and without lettering. Heraldic painting.

(7) *Interior Decoration*. The orders and styles of architecture for decorative use; chief characteristics of period decorations. Representation of decorated interiors in line and colour, using both axonometric projection and perspective.

(8) *Wall Hangings, etc.* The hanging of silk, tapestry and similar fabrics. Period decorations.

## PAINTING AND DECORATING (PRACTICAL WORK)

### 81. FIRST YEAR OR GRADE

(1) *Preparation of Surfaces and of Paint*. Preparing new and old work for plain painting on wood and metal. Mixing and applying paints for the priming and subsequent coats. Stopping, knotting, rubbing down, etc.

(2) *Plain Painting*. Plain painting in single colour of doors, skirtings, mouldings, window frames and sashes and interior fittings. Painting cast iron rainwater fittings and other exterior ironwork.

(3) *Colour Work*. Preparation of tints and shades from pigments in general use. Colour matching. Preparation of simple colour schemes. Combed patterns and simple broken colour effects. The use of the pencil for simple marbling effects. Simple brush graining.

(4) *Free brush-work*. Free-arm production of Key and Guilloche patterns, with sable writing pencils and paint. Lay-outs of free ornament expressed in tints, etc. Simple stencils based on similar motifs.

(5) *Applying Distempers, etc.* The preparation of surfaces to receive whitewash and distemper. Stopping and repairing plaster and other wall surfaces and ceilings. Application of whitewashes and distempers.

(6) *Lettering*. Setting out and painting a standard block letter alphabet and numerals. Simple signs and posters in block lettering, executed as positive, negative and in outline.

(7) *Paper-hanging*. The preparation of wall surfaces for paper-hanging. Mixing paste. Trimming by all methods. Hanging lining papers and pulps.

### 82. SECOND YEAR OR GRADE

(1) *Preparation of Surfaces*. Burning-off and use of paint removers. Preparation of surfaces for flat, varnish and enamel finishes. Methods of working from small scaffolds, etc.

- (2) *Plain Painting*. Further work in plain painting in several colours. Lining, panelling and stencilling in oil colours. Hue charts. Colour schemes for various purposes; relation to lighting schemes. Painting on plaster, brick, concrete and various types of wall boards. Treatment of damp surfaces.
- (3) *Colour Work*. Broken colour and scumble effects. Colour combing. Graining; preparation of sheets or sample panels to show successive operations; grounds for graining; graining tools. Introduction to marbling. Varnishing and enamelling.
- (4) *Distempers*. Distemping in several colours; colour schemes; stencilling in distemper colours.
- (5) *Free Arm Work*. Execution in free arm work, with pencil and paint, of interlacing ornament; the spiral, anthemion and other forms of radiating ornament. Design and use of multiple stencil plates, both positive and negative.
- (6) *Lettering*. Setting-out and painting a Roman alphabet. Numerals. Signs, posters and inscriptions in Roman and Block lettering.
- (7) *Paper-hanging*. Measurement, trimming, cutting and hanging of patterned papers to walls and ceilings. Sizing and varnishing.

### 83. THIRD YEAR OR GRADE

- (1) *Equipment, Stores and Scaffolding*. Use of scaffolding, ladders, trestles and cradles. Care, checking and testing of tools and equipment. Management of stores. Stock keeping. Supply of materials.
- (2) *Colour Work*. Exercises calling for the mixing of pigments. Harmonising of interior schemes with furniture, wall papers, fabrics, etc.
- (3) *Decorative Painting*. Painting ornament in monochrome (all media) from architects' or contractors' drawings; painting ornament in relief. Designs from conventionalised natural and geometrical forms. The use of spray painting in this work and with stencils; use of masks and templates.
- (4) *Surface Treatments*. Colour combing and texture effects. Use of plastic and other special paints. Contrasts and combinations of glaze and scumble effects in other media. Use of spray gun for shading and similar effects.
- (5) *Lettering and Heraldry*. Use of Roman upper and lower case characters in signs and inscriptions. Use of other types of lettering. Monograms, cyphers and other decorative motifs. Use of gilding. Use of heraldic devices.
- (6) *Paper-hanging*. Measurement, trimming, cutting and hanging of plain, textured and veneered papers in panel and stile effects.

### 84. FOURTH YEAR OR GRADE

- (1) *Preparation of Working Details*. Preparation of full-size working details, based on architects' specifications and drawings, for any of the practical work carried out in the Painting and Decorating Course.

- (2) *Surface Treatments.* The more elaborate reproduction of woods and marbles. Gesso-reliefs and subsequent treatment in colours and metals. Further decorative use of the spray gun.
- (3) *Lettering and Heraldry.* Gilding and lettering on glass. Decorative use of lettering and heraldic achievements. External signs and fascias, exhibition and display work.
- (4) *Decorative Work.* Polychromatic painting of ornament from modern and historic designs. Wipe-out stencils and other mechanical means of reproduction.
- (5) *Wall Hangings.* Measurement, trimming, and hanging of raised and embossed wall-paper materials, in piece or as panel or cut-out items. Decorative treatment of raised and embossed materials.

## COURSE IN PLUMBING

### 85. GENERAL NOTES

(a) This Course in Plumbing is arranged as a Four Year Course under the following main divisions :

- I. Technology.
- II. Practical Work.
- III. Associated Subjects :
  - (i) Craft Calculations.
  - (ii) Geometry and Drawing.
  - (iii) Craft Science, and
  - (iv) Building Construction.

(b) The distribution of the Associated Subjects, grade by grade, is explained in paras. 13 and 14. (See also the General Notes on Technology and Practical Work, paras. 19 to 30.)

(c) The treatment of the craft under several subject headings, all closely related, should be explained early in the Course. Emphasis should be laid upon the way in which this method increases the practical value of the Course, by ensuring that it is broadly based upon a wide knowledge of craft practices and of the technical and scientific reasons underlying their adoption.

(d) While instruction in the Associated Subjects will be given mainly in the special classes provided for that purpose, it is intended that there should be frequent references to and utilisation of all this related knowledge throughout the Course, in both Technology and Practical Work.

(e) It is assumed that the methods of geometrical and free drawing will be used and developed during the Course to the full extent and in the manner required by the craft. They should include plane geometry, sketching and free drawing, the projection of related views by geometrical methods, the preparation of detail drawings, full-size and to scale, and the reading of architects' plans and working drawings.

(f) Some introductory talks of a general character should be given in the First Year or Grade. These should cover in a simple and interesting manner the work of the craft, its relation to other crafts and to building generally.

### PLUMBING (TECHNOLOGY)

#### 86. FIRST YEAR OR GRADE

(1) *Tools.* Description of the tools commonly used by the plumber for the manipulation and joining of lead. Their construction and maintenance.

(2) *Materials.* Introduction to the materials commonly used by the plumber; lead, iron, copper, tin and zinc. Sheet lead; weights and thicknesses. Lead pipe; weights, diameters and thicknesses. Simpler properties of plumber's solder.

(3) *Leadwork to Roofs.* Methods of joining sheets of lead with laps, drips and rolls. Lining tapering gutters and cesspools. Flashings to slated and lead covered roofs. Fixing C.I. rainwater gutters and down pipes.

(4) *Jointing Lead and Iron Pipes.* Jointing lead and composition gas pipes. Jointing lead, water, waste and soil pipes. Jointing cast iron and wrought iron pipes.

(5) *Valves and Cocks.* Description of the common types of valves and cocks used in water supply and gas supply installations to buildings, plug, screw down, bib and pillar types.

(6) *Cold Water Supply.* General lay-out of domestic cold water supply; description of fittings.

#### 87. SECOND YEAR OR GRADE

(1) *Tools.* Description of the tools commonly used by the plumber in working the hard metals; iron, copper and zinc. Appliances and methods of bending lead, copper and iron piping to given dimensions and angles.

(2) *Materials.* More detailed consideration of plumbing materials; thicknesses and gauges of copper and zinc sheet, diameters, weights and thicknesses of copper and iron pipes. Cast iron rain water and soil pipes.

(3) *Roofwork in Lead.* Lining gutters and cesspools to larger roofs; coverings to flats, hips and ridges, preparing and fixing straight, stepped and raking flashings. Methods to prevent leakage by capillary attraction. Methods to prevent cracking of lead sheet by creep under ordinary weather conditions.

(4) *Roofwork in Copper and Zinc.* Different types of copper rolls, welts, standing seam, single and double lock. Similar connections for sheet zinc.

(5) *Cold Water Supply.* Domestic systems of cold water supply; approximate sizes of pipes, cisterns, fittings and valves and the

connections between them. Requirements of Model Building Byelaws. Precautions against frost in domestic supply systems.

(6) *Hot Water Supply.* Small domestic systems of hot water supply; approximate sizes of pipes used (lead, copper and wrought iron), cisterns, cylinders, boilers, fittings and the connections between them. Precautions against accidents; provision to facilitate cleansing and repair. Effects due to waters of differing hardness.

(7) *Sanitary Equipment.* Sinks, wash basins, baths, water closets and methods of fixing and connecting to supply and waste systems, traps, soil, waste and ventilation pipes. Connections to earthenware pipes. Requirements of the Model Building Byelaws.

(8) *Gas Equipment.* Installation of gas systems and gas fittings and equipment; testing gas pressure. Arrangements to facilitate repairs and maintain full supply.

#### 88. THIRD YEAR OR GRADE

(1) *Materials.* The use of cast and milled sheet lead and plate lead. The use of tin and tin-lined pipes. Methods of jointing each kind of pipe used in plumbing, including screwed joints, in the hard metals, and patent joints.

(2) *Roofwork in Lead.* Sheet lead work to dormers, turrets, etc. Secret gutters, hip and valley coverings, finials, secret tacks. Fixing socket pipes.

(3) *Roofwork in Copper and Zinc.* More advanced work in copper and zinc roof coverings. Finish at eaves, ridges and chimney stacks. Use of rolls and standing seams.

(4) *Cold Water Supply.* Systems for domestic and trade purposes. Methods of preventing contamination within the system. Connections to mains. Types of storage cisterns, flushing tanks, water waste-preventers; connections thereto and warning and overflow pipes. Causes of water-hammer and other noises; prevention of damage by frost.

(5) *Pumps and Pipes.* Principles involved in the construction and use of simple types of jack pumps, lift and force pumps and hydraulic rams. Flow of water through pipes, and valves, using established formulae.

(6) *Hot Water Supply.* Cylinder-tank and indirect systems of hot water supply; range and independent boilers. Packing for and access to manholes. Prevention of loss of heat by radiation. Cause and prevention of collapse of cylinders; use of safety valves; causes of corrosion and incrustation in pipes, boilers, cylinders and tanks. Calculations of "circulating head" in simple cases. Loss of heat due to friction in pipes and fittings.

(7) *Gas Equipment.* Fixing, ventilating and maintaining gas fires, cookers, radiators and geysers. Pipe sizes and meters for specified use. Thermostatic devices. Gas lighting. Gas consumption; use of the "therm"; control of calorific content.



- (8) *Sanitary Equipment.* Arrangement, fixing and connection of all types of sanitary fittings and equipment, domestic and public. Arrangement and sizing of supply, waste soil and ventilation pipes. The "one-pipe" system. Connections to drains. Copper pipe fittings.
- (9) *Drainage.* The construction and lay-out of drainage systems in earthenware, stoneware and cast iron. Ventilation of drains and soil pipes. Cast iron covers to manholes and inspection chambers. Requirements of Model Byelaws.
- (10) *Lead Burning.* Equipment for lead burning by oxy-hydrogen, oxy-acetylene and air-hydrogen systems; gauges, regulators and burners; flame adjustment. Safety regulations. Types of joints used in joining sheet lead and lead pipes.

#### 89. FOURTH YEAR OR GRADE

- (1) *Roofwork.* Practical details of the covering of roofs, domes, turrets, gutters, and flats with cast or milled lead, copper and zinc sheet. Specifications and quantities for any part of roof work in which plumbing occurs. Glazing, ordinary, lead and patent.
- (2) *Cold Water Supply.* Sources of cold water supply; rainfall; properties of waters from wells and springs and from moorland and limestone areas; pollution and sterilisation of water; plumbosolvent waters. Storage treatment and distribution; quantities per head. Flow of water in channels and pipes. Setting-out complete water supplies for buildings, including the use of pumps or rams, with details as to size and type of fittings required.\*
- (3) *Hot Water Supply.* Complete systems of hot water supply, direct and indirect. Calorifiers. Electric immersion heaters and elementary knowledge of the circuits required. Independent and sectional boilers; use of boiler rating tables. Complete line diagrams in isometric projection of pipe installations. Necessary calculations as to diameter of pipes required for hot water and steam calorifiers. Thermostatic control.
- (4) *Heating by Hot Water.* Low pressure system of heating by hot water; loss of heat through external walls and other parts of the structure. Heating surface required in buildings; distribution of heating units. Calculation of "circuit height" of system; size of boiler required.
- (5) *Sanitary Equipment and Drainage.* Arrangements for fixing of sanitary fittings in hotels, hospitals, and public buildings. The "separate" and "one pipe" arrangement of soil and waste pipes. Ventilation of sanitary apartments. General lay-out, construction of isolated drainage schemes for country houses. Sizes, gradients and the ventilation of drains; testing of drains and soil pipes by means of smoke, water, chemicals, and air pressure. Outline of systems of sewage treatment.

\*Reference should be made to the Model Specifications of Water Pipes and Fittings, issued by the Ministry of Health (revised 1926), and to the Standard Specifications of the Institute of Plumbers for Water Services, Sanitation and Drainage.

(6) *Advanced Workshop Methods.* Methods of brazing and welding hard metal pipes and sheets. Use of fluxes for soldering, welding and brazing. The methods of bending hard metal pipes by machine or otherwise; methods of jointing such pipes and fittings.

(7) *Measurement of Plumbers' Work.* The preparation of quantities for plumbers' work. Measuring completed work. B.S. Specifications. The Building Regulations.

### PLUMBING (PRACTICAL WORK)

#### 90. FIRST YEAR OR GRADE

(1) Bossing external angles or corners of sheet lead up to 4 in. Roll ends, aprons, and welts.

(2) Setting-out and fixing of flashings. Setting-out and soldering of small cisterns.

(3) Preparation of lead pipe joints up to 1 in. diameter. Wiping 1 in. lead pipe joints.

(4) Preparation and making of gas pipe joints up to  $\frac{3}{4}$  in. diameter. Copper bit work.

(5) Bending of lead pipes up to  $1\frac{1}{4}$  in. diameter, to an easy radius. Use of bobbins.

#### 91. SECOND YEAR OR GRADE

(1) The preparation and making of joints for gas and water pipes up to 2 in. diameter.

(2) Rolls, drips and welts.

(3) The bossing of sheet lead, including internal angles or breaks up to 4 in.

(4) Bending lead pipes up to 2 in. diameter.

(5) Joint wiping on lead pipes up to 2 in. diameter.

(6) Bending light gauge copper pipe up to 1 in. diameter by means of the machine. Bending steam pipe up to 1 in. in diameter by means of the furnace or flame; the work to be confined to a simple bend to a single radius.

(7) The formation of simple rolls, welts, and locks in 24 standard gauge sheet copper.

(8) Lead burning; use of ordinary plant and the preparation and burning of a solid flat seam (butt or lap) up to 2 ft. long.

#### 92. THIRD YEAR OR GRADE

(1) Joint wiping on lead pipes up to 3 in. diameter in normal positions.

(2) Bending of lead pipes up to 3 in. diameter.

(3) Lead bossing internal and external angles up to a height of 6 in.

(4) Hollow and solid lead rolls.

- (5) Lead burning, flat and upright (butt and lap); simple pipe work; simple ornamental work in lead burning.
- (6) Bending of wrought-iron pipes up to  $1\frac{1}{2}$  in. diameter, by means of a forge or other means of heating.
- (7) Bending of copper pipes up to 1 in. diameter, by any recognised workshop method other than the machine.
- (8) Welts, gussets, chimney backs and aprons in 24 standard gauge sheet copper. Also in zinc. Preparation for brazing and bronze welding of sockets and intersecting pipes in copper.
- (9) Jointing sanitary fittings to waste pipes and drains.

### 93. FOURTH YEAR OR GRADE

- (1) Joint wiping on lead pipes up to 4 in. diameter in normal positions.
- (2) Bending of lead pipe up to 4 in. diameter.
- (3) Lead burning; seams, joints, patches, bends, upright burning, hollow burning. Applications to roof work.
- (4) The bossing of sheet lead, including external angles or corners and internal angles or breaks up to 6 in. high.
- (5) Ornamental leadwork embodying bossing, casting, soldering and lead burning.
- (6) Bending of copper pipe of any gauge up to 2 in. diameter and wrought-iron up to 2 in. diameter, by any recognised workshop methods.
- (7) Welding wrought-iron pipes, tees, elbows, pipe intersections. Copper welded flange joints.
- (8) Brazing and bronze welding of socketed, "mitred," saddled and cup joints up to 1 in. diameter in copper pipe.
- (9) Welting, jointing, and brazing of sheet copper for roof coverings, domes, gutters, and flats, including internal and external angles and roll ends. Similar work in zinc sheet.

## COURSE IN SLATING AND TILING

### 94. GENERAL NOTES

(a) This Course in Slating and Tiling is arranged as a Two Year Course only under the following main divisions:

- I. Technology.
- II. Practical Work.
- III. Associated Subjects:
  - (i) Craft Calculations.
  - (ii) Geometry and Drawing.
  - (iii) Craft Science, and
  - (iv) Building Construction.

(b) The distribution of the Associated Subjects, grade by grade, is

explained in paras. 13 and 14. (See also the General Notes on Technology and Practical Work, paras. 19 to 30.)

(c) The treatment of the Craft under several subject headings, all closely related, should be explained early in the Course. Emphasis should be laid upon the way in which this method increases the practical value of the Course, by ensuring that it is broadly based upon a wide knowledge of craft practices and of the technical and scientific reasons underlying their adoption.

(d) While instruction in the Associated Subjects will be given mainly in the special classes provided for that purpose, it is intended that there should be frequent references to and utilisation of all this related knowledge throughout the Course, in both Technology and Practical Work.

(e) It is assumed that the methods of geometrical and free drawing will be used and developed during the Course to the full extent and in the manner required by the craft. They should include plane geometry, sketching and free drawing, the projection of related views by geometrical methods, the preparation of detail drawings, full-size and to scale, and the reading of architects' plans and working drawings.

(f) Some introductory talks of a general character should be given in the First Year or Grade. These should cover in a simple and interesting manner the work of the craft, its relation to other crafts and to building generally.

(g) Most of the practical exercises must be carried out full-size. Suitable portions of roofs must therefore be made available in the Building Erection Shop (see paras. 25 to 30). Some of this preparatory work may form exercises for the other crafts.

(h) Demonstrations of the use of scaffolds and ladders and of the methods of working on roofs must be given throughout the Course.

## SLATING AND TILING (TECHNOLOGY)

### 95. FIRST YEAR OR GRADE

(1) *Tools.* The tools commonly used by the slater and tiler; axe or zax, gauge stick or scantel; cutting iron or dog, hammers, ripper, drilling machines, trowels, square and chalk line. Safety precautions in working from ladders and scaffolds and on roofs.

(2) *Materials.* The common types of slates, brief description of the sources of supply and methods of preparation at the quarry; sizes, terms in use. Common types of tiles, brief description of their manufacture, sizes, terms in use. Use of lime and cement mortars in bedding and torching, materials used, proportions, methods of mixing and laying. Types of nails used.

(3) *Slating.* General outline of methods of laying slates; pitches for slates; head- and centre-nailed slating; fixing lap, margin and gauge. Sizes and spacing of battens. Ordinary treatment at eaves, gutters, ridges and verges. Close and open slating. Torching and bedding.

Types of ridge tiles and finishes. Formation of open valleys. Calculation of slates to cover given area. General procedure in laying slates on roofs, on battens only and also over close boarding.

(4) *Tiling*. General methods of laying tiles; pitches for tiles; spacing battens and fixing tiles, treatment at eaves, gutters, ridges and verges; types of ridge tile and finishes at ridges. Formation of open valleys. Calculation of tiles to cover given area. General procedure in laying tiles on roofs, with or without close boarding.

(5) *Preparation for Slating and Tiling*. Construction of roofs for slating and tiling; terms used; preparation in wood at eaves, ridges, gutters, hips and valleys in timber; fixing tilting fillets and battens for slating and tiling; close-boarded roofs; double battens. Use of underfelts and untearable felts.

(6) *Damp-proofing*. Treatment of slating and tiling at junctions with walls and chimneys; use of lead in flashings and soakers, gutters, hips and valleys.

#### 96 SECOND YEAR OR GRADE

(1) *Tools and Tackle*. Introduction to the use of timber and steel scaffolding; special tackle for roof work, including lifts. Safety measures; the Building Regulations.

(2) *Materials*. Sources of supply and the preparation of special types of slates from British quarries; foreign slates; colours and sizes of special slates; "randoms". Stone tiles. Wood shingles. Design and manufacture of special interlocking tiles; concrete tiles; pantiles; asbestos cement roofing materials. References to British Standard Specifications and common tests of slates, tiles and other materials used by the slater and tiler.

(3) *Slating and Tiling*. More advanced details of slating; special finishes at eaves and verges; the laying of swept and laced valleys; vertical slate and tile hanging; use of purpose-made tiles for hips, ridges and valleys. Use of wood shingles. Tracing and repair of faults in slated and tiled roofs.

(4) *Single-layer Tiling*. Introduction to single-layer tiling in pantiles, Roman, double Roman, and interlocking clay and concrete tiles. Methods of laying and fixing; terms used; comparison with plain tiling; treatment at eaves, ridges, verges, hips and valleys; treatment at junctions with walls by lead or other metal sheet, or by cement mortar fillets.

(5) *Other Forms of Roof Coverings*. Asbestos cement slates, tiles and sheeting; corrugated iron sheeting; sizes, methods of laying and fixing, treatment at eaves, ridges, verges and at junctions with side walls and chimney stacks. Use of lead, copper and zinc with the above forms of roofing. Use of bituminous felt as underlays or as roofing. Reed thatching.

(6) *Measurement and Organisation.* The supervision and organisation of roofing work. The Building Byelaws. British Standard Specification and tests relating to roofing materials. Methods of measuring, slating and tiling and other forms of roofing.

### 87. SLATING AND TILING (PRACTICAL WORK)

#### 97. FIRST YEAR OR GRADE

- (1) Sorting, dressing, holing, sizing and stacking slates for practical use.
- (2) Completion of panels of roof slating in centre-nailed and head-nailed slates to given laps and margins. Application of torching.
- (3) Completion of similar panels with splayed ends.
- (4) Completion of roof surface, including eaves, ridge, verge and flashings (either to gable or chimney stack).
- (5) Completion of tiled surfaces as in (2), (3), and (4).
- (6) Completion of panel in open slating and in diminished coursed slating.
- (7) Preparation of roof surface for laying slates and tiles with battens only and also with close boarding, felting and double battens.
- (8) Completion of hips and valleys to a slated roof and also to a tiled roof (with special hip tiles).

#### 98. SECOND YEAR OR GRADE

- (1) Vertically hung surface in slating and in tiling.
- (2) Swept or laced valley in slating.
- (3) Valley in tiling with purpose-made tiles.
- (4) Carrying out repairs to a completed roof in slates and also in tiles.
- (5) Completion of portion of a roof, including ridge or eaves, in some forms of single-layer tiling, which should include pantiles.
- (6) Treatment at hips and valleys to example (5).
- (7) Complete exercise in one of the special forms of roofing mentioned in para. 96 (5).

## COURSE IN MASTIC ASPHALT WORK\*

### 99. GENERAL NOTES

(a) This Course in Mastic Asphalt Work is arranged as a Two Year Course only under the following main divisions :

- I. Technology.
- II. Practical Work.
- III. Associated Subjects :
  - (i) Craft Calculations.
  - (ii) Geometry and Drawing.
  - (iii) Craft Science, and
  - (iv) Building Construction.

(b) The distribution of the Associated Subjects, grade by grade, is explained in paras. 13 and 14. (See also the General Notes on Technology and Practical Work, paras. 19 to 30.)

(c) The treatment of the craft under several subject headings, all closely related, should be explained early in the Course. Emphasis should be laid upon the way in which this method increases the practical value of the knowledge and training acquired during the Course, by ensuring that it is broadly based upon a wide knowledge of craft practices and of the technical and scientific reasons underlying their adoption.

(d) While instruction in the Associated Subjects will be given mainly in the special classes provided for that purpose, it is intended that there should be frequent references to and utilisation of all this related knowledge throughout the Course, in both Technology and Practical Work.

(e) It is assumed that all students entering this Course will have at least an elementary knowledge of the methods of geometrical and free drawing. Their knowledge should then be developed during the Course to the full extent and in the manner required by the Craft. In all the Crafts it should include plane geometry, sketching and free drawing, the projection of related views by geometrical methods, the preparation of detail drawings, full-size and to scale, and the reading of architects plans and working drawings.

(f) Some introductory talks of a general character should be given in the First Year or Grade. These should cover in a simple and interesting manner the work of the craft, its relation to other crafts and to building generally.

(g) To understand the relation of this work to building generally the student of mastic asphalt work should give some time to the study of those items of construction, in brick, concrete, masonry and timber, to which the mastic asphalt is generally applied.

(h) The craft of the bricklayer being at present the one to which this

\*By kind permission of the representatives of the National Joint Council for the Mastic Asphalt Industry, these syllabuses have been based upon a course of instruction recently prepared by them in connection with their National Apprenticeship Scheme.

work is most frequently applied, some of the paragraphs in these syllabuses follow closely the corresponding paragraphs in the Brickwork (Technology) syllabuses.

(i) This method will ensure a sound knowledge of sections of construction with which the work of the mastic asphalter is closely associated. It will also facilitate some measure of joint instruction, which will be particularly desirable where the numbers of mastic asphalters are not sufficient to justify the provision of entirely separate courses of instruction.

### MASTIC ASPHALT WORK (TECHNOLOGY)

#### 100. FIRST YEAR OR GRADE

(1) *Introduction.* The work of the mastic asphalter in the provision of protective and damp-resisting coverings to various parts of buildings, as in damp-proof courses, roofs and floors. Relation to other crafts, particularly to the bricklayer, concreter, mason and carpenter.

(2) *Tools.* The tools and equipment of the mastic asphalter; hand tools, setting-out tools, levels and straight edges, cauldrons, mechanical mixers.

(3) *Materials.* Introduction to the materials of the mastic asphalter. The normal constituents of mastic asphalt (illustrated by samples, photographs and diagrams), rock asphalts, lake asphalts, limestones, sands, and grit. Outline of manufacture of mastic asphalt and its preparation for laying.

(4) *Brick Walls.* Construction of brick walls, up to  $1\frac{1}{2}$  bricks in thickness, including the necessary footings and foundations.

(5) *Damp-proof Courses.* The purpose and placing of horizontal damp-proof courses. The various materials and methods used, including mastic asphalt. The purpose and construction of cavity brick walls.

(6) *Flat Roofs.* Construction of simple flat roofs in timber and concrete, including the construction of brick parapet walls with copings. Laying mastic asphalt to flats, including the formation of falls; precautions to be taken before laying the asphalt. Purpose of the underlay or felt; screeding to given levels and thicknesses; jointing and over-lapping in one- and two-coat work.

(7) *Various Finishes.* Formation of skirtings, fillets and tucks on small vertical surfaces. Treatment at angles. Various forms of keying or reinforcement on vertical or steeply pitched surfaces.

(8) *Floors.* Damp proofing solid concrete ground floors with a continuous layer of mastic asphalt or other bituminous preparation.

#### 101. SECOND YEAR OR GRADE

(1) *Materials.* Further study of the materials of the mastic asphalter. Bitumens and asphaltic bitumens; the "residual" bitumens: fluxing oils; tars and pitches. Practical problems in the manufacture and use of mastic asphalt. Control of temperatures. Outline of the



British Standard Specifications and of the simpler forms of testing; e.g., the penetration test, hardness test, the grading of limestone (after grinding) by sieving, the solubility test. (*Note.* The general experimental treatment of damp-resisting methods in building is dealt with in the subject of Craft Science.)

(2) *Damp-resisting Construction.* Cavity walls, dry areas, ventilation beneath floors, treatment of main walls. Applications of mastic asphalt and other damp-resisting materials.

(3) *Basements.* Methods of damp-proofing deep basements; asphaltic membranes and linings. Treatment of asphalt linings subject to water pressure; "tanking" to basements and stanchion foundations. Outline of methods of timbering, excavations and of underpinning, in relation to the work of the mastic asphalter.

(4) *Flat Roofs.* Treatment of large flat roofs, arrangements of falls by mitres, use of steps, breaks, skirtings and kerbs. Treatment of projections through flat roofs, and of gutters and outlets. Methods of protecting flats from excessive exposure to thermal and light effects and from traffic.

(5) *Damp-resisting Construction.* Treatment of parapet walls, chimneys, and in gutters to pitched roofs.

(6) *Floors.* Laying floors in mastic asphalt; coloured asphalts; laying borders and patterns. Use of pitch mastic for flooring.

(7) *Vertical and Pitched Surfaces.* Treatment of such surfaces in tanks baths and to Mansard roofs; treatment of projections and skirtings to such surfaces.

(8) *Floors.* Granited mastic asphalt for heavy duty floors with percentage addition of granite chippings or grit.

(9) *Road Surfaces.* Granited mastic asphalt for roads with percentage addition of granite chippings; method of laying cambers, crossfall and gradients.

(10) *Measurement of Work.* The standard of measurement of mastic asphalters' work. Introduction to the preparation of quantities and simple costing.

### MASTIC ASPHALT WORK (PRACTICAL WORK)

102. GENERAL NOTES (see also paras. 25 to 30).

(a) This series of practical examples assumes that the brickwork, concrete work, masonry and timber constructions forming the basis of the work will be prepared, at least partially, by students of the other trades.

(b) Where time permits the mastic asphalt student would, however, gain a useful knowledge of the methods of the crafts with which he will be later associated if he is allowed to assist in this preparatory work.

## MASTIC ASPHALT WORK (PRACTICAL WORK)

## 103. FIRST YEAR OR GRADE

- (1) Preparation of the mastic asphalt for laying. Preparation of the surfaces; need for level, clean and dry surfaces. Control of heating temperatures.
- (2) Laying a length of damp-proofing on a  $4\frac{1}{2}$  in. brick wall.
- (3) Laying a length of damp-proofing on a  $13\frac{1}{2}$  in. brick wall.
- (4) Laying a length of damp-proofing on a 9 in. wall, with one or more stepped breaks (not more than two courses in height).
- (5) Laying a stretch of one-coat work on a wood or concrete surface, with or without felt underlay. (*Note.* A sufficient length must be laid to provide practice in producing true plane surfaces.)
- (6) Laying a stretch in two coats with lapped joints.
- (7) Forming mitres to flat roofs.
- (8) Formation of a shallow skirting and angle fillet against a brick wall.
- (9) Formation of skirting 6 in. high against a brick wall, with key tuck at uppermost edge and angle fillet.
- (10) Formation of skirting 6 in. high against a brick wall, with external and internal angles.
- (11) Forming aprons and drip edges.
- (12) Metal reinforcement on wooden slopes, skirtings, etc., with use of expanded metal lathing or wire netting.
- (13) Forming cove skirtings with internal and external mitres and stopped ends.
- (14) Formation of a portion of a flat with rounded edge finishing over lead or copper gutter, including the correct method of fixing and wetting the leadflashing.
- (15) Formation of a portion of a flat, including a shallow gutter in mastic asphalt over a stone cornice or a concrete flat.
- (16) Lining a small rectangular brick tank (to be subjected to water pressure).
- (17) Formation of asphalt membrane in solid ground floor, continuous with D.P.C. in the wall but at different levels.
- (18) Formation of small pitched roof surface, having a projecting feature, to be covered with mastic asphalt. The roof surface should finish against a brick wall requiring a skirting to be formed.

## 104. SECOND YEAR OR GRADE

- (1) Horizontal D.P.C. on concrete in two or three coats.
- (2) Vertical D.P.C. on prepared brickwork in two or three coats (total height not less than 12 in.).
- (3) Vertical D.P.C. continuous with a horizontal D.P.C. and not all in one plane vertically.

- (4) Forming asphalt plates for tanking work.
  - (5) Lining brickwork "tank" (to be subjected to internal water pressure), vertical surfaces not all in one plane.
  - (6) Forming collars to pipes through vertical asphalt tanking.
  - (7) Working into bonding pockets in vertical asphalt.
  - (8) Formation of 12 in. vertical face with keys, tucks and angle fillet.
  - (9) Formation of 12 in. vertical face with internal and external vertical angles.
  - (10) Asphalt cover to cornice or curved surface, such as a small dome or pediment.
  - (11) Treatment of a vertical projection through a flat (*e.g.* cover to top of a stanchion).
  - (12) Treatment of vertical metal pipe rising through an asphalt flat.
  - (13) Treatment of a vertical outlet pipe from a gutter.
  - (14) Formation of a portion of a floor surface in at least two colours of asphalt.
  - (15) Formation of a portion of a floor surface in at least two colours of asphalt, including coved skirting and treatment at an external and an internal angle.
  - (16) Formation of a small flat and gutter behind a parapet wall.
  - (17) Formation of a gutter to a pitched roof behind a parapet wall.
  - (18) Formation of an outlet through a parapet wall, from the gutter to a rainwater head.
  - (19) Forming asphalt into and around Burn outlet.
  - (20) Forming asphalt plates for soffit work and application of plates to soffits.
- 

### III. THE CRAFT COURSES— SYLLABUSES IN THE ASSOCIATED SUBJECTS

#### 105. GENERAL NOTES

(a) As already explained (see paras. 11 to 14) the Associated Subjects constitute an essential and important part of these Courses. They are to occupy a third of the total time available and include the subjects of:

- (i) Craft Calculations,
- (ii) Geometry and Drawing,
- (iii) Craft Science and
- (iv) Building Construction.

(b) The distribution of these subjects over the Courses is explained in paras. 13 and 14 wherein it is also explained that this distribution may differ between the several Crafts according to their varying needs.

(c) It is intended (see para. 23) that, while instruction in the Associated Subjects will be given mainly under the above subject headings, the knowledge so gained shall be utilised in all sections of each Course as opportunity offers. Thus while simple mathematical methods will be dealt with in the Calculations classes, these methods will be utilised in application to each of the other subjects of the Course. Drawing and Science will be dealt with similarly. The purpose of a study of Building Construction will be to build up a general knowledge of all the Crafts in relation to each other and to building work generally. These points are referred to again in connection with each Associated Subject.

## CRAFT CALCULATIONS

### 106 GENERAL NOTES

(a) The First and Second Grades should be taken alike by all the Crafts. Simple problems related to building should therefore be drawn generally from the work of these Crafts.

(b) The First Grade should be taken in the First Year or Grade of the Course. The Second Grade may then be taken either in the Second or in the Third Year or Grade as is found to be most suitable. (See paras. 13, 14 and 19 to 24.)

(c) The treatment of the instruction should be such as to bring out first the practical value of a knowledge of simple calculations to the craftsman. At a later stage it should aim to show how much easier it is to understand and use mathematical processes if the necessary knowledge has been acquired and recorded methodically.

(d) Wherever possible the instruction should involve the measurement, weighing and handling of actual objects, preferably those used in building, and include some simple experimental work to demonstrate the truth of the relations between the dimensions, areas, volumes and weights of the objects chosen.

## CRAFT CALCULATIONS

### 107. FIRST YEAR OR GRADE

(1) *Length and Ratio.* Perimeters of the rectangle, square and circle; constant ratios between the sides and perimeters of squares and the diameters and circumferences of circles. Relations between British and Metric measures of length. Calculations involving fractions and decimals. Percentages; averages.

(2) *Area.* Areas of the rectangle, triangle, square and circle; constant ratios between the sides and areas of squares and the diameters and areas of circles. Finding the squares and square roots of numbers;

applications to actual areas by using tables and by calculations. The use of duodecimals in the calculations of building areas. Relations between British and Metric measures of area.

(3) *Areas and Volumes of Solids.* The surface areas of cubes, prisms and cylinders. The volumes of cubes, prisms and cylinders. The weights of solids proportional to their volumes and the densities of the material. Applications of the above relations in finding the surface areas of roofs, the volumes of rooms and excavations, the capacity of pipes and tanks and the densities and weights of materials. Relations between British and Metric measures of volume and weight.

(4) *Applications of the Right-angled Triangle.* Relations between similar triangles; the right-angled triangle, applications in roof pitches, ground slopes and in height and distance problems; introduction to the trigonometrical ratios; tangent, sine and cosine and their use in practical problems. Relationship between the squares on sides of right-angled triangles; 3, 4, 5 and similar fixed ratios. Applications of the above to building problems.

(5) *Use of Literal Symbols and Simple Algebraic Methods.* Use of literal symbols in any of the foregoing work; development in the form of simple equations; problems in substitution and evaluation.

(6) *Graphs.* Introduction of graphs in connection with the foregoing work, as in the variations of weight, cost, temperature, etc.; also in the ratios between size and areas of squares and circles and in the relations between British and Metric measures.

#### 108. SECOND GRADE

(1) *Mensuration.* Further work on the perimeters and areas of plane figures, including the ellipse. The areas of sectors and segments of circles. Further work on the areas and volumes of solids, including the pyramid and cone; Areas of the developed surfaces of these solids. Application of all these relations in finding lengths, inclinations, areas and volumes in building work. Further use of duodecimals in superficial and cubic building calculations.

(2) *Trigonometry.* Further work on the trigonometrical ratios as applied in practical problems involving lengths, heights, angles and areas, use of trigonometrical tables.

(3) *Formulae, Algebra and Equations.* Further work on the use of literal symbols; transformation and evaluation of the formulae used in the building crafts. Solutions of simple equations. Practical applications of the difference and sum of two squares. Indices; introduction to logarithms and the elementary use of the slide rule; applications in practical problems and in formulae.

(4) *Graphs.* Plotting and using more difficult graphs as applied in problems on costing, trigonometry, etc.; interpretation of experimental results, interpolation.

## CRAFT GEOMETRY

## 109. GENERAL NOTES

(a) The First and Second Grades set out below should be taken by all the Crafts except Painting, Decorating and Plastering, for which separate syllabuses have been provided to be used if desired.

(b) The First Grade should be taken in the First Year or Grade of the Course. The Second Grade may then be taken in the Second or Third Year or Grade as is found to be most convenient.

(c) No separate mention has been made of Geometry and Drawing in the syllabuses for Technology because it has been assumed, first that the students will enter these Courses already in possession of an elementary knowledge of the methods of geometrical drawing and projection; and second that the methods of drawing will not only be properly developed in the Associated Subject of Geometry in relation to the needs of each of the Crafts, but will also be extensively used throughout each Course as the chief method of instruction in the Technology classes. This work should include plane geometrical drawing, sketching and the projection of related views by geometrical methods (see also paras. 22 and 29). Wherever desirable these drawings should conform to the requirements of the British Standards Institution as set out in B.S.1192: 1944, "Architectural and Building Drawing Office Practice."

## CRAFT GEOMETRY

## 110. FIRST GRADE

(1) *Rectilinear Figures.* Construction and use of scales. Construction from given data of triangles, quadrilaterals and polygons. Relations between dimensions and areas of similar figures. Reduction of rectilinear figures to triangles of equal area. Enlargement and reduction of rectilinear figures.

(2) *The Circle.* Problems relating to circles; sectors and segments; lines and circles in contact. Applications in setting-out mouldings and other building details bounded by straight and curved lines; arches and arch joints; simple tracery and pattern analysis.

(3) *Projection of Solids.* The planes of projection; plan, elevation and section; simple problems relating to points, lines and planes. Projections of simple solids, including the cube, prism and cylinder. Sections of these solids and the development of their surfaces. Change of ground line. Applications in internal decoration, roof work, leadwork, intersections between plane surfaces and between straight mouldings, weathered copings, cills, etc.

(4) *Pictorial Projection.* The use of isometric and oblique projection in the representation of building craft details and as a basis for sketching. The sketching, in isometric or oblique, of tools and of mouldings and other decorative detail.

## 111. SECOND GRADE

- (1) *Plane Geometry*. More advanced examples of the application of plane geometry to building problems; enlargement and reduction of mouldings; construction of ellipse with tangents and normals; approximate ellipse; applications in arches. Three-centred arches. Construction of the parabola. More difficult examples in tracery. Construction of scrolls and application in handrails and balustrades.
- (2) *Solid Geometry*. Problems on the intersection of lines, planes and curved surfaces; intersection and development of straight and curved surfaces as in the intersection of roofs, turrets, domes, dormers, chimney, buttresses and retaining walls. Intersection of raking moulds over oblique and curved plans.
- (3) *Pictorial Projection*. More advanced problems in oblique and isometric projection, including the representation of solids with curved surfaces. Introduction to axonometric projection and simple perspective problems.
- (4) *\*Problems in Arches and Vaults*. Bevels and joint lines in stone and brick arches; segmental, elliptical and approximate ellipse. Joints and development in simple vaulting, domes and niches. Developments of centering for curved surfaces and vaulting in brick, stone, plaster and concrete.
- (5) *\*Problems in Roofwork*. Lengths and bevels of roof members; use of steel square and other methods; dihedral angles in all types of roofs. Development of curved roof surfaces and production of bevels and templets.
- (6) *\*Door and Window Openings*. Developments, bevels and moulds required for door and window jambs with splayed linings and soffits; intersections to mouldings in brick, stone, wood, plastic or metal finishings around door and window openings.
- (7) *\*Stairs and Stair Building*. Geometrical problems in the projection of complete stairs in wood or stone. Construction of scrolls and their application in stone or wood stairs. Development of strings to geometrical stairs. Setting out winders to stairs in stone or wood.

## CRAFT GEOMETRY AND DRAWING

## PAINTERS AND DECORATORS AND PLASTERERS

## 112. GENERAL NOTES

(a) Since these crafts require a broader approach to the methods of free drawing, as well as of geometry, the more comprehensive title of Craft Geometry and Drawing has been adopted.

(b) The General Notes 109 (b) and (c) apply in this case with equal force in respect of all geometrical drawing and to all working drawings.

\*These paragraphs offer alternative work for the several crafts

(c) The use of free drawing, the use of colour in the case of Painters and Decorators and of modelling in the case of Plasterers, are important extensions of the work. Alternative sections have been included in each Grade to meet the different needs of the two crafts.

## GEOMETRY AND DRAWING

### PAINTERS AND DECORATORS AND PLASTERERS

#### 113. FIRST GRADE

- (1) *Rectilinear Figures*. Construction and use of scales. Construction from given data of triangles, quadrilaterals and polygons. Application to simple geometrical patterns, Greek frets and squares; simple colour fillings. Relations between dimensions and areas of similar figures. Enlargement and reduction of rectilinear figures.
- (2) *The Circle*. Problems relating to circles; sectors and segments; lines and circles in contact. Analysis and construction of curved decorative patterns, guilloche, ogee, etc.; setting-out architectural mouldings and tracery.
- (3) *Projection of Solids*. The planes of projection; plan, elevation and section; simple problems relating to points, lines and planes. Projections of the simple solids, cubes, prisms, etc. Applications of the above in setting-out interiors of rooms and simple architectural detail.
- (4) *Pictorial Projection*. The use of isometric and oblique projection in the representation of craft details and as a basis for sketching.
- (5) *Free Drawing*. Drawing of plant and other natural forms from observation and from memory; their value as units in decorative patterns and design.  
Drawing of simple solid forms, such as the appliances used by painters, from observation and memory, including groups of larger objects common to buildings and to building craft work.  
Use of tints and washes in patterns and to emphasise silhouette, etc.
- (6) *\*Decorative Work*. Examples of simple patterns and decorative motifs in colour and relief; their application in contemporary problems.  
Pattern making, using a variety of simple practical methods, including stencil work.  
Elementary principles of colour theory, their practical application; simple exercises in tone and hue values.  
The art of Heraldry; history and contemporary examples; the principle terms, tinctures, metals, symbols, etc.; simple exercises in line and colour.
- (7) *\*Free Drawing and Modelling for Plasterers*. Free sketching of simple tools and equipment used by plasterers; simple measured sketch-drawings of these and of simple plaster work examples.  
Free drawing of general architectural and ornamental detail, in light and shade, by simple methods. Free modelling of similar detail for proportion, relief, etc.

\*These are alternative sections to serve the needs of the two crafts.



Preparing working drawings from such sketches or from others supplied. Setting out in clay, from such drawings, simple ornamental forms and patterns.

#### 114. SECOND GRADE

(1) *Plane Geometry*. More advanced examples of the application of plane geometry in decorative work; enlargement and reduction of surfaces and outlines. Construction of the ellipse, with tangents and normals; the approximate ellipse and the three-centred arch. More difficult examples in setting out tracery and patterns.

(2) *Pictorial Projection*. More advanced problems in oblique and isometric projection, including the representation of solids with curved surfaces. Introduction to axonometric projection and perspective in setting-out both internal and external decorative details.

(3) *Free Drawing*. Further study in line and colour from plant forms and also of bird and animal forms; their value and use in pattern and colour. Study of the forms used in heraldry and in architectural details. Lettering, writing and illumination; layouts and application of script and ornament.

(4) *\*Decorative Work*. Principles of interior decoration, including the preparation of colour schemes in relation to fabrics, furniture and accessories. Orders of classic architecture and the later periods; their principal and characteristic details. Decorative use of heraldry; the symbolism and representation of heraldic devices, colours, furs, textures, patterns and charges; the helm, wreath, crest, mantling and motto.

(5) *\*Free Drawing and Modelling for Plasterers*. Drawing from ornamental examples and analysis of pattern design; modelling in clay from casts of ornament in the round or in relief; also in plaster, gesso, etc., for external or internal use.

Setting-out and drafting plaster work; general architectural background with sketched details of modelled mural decoration.

Modelling and casting of simple examples of the above work.

Modelling for fibrous plaster work; casting repeats and application to decorative design.

Modelling details from the figure, hand, foot, etc.; application to the architectural problem.

## BUILDING CRAFT SCIENCE

#### 115. GENERAL NOTES

(a) Buildings of all types are expected to conform to certain standards, both in their construction and in the way they serve the purposes for which they are erected. Present day practical standards have been developed over many years on the basis of actual experience and have been embodied in specifications, in local building byelaws and in the practices of the industry.

\*These are alternative sections to serve the needs of the two craft

(b) In more recent years scientific investigation has enabled us to classify many of these standards or requirements in a manner which helps us to appreciate more readily the nature of the practical problems which are to be solved. Thus a recent Government publication states that "the basic technical considerations which affect the consumption of labour and materials in house construction are:

- (i) Strength and stability
- (ii) Moisture penetration and condensation
- (iii) Thermal insulation
- (iv) Sound insulation
- (v) Fire hazards
- (vi) Maintenance and durability
- (vii) Vermin infestation."

(c) The satisfactory solution of all the practical problems which may arise calls for a great range of knowledge and skill on the part of the architect, the builder and the scientist. The craftsman also has a part to play and if he is to do this intelligently he must have some idea of the reasons which underlie the methods adopted in dealing with building materials, new or old, both when used separately and when used in combination with each other. Fortunately many of the scientific ideas which are involved can be illustrated and explained in a simple manner by means of practical tests, some of which can be carried out in the workshop or on the building, while others call for some laboratory equipment. The following courses of instruction in Craft Science are intended to introduce these elementary scientific ideas in an interesting manner and to provide opportunities for carrying out some of the tests and experiments. An elaborate treatment of the experimental work is not intended.

(d) The laboratory accommodation and equipment called for need not be on an elaborate scale. It should, however, be such as will enable the students to take some part in carrying out the demonstrations and experiments, including the necessary measurements, weighings and calculations. The explanations given of the uses of the various building materials and methods of construction should be closely related to the instruction which is being given at the same time in Technology and Practical Work.

(e) By these methods interest will be aroused and the students should come to appreciate that the use of tests or experiments to check the claims which may be made for various materials or methods of construction is a method of great practical importance. Tests called for by standard specifications will usually be too advanced to carry out in these courses, but the students should be led to appreciate their importance and value.

## BUILDING CRAFT SCIENCE

### 116. FIRST GRADE (ALL CRAFTS)

*Note.* The First Grade of the Course is intended to be taken by all the crafts alike, since it deals with certain simple but fundamental

ideas about building which should be known to all skilled workers in the industry.

(1) *Protecting Buildings from Rain.* Explanations, with experimental demonstrations, of the methods used to prevent rain entering buildings; the overlap of slates and tiles and the slopes of roofs; the functions of overhanging eaves, cornices, weatherings, copings, cills, drips and throatings. Covering flat roofs with metal sheets; forms of joints to exclude water. Functions of flashings where roofs butt against walls and copings; treatment of bituminous covered roofs at these junctions. Capillary effects between surfaces close together; use of the capillary groove, penetration of water through cracks.

(2) *Control of Absorbed Moisture in Buildings.* Experiments to show that many building materials are porous and will absorb moisture. Comparison, by immersion and weighing, of the varying powers of absorption of different building materials, such as brick, stone, concrete, mortar, tiles, slates and timber. Effect on absorption of the painting of brick, stone and timber surfaces; control of "suction" effects in carrying out brickwork, plastering and distempering. The capillary effect in porous walls; the uses of damp-proof courses and layers at the base and tops of walls and in solid floors resting on the ground. The protection afforded by cavity walls.

(3) *Atmospheric Moisture. Rusting and Decay.* Simple demonstration of the presence of moisture in the air. Variations in humidity; condensation on cold wall surfaces; drying hindered by a moist atmosphere; value of a current of dry air, *e.g.*, in keeping a timber floor dry; simple explanation of the seasoning of timber. Variations in the moisture absorbed by seasoned timber with changes in humidity; effects upon its shape and size. Protection of timber against decay, (a) by proper ventilation; (b) by painting; why timber must be dry before painting. Demonstration of the corrosion of iron in moist air; the prevention of corrosion by painting; reasons for removing rust scale before painting.

(4) *Mixing Mortars and Concretes.* Sand: measuring the volume of voids in sand by inundation; simple tests for cleanliness; demonstration, by sieving, of the varying sizes of sand grains. Demonstration of the reduction in total volume when sand and lime (or cement) are mixed to make mortars or plasters, and when sand, cement and aggregate are mixed to make concrete. Elementary examination, for workability and use, of mortars and concretes made with varying amounts of sand and mixing water; also of varying amounts of "fines" in concrete. Use of the slump test to indicate workability; simple tests of these sample concretes, when matured, for porosity and (if strength-testing equipment is available) for strength.

(5) *Limes, Plasters and Cements.* Demonstration of the production of lime from limestone by heating (the "burning" of limestone; explain that a gas is driven off). The "slaking" of lime with water; the expansion of lime on slaking, the power of unslaked lime to fracture bricks and plaster when accidentally embedded in them. Elementary

explanation and comparison of the setting of limes and Portland cement. Demonstration of the production of plaster of Paris by heating powdered gypsum ("boiling" the gypsum; explain that only water is driven off). The setting of plaster of Paris when water is added; the expansive effect on setting; purposes of the addition of sand. Simple explanation of "efflorescence" on brickwork (*e.g.*, by the solution and recrystallisation of a suitable salt); experimental demonstrations of efflorescence on brickwork. Efflorescence indicates presence of absorbed moisture, methods of tracing defects where this moisture is excessive.

(6) *Effects and Control of Heat in Buildings.* Expansion and contraction of various metals with changes in temperature; precautions adopted in laying lead and zinc on roofs. Simple explanations of heat effects on air and water; convection movements in flues, rooms and boilers. Boiling points and melting points of liquids commonly used in building processes; precautions to be adopted with inflammable liquids. The expansion of water on freezing; frost bursts in water pipes; methods of prevention. Demonstrations of the effects of repeated freezings on brick, stone and concrete specimens. Simple demonstrations of the insulating values of some building materials, also of the special insulating materials; their use in wall, ceiling and floor construction in protecting pipes carrying hot or very cold water and to prevent freezing.

(7) *Mechanics of Lifting Tackle, Scaffolding, etc.* Demonstrations of the mechanical advantages in the use of levers, crowbars, bench vices and cramps and screw blocks. Centres of gravity; simple demonstrations of the stability of walls and scaffolding under vertical loads and side pressures, *e.g.*, wind pressure. Finding the supporting forces to scaffold planking and beams; how to avoid excessive deflection in scaffold planks, effect of varying span and thickness. Demonstration of the rigidity of the triangular frame; applications in scaffolding and simple roofs; use of steel scaffolding and patent fixings.

## BUILDING CRAFT SCIENCE—BRICKWORK, MASONRY AND PLASTERING

### 117. SECOND GRADE

*Note.*—At this stage the needs of each particular craft will have become clearer and it should be possible to carry out experimental work with greater accuracy and thoroughness. The general aim should be to help the student to understand some of the more advanced applications of science which are to be found in his craft.

(1) *Control of Moisture in Brickwork.* Further work on the absorption of moisture by brick, stone, concrete and wood. Control of "suction" in mortared joints and plastered walls, possible effects of excessive "suction" on mortars and plasters. Provision of ventilation to wood floors. Impervious materials; functions of damp-proof courses and of water-proof layers in walls, floors and basements. Efflorescence on brickwork; prevention or removal of defects. Demonstration of

upward pressure in water-logged foundations; seasonal variation in sub-soil water, effect on stability of shallow foundations.

(2) *Mixing Mortars, Plasters and Concretes.* Voids in granular materials; effect of grading on density; effect of compacting concretes by vibration; characteristics of "no fines" concretes. Simple tests of porosity and strength of matured concretes to show effects of grading, compacting and omission of "fines." Defects of excessively rich mortars in brickwork (*e.g.*, producing cracks in long walls); defects of rich mixes in internal and external plastered wall surfaces (*e.g.*, producing cracks and crazing).

(3) *Limes, Cements and Plasters.* Lime; calcination of limestones; hydration or slaking of limes; setting of limes, including hydraulic and pure limes; use of limes in mortars and plasters. Portland cement; outline of manufacture; conditions for setting; effect of frost during setting; practical precautions with concretes made with quick-setting cements.

*Gypsum products*; outline of manufacture; comparison of types of gypsum plasters and cements; conditions for use.

(4) *Protection from Corrosion.* The protection of iron and steel from corrosion when used in conjunction with brickwork and concrete. Waterproofing concretes. Protection of iron and steel in magnesite floors.

(5) *Fire Resistance.* Fire resisting values of brickwork, concretes and plasters; fire effects on brick and stone structures; fire protection of iron and steel.

(6) *Sound Insulation.* Sound resisting values of solid walls in brick and concrete; hollow walls; suspended ceilings and isolated foundations. Characteristics of acoustic plasters and similar wall and ceiling linings.

(7) *Lifting Tackle.* The mechanical advantages and efficiencies of lifting tackle, including the crab winch. Use of the screw jack and hydraulic jack.

(8) *Beams in relation to Brickwork.* The reaction of beams under vertical loading. Simple explanation of the relations between the external and internal forces in a loaded beam with reference to beams of timber, steel and reinforced concrete; the function of steel in reinforced concrete and in reinforced brickwork.

(9) *The Stability of Brick Structures.* The composition and resolution of forces. Elementary treatment of the stability of walls, piers and buttresses, subject to vertical and inclined loads. Safe compressive stresses for brickwork, masonry and concrete. Normal foundation pressures. Introduction to the problems of ensuring the stability of scaffolding and jib cranes and of buildings temporarily secured by raking and dead shores; precautions necessary in shoring and underpinning operations.

## BUILDING CRAFT SCIENCE CARPENTRY AND JOINERY

### 118. SECOND GRADE

*Note.* At this stage the needs of each particular craft will have become clearer and it should be possible to carry out experimental work with greater accuracy and thoroughness. The general aim should be to help the student to understand some of the more advanced applications of science which are to be found in his craft.

(1) *Timber.* Outline of growth, structure and conversion of timber; examination of hand specimens and micro-sections. The preservation of timber; protection by absorbed toxic liquids; protection by painting. Principles of manufacture of all types of plywood.

(2) *Timber and Moisture.* Experimental determination of moisture contents, variations with alterations in atmospheric humidity; effect of moisture contents on shape, size and strength. Principles and methods used in natural and kiln seasoning. Control of humidity during fixing of timber in buildings; precautions in centrally heated buildings.

(3) *Timber in Heat Insulation.* High heat insulating value of timber; methods of use in timber constructed buildings and as wall linings; use in cooling and refrigerating plant and in association with other insulating materials.

(4) *Timber in Sound Insulation.* Value of massiveness and discontinuity in sound insulating construction; use of deadening in floors, and of suspended or isolated ceilings; isolation of timber framings from main structure; principle of the "floating" floor. Resonant value of timber in platforms and stage surrounds.

(5) *Strength of Timber.* Stress, strain and elasticity; breaking stresses; factor of safety and working stresses of principal timbers. Simple consideration of strength of long compression members. Safe bearing stresses for brickwork, masonry and concrete; normal foundation pressures. Safe tensile stresses of iron and steel fastenings.

(6) *Timber Beams.* Reactions of beams under vertical loading. Elementary discussion of the tensile, compressive and shear stresses produced by bending. The use of bending moment diagrams. Calculations of bending moments for concentrated loads on cantilevers and simply supported beams. Simple explanation of the relation between bending moment applied to the beam and stresses within the beam, as shown by the formula  $B = \frac{fbd^2}{6}$ . Calculation of

sizes of rectangular timber beams in cases of simple loading. Control of deflection in timber floors.

(7) *Strength of Framed Timber Structures.* Reactions at the supports of frames vertically loaded. The experimental and graphical determination of forces acting in jib cranes and in roof trusses. The mechanical principles involved in the construction of simple framed

timber structures; stresses due to methods of tightening-up; cambering. Strength of timber joints; approximate values for strength of nailed, screwed, glued, and bolted joints (with or without connectors); the various glues and the synthetic resin adhesives, modern uses in timber construction.

(8) *Strength and Stability of Temporary Timber Structures.* Strength and stability of scaffolding—vertical, cantilevered and suspended. Support and strength of timber centres and formwork; changes of stress during placing of parts of structure or of placing of concrete. Simple treatment of mechanics of dead and raking shores and of underpinning.

## BUILDING CRAFT SCIENCE—PLUMBING

### 19. SECOND GRADE

*Note.* At this stage the needs of each particular craft will have become clearer and it should be possible to carry out experimental work with greater accuracy and thoroughness. The general aim should be to help the student to understand some of the more advanced applications of science which are to be found in his craft.

(1) *Plumbing Materials.* Characteristics of the chief plumbing materials, including lead, copper, iron, tin, zinc. Explanation of the processes of hardening, tempering and annealing. Elasticity of metals; flow of metals under stress, as in lead bossing. Soldering and welding; the function of fluxes. Alloys; the properties of plumber's and other solders; examination of solders by means of cooling curves; the range of workability for plumber's solder.

(2) *Pressure in and flow of Water.* Water pressure; increase with depth; flotation; methods of measuring water pressure. Atmospheric pressure; vacuum; cause of collapse of cylinders. Action of the syphon. Flow of water through pipes; effect of friction and bends on flow; air locks; quantity discharged, using good approximate formulae; discharge through vertical and horizontal orifices, using good approximate formulae. Principles of action of ordinary pumps and of hydraulic rams. Causes of noise in water pipes.

(3) *Circulation of Heated Air and Water.* The measurement of temperature; variations in density of water and air with temperature; convection currents in water and air; circulation of heated air in rooms and flues, and of water in boilers, hot water and heating systems. Latent heat of steam; relations between temperature and pressure.

(4) *Principles of Heating and Ventilating.* The measurement of heat; British Thermal Unit; Calorie; Therm; simple mixture experiments. Specific heats of plumbing materials. Transfer of heat by conduction, convection and radiation. Heat emissions from pipes and simple radiators. Total heat requirements of a room; loss of heat through walls, floors and partitions constructed with various materials; loss through changes of air. Use of insulating materials.

(5) *Combustion and Corrosion.* Composition of water; hydrogen.

Combustion; oxidation and burning; the production of carbon dioxide and water; the Bunsen burner. Elementary treatment of gases used for illumination, heating and welding. The action of acids and gases on metals and alloys; factors affecting corrosion; comparison of resistance to corrosion of various metals used in plumbing.

(6) *Water Supply*. Hard and soft waters; temporary and permanent hardness; effect on pipes and boilers; simple tests for hardness. Impurities in supply waters; gases and solids in solution; plumbosolvency. Principles of water treatment; filtration, softening, chlorination.

## BUILDING CRAFT SCIENCE PAINTING AND DECORATING

### 120. SECOND GRADE

*Note*. At this stage the needs of each particular craft will have become clearer and it should be possible to carry out experimental work with greater accuracy and thoroughness. The general aim should be to help the student to understand some of the more advanced applications of science which are to be found in his craft.

(1) *Paint Materials*. Densities and specific gravities of paint materials, use of hydrometers with liquids. The composition, grinding and mixing of paint. Simple tests for flow, drying, thickness of film and opacity.

(2) *Paint Protection from Moisture Absorption*. Moisture absorption in buildings by wood, brick, stone, plaster, etc.; effect and value of protective paint films; immersion tests; painting on absorptive surfaces, methods to induce uniform "suction." Defects arising from enclosed moisture; blistering. Abrasives; wet and dry rubbing-down. General hygienic precautions.

(3) *Elementary Chemistry of Paints*. Elementary principles of chemistry in relation to painting; composition of air; composition of water; atoms and molecules. Elements, mixtures and compounds; use of simple formulae in chemical reactions. Oxidation in air and moisture; rusting; corrosion; rotting; burning; protection by paint films. Simple acids and alkalis; reactions between surfaces and the paints applied to them. Use of paints on metals and of the metallic paints.

(4) *Pigments, Solvents and Drying Media*. General classification and experimental preparation of the common pigments. Elementary study of solvents and drying oils. Comparison of the drying of paints and varnishes. Nature and use of cellulose paints.

(5) *Paint and Heat*. Temperature and heat. Expansion due to heat. Effect of heat on painted surfaces, pigments, oils and grounds. Fire-resisting paints. Boiling and melting points; evaporation; precautions with volatile materials; condensation; humidity; hygroscopic materials and their treatment.

(6) *Paint and Light*. Reflection and refraction of light. The sources and nature of colour. Demonstration of the spectrum. Comparison



of the effects on colour of natural, artificial and coloured light ; fluorescent lighting. Comparison of chromatic and pigmental mixing of colours. Effect on paints of exposure to light.

(7) *The Stability of Scaffolding.* Factors affecting the stability and safe use of scaffolding, including suspended scaffolding and travelling cradles. Mechanical and physical principles involved in the use of mechanical apparatus such as blow lamps and spraying equipment.

## BUILDING CONSTRUCTION

### 121. GENERAL NOTES

(a) This subject should be taken by all the crafts, either in the Third or Fourth Grade, or spread over both these Grades, as is found to be most convenient.

(b) While at this stage in the Course each student will have a fair knowledge of his own craft, he will not yet have had an opportunity of considering fully the work of his craft in relation to other crafts and to complete buildings. This study of Construction is therefore intended to provide such an opportunity.

(c) Following a simple introductory survey of the principal building methods now in use, the paragraphs are so arranged as to draw attention to the major parts into which all buildings may be divided and to the main functions of these parts. This knowledge should be developed in the first place in relation to the normal methods of constructing dwelling houses. Eventually it should form a basis of comparison in studying the other methods now coming into use. The treatment should not, however, be developed beyond the capacity and knowledge of the students at this stage.

(d) References to materials and processes should be developed during the Course in relation to the work dealt with in each paragraph. These references should be illustrated by the use of samples, photographs, charts, pamphlets, films (strip and moving), demonstrations and visits.

(e) The instruction should involve the use of scale drawing, sketching and note-taking from the start, but the over-elaboration of detail should be avoided. Students should be guided in their use of text books and other sources of information.

(1) *Introduction to Building.* Simple survey of the principal methods now in use for constructing dwelling houses. Differences between solid and framed construction ; load-bearing and panel-filling walls. Brief outline of the principal structural materials and their methods of use ; brick, stone, timber, concrete and steel. Outline of the services required in dwelling houses ; water, heat, light and drainage.

(2) *Site Preparation and Foundations.* The removal of vegetable soil and the provision of surface concrete. Depth of foundations ; the bearing powers of sub-soils ; the distribution of vertical loads on isolated and continuous foundations. Timbering to shallow trenches ;

the laying of concrete foundations and the construction of brick footings. Setting out walls and foundation trenches for small buildings.

(3) *Walls.* Construction of brick walls in English, Flemish and Garden wall bonds, up to one and a half bricks in thickness; straight walls and square angles. Bonding at quoins. Cavity walls. Boundary walls in brick and masonry. Copings and other forms of weather protection courses. Damp-proof courses; their position in walls.

(4) *Floors and Stairs.* Timber ground floors, sleeper walls, ventilation. Solid ground floors in concrete. First floors, including the necessary trimmings at hearths and openings; strutting and sound insulation. Surface finishes to floors in wood boarding and wood block. Asphalt and composition floor surfaces. Straight-flight stairs in wood, stone and pre-cast concrete.

(5) *Roofs.* Pitched roofs up to 25 ft. span without trusses or hips. Ridges, eaves, chimneys and verges; trimmings to openings. Slating and plain tiling. Construction of flat and low-pitched roofs in timber. Roof finishes in lead and copper; bitumen sheeting and asphalt. Leadwork in flashings, gutters and cesspools. Eaves, gutters and down pipes in cast iron and asbestos cement.

(6) *Partition Walls. Plastering.* Partitions in brick, terra cotta or concrete blocks and in plaster or sheeting on stud partitions. Timber framing in partitions. Lime plastering to walls and ceilings. Finishes to walls at angles, openings, simple cornices and skirtings. Dis-tempering and paper-hanging. Rendering to external walls.

(7) *Fireplaces.* Construction of flues and fireplace openings in brick for a two-storey house; treatment of hearths to ground floor and first floor; finishes to chimney stacks and around chimney pots.

(8) *Openings in External Walls.* The bonding of jambs to openings in brick walls; cills and heads in stone; lintels in wood and reinforced concrete. The construction of flat, segmental and semi-circular arches of small span in brick and stone; construction and use of timber centres.

(9) *Doors and Windows.* Simple door linings and frames; including grounds and architraves. Sizes and proportions of internal and external doors, including four-panelled doors; construction of flush doors. Solid window frames with casements opening outwards. Metal windows. Glazing. Door and window furniture. The painting of interior and exterior woodwork and ironwork.

*Publications of the*  
**MINISTRY OF EDUCATION**

---

**GENERAL**

A GUIDE TO THE EDUCATIONAL SYSTEM OF ENGLAND AND WALES.  
(Pamphlet No. 2.) 1945. 1s. (1s. 1d.).

THE EDUCATION ACT, 1944. 2s. (2s. 2d.).

**PRIMARY AND SECONDARY EDUCATION**

THE NATION'S SCHOOLS: THEIR PLAN AND PURPOSE. (Pamphlet  
No. 1.) 1945. 6d. (7d.).

PRIMARY AND SECONDARY SCHOOLS (GRANT CONDITIONS) REGULA-  
TIONS. (S.R. & O. 1945, No. 636.) May 1945. 5d. (6d.).

CIRCULAR No. 30. March 1945. Deals with the Regulations, and in  
particular with the qualifications of teachers in maintained  
schools. 1d. (2d.).

CIRCULAR No. 32. March 1945. Deals with new conditions for  
Direct Grant recognition of certain grammar schools. 1d. (2d.).

BUILDING REGULATIONS FOR PRIMARY AND SECONDARY SCHOOLS.  
(S.R. & O. 1945, No. 345.) March 1945. 6d. (7d.).

MEMORANDUM ON THE BUILDING REGULATIONS. April 1945. 6d. (7d.).

CIRCULAR No. 10. November 1944. Deals with the Building  
Regulations. 1d. (2d.).

REPORT OF THE NORWOOD COMMITTEE ON THE CURRICULUM AND  
EXAMINATIONS IN SECONDARY SCHOOLS. 1943. 1s. 6d. (1s. 8d.).

REPORT OF THE FLEMING COMMITTEE ON THE PUBLIC SCHOOLS AND  
THE GENERAL EDUCATIONAL SYSTEM. 1944. 1s. 6d. (1s. 8d.).

STANDARD CONSTRUCTION FOR SCHOOLS. Post-war Building Studies  
No. 2. (Ministry of Works.) 1944. 6d. (7d.).

REPORT OF THE LOVEDAY COMMITTEE ON THE PROVISION IN SECONDARY  
SCHOOLS OF COURSES PREPARATORY TO AGRICULTURAL EMPLOY-  
MENT. (Issued jointly with the Ministry of Agriculture and  
Fisheries.) 1945. 3d. (4d.).

**MEDICAL SERVICES, SCHOOL MEALS AND MILK**

HANDICAPPED PUPILS AND SCHOOL HEALTH SERVICES REGULATIONS. 1  
August 1945. 4d. (5d.).

CIRCULAR No. 41. April 1945. Deals with the Regulations. 2d. (3d.).

PROVISION OF MILK AND MEALS REGULATIONS. (S.R. & O. 1945,  
No. 698.) June 1945. 1d. (2d.).

CIRCULAR No. 34. March 1945. Deals with the Regulations. 1d. (2d.).

## TRAINING OF TEACHERS

REPORT OF THE MCNAIR COMMITTEE ON THE TRAINING AND RECRUITMENT OF TEACHERS AND YOUTH LEADERS. 1944. 2s. (2s. 3d.).

CIRCULAR No. 18, December 1944, 1d. (2d.). This and BOARD OF EDUCATION CIRCULAR No. 1652, May 1944 2d. (3d.) deal with the scheme for providing intensive "emergency" courses for men and women demobilised from the Forces or released from civilian national service.

TEACHERS' EMERGENCY TRAINING (STUDENTS' GRANTS) PROVISIONAL REGULATIONS, 1945. 1d. (2d.).

TEACHING AS A CAREER. For men and women released from H.M. Forces and other forms of National Service. 1945. 3d. (4d.).

## FURTHER EDUCATION

FURTHER EDUCATION GRANT REGULATIONS, 1945. (Draft) 2d. (3d.).

REPORT ON COMMUNITY CENTRES. 1944. 9d. (10d.).

YOUTH'S OPPORTUNITY: FURTHER EDUCATION IN COUNTY COLLEGES. (Pamphlet No. 3.) 1945. 1s. (1s. 2d.).

## YOUTH SERVICE

THE YOUTH SERVICE AFTER THE WAR. Report of the Youth Advisory Council. 1943. 6d. (7d.).

THE PURPOSE AND CONTENT OF THE YOUTH SERVICE. Report of the Youth Advisory Council. 1945. 4d. (5d.).

POST-WAR YOUTH SERVICE IN WALES. Report of the Welsh Youth Committee. 1945. 4d. (5d.).

YOUTH REGISTRATION IN 1942. (Cmd. 6446.) 1943. 6d. (8d.).

YOUTH IN A CITY. Educational Pamphlet No. 117. 1943. 2d. (3d.).

SIMPLE HEALTH HINTS. Notes for the use of Youth Group Leaders. Revised October 1943. 3d. (4d.).

## SCHOLARSHIPS AND AWARDS

REGULATIONS FOR SCHOLARSHIPS AND OTHER BENEFITS. S.R. & O. 1945, No. 666.) May 1945. 1d. (2d.).

CIRCULAR No. 26. March 1945. Deals with the Regulations. 1d. (2d.).

FURTHER EDUCATION AND TRAINING PROVISIONAL GRANT REGULATIONS, 1945. 1d. (2d.).

*Prices in brackets include postage.*

Obtainable from  
HIS MAJESTY'S STATIONERY OFFICE  
at the addresses on outside back cover  
or through any bookseller.

*Crown Copyright Reserved*

To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:  
York House, Kingsway, London, W.C.2; 13a Castle Street, Edinburgh 2,  
39-41 King Street, Manchester 2; 1 St. Andrew's Crescent, Cardiff;  
80 Chichester Street, Belfast;  
or through any bookseller