Technical Drawing – Alive or Dead?

The case for technical graphics

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I have set out to take a very critical look at Technical Drawing in schools, and agreement or disagreement with my views is not so important as that they should generate discussions and debate. There is no doubt that the subject has stagnated for several decades, and little doubt that many teachers are unhappy (to put it mildly) with the present state of it. I have developed a particular point of view over a period of years, spent as an engineering craftsman and a teacher of the subject at all levels, and this view is the basis for this article. I would ask readers to remember that these are not necessarily the views of either my headmaster or my colleagues in the school's Design Department.

My first doubts about the suitability of Technical Drawing in schools arose because I found it almost impossible to get my pupils to appreciate the subject as I saw it – the engineer's medium of communicating ideas and information. They were correct to resist the idea, I now feel. Industry had drawn the techniques together and developed them for a clearly defined purpose as an integral part of the production process. The way I saw the subject had developed because this was how I had experienced it and used it, which was to perform its proper function. In schools, above the relatively elementary level (workshop drawings) the pupil's drawings patently fail to communicate anything real to anyone involved in production. This led me to examine the structure of the subject. I found that it made little sense, and could hardly be described as a number of interrelated parts constituting an integrated whole!

As it is at present constituted it (typically) contains several relatively distinct areas. They are *Plane Geometry* which involves the construction of a variety of plane geometric figures, almost invariably *not* accompanied by their logical proofs, and which are supposed to complement the other areas. In the worst instances these constructions are treated in isolation from both each other and the other areas, and too often treated as examination 'primers'.

Solid Geometry is *presumably* intended to develop the pupil's awareness of the logic of spatial relationships, but usually ends up serving the cause of practice of orthographic projection. That is to say, the logical progression from plane geometric construction through projection of points, lines and planes to projection of solids tends not to be specifically taught, rather the individual becomes aware of the relationships incidentally if at all! This is certainly true at the lower levels of the subject.

Pictorial Drawing is concerned with the pictorial presentation of various geometric and engineering objects. I doubt that many teachers have made theeffortto study the proper bases for obtaining such views. For example, the vast majority of teachers treat isometric views as always having to be drawn using the two lines at 30° to the horizontal, whereas it should be taught on the basis of three 120° axes. How many teachers fully understand the derivation of trimetric *and* dimetric techniques?

Engineering Drawing is directed towards the conventional representation of engineering objects, and there is a somewhat sloppy attempt to bias this towards engineering proper. This is done by introducing a number of largely isolated engineering facts, one or two apparently arbitrarily selected engineering concepts and a small number of graphical techniques of treating engineering problems. Below 'O' level/CSE level the engineering content is almost wholly confined to *machine* drawing. If one analyses the subject in an attempt to identify educational objectives, they *could* be

1. to help the individual develop skill and understanding in graphical techniques of communication;
2. to help the individual to develop an understanding of the logic of spatial relationships;
3. to help the individual develop an understanding and skill in main aspects of engineering.

But from where I view the subject it cannot possibly achieve these educational aims to any proper degree. The logic of spatial relationships is sacrificed to the expediency of learning an appreciable number of irrelevant geometric constructions. Graphical communication skills cannot be properly developed to a real degree of fluency using such a restricted and restrictive set of techniques. Lastly, the pressure from the other areas of the subject for time, plus the fact that drawing is neither an efficient nor particularly suitable medium through which to teach engineering ensures that little engineering is taught.

In the Schools

The accurate drawing of various objects is clearly necessary in order to develop a degree of expertise, but how much is necessary? I believe that there is unnecessary repetition of work. How many sections of objects need to be drawn to establish the correct approach? Why do many teachers insist upon using two different methods of sectioning where one is quite adequate? Why do teachers insist upon pupils redrawing an object several times in order to carry out various operations on it. Would it not be more sensible to draw it once and carry out the operations on it? I am aware that some teachers do this, but I am also aware that a good many more do not. There are ways of reducing the endless repetition of operations if they are looked for.

In the field of engineering drawing I feel that teachers have, as it were, backed themselves into a corner. One can use drawing very effectively in schools for design projects. When this has been said in my presence in the past, most teachers have immediately pointed out, quite rightly, that unless pupils have adequate experience and background knowledge, which means usually that they need to be older, they cannot realistically attempt design work. Since almost all engineering work in Technical Drawing is *machine* work, this is fair enough. But the field of engineering is very much wider than just machines, and there are areas where pupils could quite realistically attempt design

problems even at the age of thirteen upwards. For example, plant and machinery layout, piping arrangement and design, dashboard layout etc. etc. Most pupils could (a) substitute given figures into standard formulae and learn to manipulate them (b) match the resulting design figure with those in manufacturers' catalogues or parts and fittings. The selection of such fittings and parts on this basis, for a given purpose within a specification can involve minor design work. How many teachers have in their drawing offices or classrooms a selection of such catalogues, standard parts sheets from local firms, brochures containing details of appliances etc? It seems to me that a large number of teachers have let the examining boards dictate not only the form of the subject overall, but also the small area of engineering to which it is applied. There is provision for teachers to have their syllabuses considered for acceptance both by 'O' level examining boards and CSE examining boards.

In the context of educational aims of Technical Drawing in schools I regard BS:308 as a minor disaster. It was compiled and published as a series of *recommendations* to industry, and this is exactly how industry uses it – as a guide to drawing practice. Unfortunately, teachers tend to show almost a fanatical adherence to it, so that its recommendations assume the nature of the Ten Commandments. The excuse that it is 'in the syllabus' is really not good enough since their opportunities to alter or design syllabuses have already been mentioned. They also tend to ignore several other British Standards publications which are very relevant, and I find it difficult to believe that this is the result of judicial consideration. Also reflecting this rather legalistic attitude to the subject are one or two other practices. In particular are the insistence upon the freehand drawing of compound curves and the use of compasses for very small circles. It is almost as if teachers want to make tasks difficult by barring French and radius curves. There there is the practice of making pupils sketch objects such as handtools – from memory. This old favourite still comes up in examinations and I would be grateful to those who could really put forward some justification for it. It seems to prove that some artists have good memories!

The mass of pupils who take technical Drawing both at CSE level and in GCE are rather ordinary beings, and whilst many are quite intelligent enough, they are not basically academics. Despite this there has been a general movement to increase the academic approach to the subject, particularly at 'A' level. Rather isolated concepts have been introduced (e.g. relative velocity) which bear little resemblance to what has gone before, and which have little connection with the other areas of the subject. I view with disfavour this particular kind of 'development' since it tends to fragment the subject even more than it is. I also suspect that the increase in engineering content at 'A' level has been to a large degree motivated by status considerations rather than educational ones, despite the rather facile argument that such status-raising indirectly advances the subject in various ways. I should like to keep university influences at the minimum, for if they control the upper reaches of the subject they indirectly control the lower ones too, and straining to achieve university recognition of the subject can be at best a mixed blessing.

I place the blame for the present parlous state of the subject on teachers, fairly and squarely. They have not been critical enough of what they were doing, how they were doing it nor why they were doing it. Even allowing that it requires time to design and

implement syllabuses, concern for their activities, where they felt there was room for improvement, should have impelled at least a few to consider major revisions and developments. The record of inactivity by the majority of teachers is eloquent. Perhaps the great number of non-specialist Technical Drawing teachers has something to do with this, since, although the vast majority teach their syllabuses quite competently, one cannot expect them to work up a lather over the subject if their primary interests and activities are handicrafts or mathematics. They are probably less than enthusiastic about critically examining the philosophical basis of the subject.

The lack of development and areas of intrinsic interest was demonstrated for me quite forcibly just recently. I went to the library of a College of Education specialising in Design and Craft courses, and found the Technical Drawing section. There were three shelves of relevant books jam-packed, but I was appalled at their contents. The overwhelming majority of them could have been interchanged with no loss, increase or even differences in content. A small number of them contained really useful and interesting ideas and information, whilst about two dealt with the wider field of graphical communications. The rest showed hardly an original idea between them, either in content or presentation, and one or two were simply of the 'Examples for 'O' Level' stamp. None made any attempt to present a coherent rationale for what they contained, but then, so far as I am aware, this has nver been satisfactorily done. Could it be that my original comment about the illogical structure of the subject is correct?

Having rather violently attacked Technical Drawing, I shall put forward a somewhat different view of what we should be doing in schools, and then set out to syllabuses which, between them, can handle most aspects of graphics used for purposes of design and communication. One has been in operation for a year and the other has just been accepted by the East Midlands Regional Examinations Board who have been open minded enough to accept both, despite their novel approaches.

Graphical Communication

There is, central to the present dilemma about the future of the subject, an indecision about whether it is primarily concerned with engineering or communication. *If* teachers turn towards engineering then drawing is not the best way to approach it. *If* they turn towards communication in graphical terms then there is little sense in restricting the techniques to those at present contained in Technical Drawing. It would be just as sensible (or even more sensible) to deal with the engineering aspects in a craft-based or science-based engineering course, the geometrical parts in an applied mathematics or engineering course, leaving the graphical techniques where they should be – as part of a course in graphical communication.

Since I am not qualified to take either mathematics or engineering to the depth which would be required, and since my inclinations are towards the design/communications aspects of graphics, I have chosen to develop, or rather evolve, a proper basis for a course involving the study of graphical communication. The other two areas are already largely developed in other courses, and a satisfactory communications course would seem to be a sensible thing to develop.

The term 'graphical communication' has been used, but what is meant by it? Here is a multiple definition which covers the various functions of it.

1. *Refining & Clarifying Ideas:* This is a part of most design activities, where ideas reach a point requiring graphical representation to clarify and refine them.

2. *Recording & Implementation:* More often than not it is necessary to communicate the final forms of ideas, in detail, to others who will be involved in implementing them. And for future reference, these are also recorded.

3. *Dissemination of Information & Ideas:* Very often it is necessary or desirable to inform others (outside of the design/production group) of recorded ideas and information, yet without complete detail so that the essential features can be comprehended. This is usually done in a highly formalised way (e.g. Artists impressions, Technical Illustrations)

   (NOTE: Graphical calculation is *not* included since its primary function is not communication. The results of such calculations are usually added to a drawing which is a communication sheet.)

It should be appreciated that these functions need not all be included as a requirement, since very often this would not be either necessary or appropriate. (e.g. One would not go through them all to make a simple bracket for one's kitchen)

Some Propositions

1. A technique of graphical communication cannot be regarded as belonging to any subject *unless* it is impossible to use it for other subjects. For example, orthographic projection is almost always thought of as belonging to engineering, yet biologists readily use it to project sections of cellular leaf structures, and geographers use it to project geological sections. The point being made is that one should never confuse graphical techniques with the subjects for which they are most commonly use.

2. Proposition No.1 may seem to be an unnecessary statement of the obvious but if it is spelled out in this way, it enables one to ignore subjects and concentrate on the techniques. It is clear that there is a range of graphical techniques utilised by very many subjects for the same purpose – conveying technical/factual information and ideas graphically. At present there is a tendency to define the techniques by reference to the subjects with which they are used most, but it is logical to define them in terms of their *function* regardless of subjects with which they are used.

3. Defining them in this way establishes a central element that they have in common, and it is possible to identify other common elements which can be reconstituted to

form a proper theoretical framework from which a coherent philosophy can evolve. This in turn lays the groundwork from which a systematic teaching approach becomes feasible.

On the basis of this rationale, two syllabuses have been designed at this school which, because of their complementary functions, cover all aspects of this kind of graphical communication. 'Design Drawing' which is one of them deals with the function of graphical communication in the design and implementation processes (but also, because of other considerations, includes the study of other features of these processes). The second syllabus is Technical Graphics which after a year in operation, is beginning to settle down. Since it is introducing the staff to new ideas and techniques as well as the pupils, it is proving to be extremely interesting. It isn't *the* answer to anything, but is an answer. Those involved are CSE only (4th and 5th Years) and are allowed 4 x 40 minutes per week. The equipment is standard Technical Drawing equipment apart from felt-tip pens, coloured inks, transfer lettering and any odds and ends which can be used for 'one off' jobs. The two staff involved have had no training in anything other than normal Technical Drawing, and have learned or picked up other techniques as and when possible or necessary.

The crude outline of the Technical Graphics course is simple. A first period of seventeen weeks to learn the basic forms of the techniques is included, but from then onwards *all* work is project-centred. The subjects are a completely free choice since the course is concerned with communication techniques in graphics and *not* subject matter in the usual sense. Thus projects so far have ranged from the Wankel engine to the Fishing Industry, from football to the redesigning of our new block's interior.

After the year it appears to be fulfilling the purpose for which it was designed, which is to increase the individual's awareness of, and facility with, graphical techniques of communication. Out of it has come such things as the realisation that accurate information can be presented in such a way as to create inaccurate impressions; that certain kinds of information almost determine the techniques by which it should be conveyed; that undisciplined use of colours can confuse rather than clarify, despite accurate presentation; that certain shapes tend to have greater visual impact than others. These may seem rather obvious to teachers, but they are not at all obvious to pupils. One has only to look at textbooks, magazines, newspapers, TV, and all manner of media to realise the enormous importance and increase in graphical communications. Our pupils are confronted by all manner of graphical presentations and *need* to be aware of their strengths and weaknesses.

In terms of other subjects in the school the course is beginning to show benefits. Several projects that have been produced (using techniques taught in the course) for subjects such as biology, history, geography have been of a markedly higher standard than those of pupils not taking Technical Graphics. Another unexpected spin-off has been an apparent tendency for pupils to turn up for a particular subject with the proper equipment to produce graphical material. But I wonder if the most useful application of the course would not be as a kind of school resource. A studio/Drawing Office containing materials,

equipment and with expertise available would be most useful. Pupils (and staff) could use it in the same way as a resource centre for graphics, for *all* subjects. Perhaps all teachers should have graphical communication included in their training whatever their subject specialisms.

The last point I should like to mention is the interface between technical graphical work and artistic graphical work. The two areas are concerned with communication and can benefit from each other's techiques. The Art teacher at my school has already discussed the possible links in this area and we shall soon try one or two ideas out. It seems to me that in all areas where drawing or graphics are use, a prime criterion of the judgement of the work should be whether it has fulfilled its communicational functions. Arguments about the relative merits or appropriateness of techniques then assume a proper perspective. Once the techniques assume more importance then the communicational aspects, just as in Technical Drawing, the subject is *dead*.

I am grateful to Mr. C. Knott for permission to quote his Design Drawing syllabus. I also owe thanks to those teachers and others who have constructively argued about and criticised my ideas. Without this I could not have clarified them so well so quickly. I would also recommend those teachers who have not read the article 'Technical Drawing' in the recent issue of 'Trends' to do so. This was written by a group of H.M. Inspectors who see Technical Drawing throughout the schools in the country.

Design Drawing

C.S.E. Mode III – North Leicestershire

To be offered as a two year Depth Course as part of the Design Department's Integrated Scheme.

(N.B. This Course is intended to replace technical drawing Mode III at present taken by the school.)

Aims of the Course:

The aim of this course is to provide a broad-linking framework through which:

(a) Drawing skills can be developed
(b) A systematical study of design can take place.

"At present the lack of understanding of design and visual education is particularly acute in Britain. The actual understanding in primary and secondary schools about architecture, planning, industry and design is very low." Quoting from K. Baynes "Industrial Design and the Community." (1966) he continues, "The conscious shaping of the environment, which is one of the fundamental attributes of civilization, may occasionally be the subject for a special lecture or a museum visit, it is hardly ever systematically presented as a major intellectual activity."

The success of the Course will largely depend upon the development of a basic visual language exercised through sketching, colour, perspective drawing BS308 and photography. This language will then become the medium through which the pupils will express their ideas and develop their creative potential.

These graphical studies will take place as part of the integrated Design scheme already submitted by this school and there will be many links between this Course and the practical courses involving the physical manipulation of resistive materials.

Organization:

The course falls into three main areas:

1) Graphical Studies.

2) Prototype and Model-making.

3) Sources of Design.

SECTION ONE – Graphical Studies:

The graphical studies are concerned with developing a student's ability to communicate his ideas two dimensionally through observation, sketching and associated techniques.

The purpose of the work in this section is usefully summed up by Norman Potter in "What is a Designer". Drawings can never be an end for a designer (except an illustrator), they are a means to the end of manufacture, and their expressive content is strictly limited to the purpose of relevant communication.

SECTION TWO – Prototype Work and Model-making:

Model-making is a valuable element in the design process. Often this is as far as a designer goes in actually making anything.

These models may be scale models or full size prototypes. They may be used for testing full size details; for prototype work where visualization of the finished object is important or where the construction of a model may appear to be the easiest way of producing a solution to a problem particularly where space and the movement of related components are involved.

When a model exists analysis of the details involved in the production of each component and of the problems of their assembly is a great deal easier and it is much more likely that fewer problems will have been overlooked, as inevitably happens. Subsequent discussion of design detail or production problems can be carried out with direct reference to a concrete object rather than a formal abstract two dimensional representation.

Photographic techniques will also be used as often a photograph of a well made model can pass as the real thing.

SECTION THREE – Sources of Design:

Sometimes design is confused with invention and as David Pye points out in his book 'The Nature of Design', the two are not the same. A proposed design will often be a novel arrangement of a particular set of elements to suit a particular situation. An invention is likely to be an entirely new 'element' conceived under different constraints to that of a designers solution to a problem. When the invention becomes available to designers it presents itself as a new piece of knowledge, material or a system ready to be used how and when the designer sees fit. It is designers who frequently determine how and when an invention can be used most profitably, e.g. plastics were invented by chemists but are dispensed by designers. The same can be said of the steam engine. The nature of the vacuum was understood by scientists throughout the world in the 17th Century but it was an ironmonger who arranged the elements in a fashion which suited his particular needs producing the first steam engine.

There are four sources of design, Natural form, Geometric, Man-made and World History. The first needs no mention. The second is illustrated by the work of Conbusier, Buckmaster-Fuller and Kent Rowlands. The third includes the History of Technology, mechanical systems, man-made supplies of material, processed material and waste. The fourth area, World History, could include the evolution of furniture styles from the 15th Century, architectural styles, William Morris and the Arts and Craft Movement, Pioneers of modern design etc.

This section although very important can only play a supporting role to the first and second section of the syllabus because of the lack of time. A student is not expected to have studied all the four sources of design mentioned but it expected to know of them and to show evidence of detailed study of at least one of them.

The Syllabus:

SECTION ONE – Graphical Studies:

Sketching: Observing the environment, learning to see and observe details. The use of different tools and implements for drawing and a wide variety of papers and materials on which to draw. Observation of colour and light indeterminingform and simple techniques of showing this. Allusion may be made to contrast, texture, line and weight if it is relevant to the needs of the pupil.

Perspective Drawing: At this stage only using a simple approximate method to indicate the shape of a rectangle, e.g. a shape similar to that achieved by using a two point perspective. Pupils can then take this rectangular shape and design within it, perhaps achieving more realistic proportion but without restricting their freedom of expression.

Component and Assembly Drawing to BS 308: Orthographic Projection first and third angle. Basic Dimensioning, Sectional drawings and assemblies. Isometric and axonometric types of projection.

During the initial stages of the Course these technical methods of drawing need only be understood in breadth not depth. Rigid adherence to BS308 is the minutest details by students is not called for. What is wanted is an understanding of this method of conveying information. If too much emphasis is laid on this section of the syllabus students may be inhibited in the development of freer forms of expressing ideas.

Documenting: Documenting and reporting is an aspect of design often neglected. Stress should be laid on the need for explanatory notes to accompany drawings and sketches or details, or explaining the reason for continuing with a particular line of development or for terminating it. Also the recording of information gathered from research. The aim of the work in this section is to assist the pupil in organizing a design brief into a working set of assumptions covering those considerations essential for a successful solution. It should also help the student present his work as a running sequential account of his thinking from beginning to end (accompanied by relevant diagrams)

Rendering: Applying a wash to drawings using artists colours and artists paints.

Lettering: Use of dry transfers, ink stencils etc.

Further work on Perspective Drawing: Introduction for formal constructional methods of one and two point perspective. The use of perspective grids. Determining measurements in proportion on drawings using the measuring point system (rather than projecting points form additional views).

Further work on technical drawing: Using rapeidagraph of graphics pens producing ink drawings on tracing paper. Methods of reproducing dyline copies etc. and adding further types of information to different copies e.g. dimensioning instruction on one sheet, assembly details on another, and third used perhaps for illustrative purposes.

Presentation Drawings: Wash rendered drawings. The mounting of drawings and photographs and picture mounts.

Photography: Photography used as a method of recording information, abstract shapes from the environment and as a permanent record of temporary structures, models, mock-ups or shapes.

SECTION TWO – Prototype and Model-making:

Model-making: The purpose of the model. Scale of models. Suitable materials, card, balsa-wood, clay, perspex, polystyrene, plus glues, solvents, Araldite, soft solder and tin plate, etc.

Types of finish – hand painted, aerosol sprays, printed paper etc.

Tools – steel rulers, model makers knives, hot wire cutter, strip heaters.

SECTION THREE – Source of Design:

Sources of Design:
Natural form.
World History.
Geometric.
Man Made

References
Corbusier – Towards a new Architecture.
Natalie D'Oberlof – An Artists Workbook.
D. Pye – The Nature of Design.
N. Potter – What is a Designer.
M. de Sauzmaurez – Basic Design.
K. Rowlands – Looking and Seeing.
Pesvner – Pioneers of Modern Design.

Proposed Course Technical Graphics – C.S.E. Mode III

The nature of our society is such that graphical communication will increase in volume, and probably in complexity, and it is therefore reasonable to expect schools to provide courses dealing with the understanding and use of this mode of conveying information. Certainly we have Technical Drawing, but its value lies in its 'depth' treatment of a restricted number of techniques, and hence it is concerned to teach a degree of engineering and architectural knowledge. We need a subject whose concern is the wide range of graphical techniques which are normally neglected. Such a course would in no way be a substitute for Technical Drawing, but would be a complement or alternative. One form which the subject could take is set out below.

Form of Course

The course consists of Four stages covering the period from the beginning of the Fourth Year Autumn Term to the end of the Fifth Year Spring Term (approximately). Each stage would be about seventeen weeks in length.

STAGE I – Basic Techniques and Basic Forms

During the initial stage of the course the pupil will be taught basic techniques, the use of various media (see Syllabus Part A, No.6) and how to use drawing instruments and aids. These will be exercised in learning to draw the Basic Forms (Syllabus Part A, Nos.1-5) and problems will take the form of translations of verbal information into graphical terms, and translation of schematics into other graphical forms.

STAGE II – Extension of Basic Forms and Choice of Major Area of Study

The pupil will have to make a choice between the following:

a) concentrating upon 2D techniques and continuing 3D as a subsidiary

b) concentrating upon 3D techniques and continuing 2D as a subsidiary

3) studying both to the same depth

Problems at this stage will be more difficult, calling for minor investigations or research before they can be solved.

STAGE III – Full Scale Problems and Tasks

The pupil will by now be fully conversant with the range of techniques, all of the media, and will have fully explored the Basic Forms. He will have coped with a series of graded problems, and be ready to attempt full scale problems.

STAGE IV – FORMAL ASSIGNMENTS

This stage consists entirely of the pupil working on two major problems and without assistance. One of the assignments must be in his preferred area of study and the other in his subsidiary area of study **or** both must be of equal standing if he preferred to follow both areas to the same depth. (See choices in Stage II). These assignments must be presented in display, again without assistance. Accompanying the final display must be the development sheets showing his progress towards the final solutions.

So far problems have been mentioned, but there has been no real indication of the type of problem encountered. In fact the problems divide fairly clearly into two types - Graphical Statement Design and Planning or Arrangement Design. Below is an expansion of these.

Design of Graphical Statement

There are several stages involved in solving such a problem. The first is to make a preliminary translation of the material into graphical terms, and then see if it lends itself to other graphical techniques or Basic Forms. This involves consideration of the appropriate Mode of Expression (See Syllabus Part B). The next consideration is that of whether or not to use colour, textures, etc. The final stage is the most difficult, for it involves decisions about how to relate the various parts of the statement to one another, how to emphasise and differentiate them in such a way as to achieve maximum impact, communication and clarity. This can perhaps be appreciated if one thinks about trying to create a display of a high standard, which would show the social structure of a school and the range of activities which go on in the school. To achieve any measure of impact one could not simply use organisational trees with drawings. Considerable though would have to be given to this, for as there is a similarity between certain subjects, and difficulty in showing activities such as essay writing etc., there would be a natural tendency to use similar Basic Forms which would result in an uninteresting display.

Planning or Arrangement Design

The problems encountered in this work are of a different type. The words 'planning' and 'arrangement' do not refer to the design of the graphical statement, but they do refer to routes, objects, sequences etc. For instance, suppose that a pupil were asked to redesign the interior of, say, a school's Domestic Science room. The nature of the problem is such that it revolves around the function of, and activities in a Domestic Science department. He would have to ascertain these by investigation, then, after formulating and refining his ideas through discussion, etc., he would have to place mains service points, consider worktop heights and so on. Work out whether whole or part elevations were needed in addition to a plan or plans, and finally arrange the various appliances in their proper positions. The decisions about Basic Forms, media and integration of various parts are here relatively simple.

Clearly both types of design are present in all problems to some extent.

THE SYLLABUS

The syllabus is presented in two sections, PART A giving details of the course of work to be followed, and PART B explaining the approach to this coursework. However, before these are presented it is necessary to define what is meant by Technical Graphics.

TECHNICAL GRAPHICS is concerned with

1. the understanding and use of graphical techniques appropriate to the communication of factual/technical information and ideas based upon it;

2. the graphical communication of trends and forecasts;

3. the graphical communication of the results of mathematical calculations.

SYLLABUS – PART A (Basic Forms and Techniques; Media)

1. **Orthographic Projection** – Simple geometric solids will be used to teach basic projection, sectioning, auxiliary views, inclined views, and these will then be applied to manufactured articles and structures e.g. water tap, catch plate, electrical plug and socket, door catch, tool post, shed. Both individual items and assemblies will be shown.

2. **Pictorial Views** – Isometric, oblique, planometric and perspective techniques will be learned using simple geometric solids, and then they will be applied to manufactured articles and structures. Within each technique exploded views will be attempted.

3. **Mapwork** – Distribution maps of ALL kinds; relief maps; geological strata; projected sections; enlargement and reduction of maps; stylised maps; town plans; site plans; etc.

4. **Schematics** – Diagrams and charts representing:
   a) the geographical movement of objects, organisms and fluids;
   b) the movement in time of objects, organisms and fluids;
   c) the representation of permanent or static relationships between quantities, groups divisions etc. For example, traffic flow, animal migration, progress charts, wiring diagrams, printed circuits, pipeline layouts, block diagrams, organisational trees, sociograms etc.

5. **Graphs** – Block charts, either vertical or horizontal showing one or two variables; pie-graphs showing proportions, divisions, and any other generic methods of showing such things; single or multi-line graphs showing the results of mathematical calculations, past, present or future quantities or trends.

6. **Media, Instruments and other Aids** – Pencil; pen; crayon; ink; paint; such media to be used for hatching or as solid colour or wash, spray etc., freehand printing; stencil; type; transfer characters (e.g. Lettraset) Scales, Scale rules; drafting instruments; perspective grids; templates.

SYLLABUS – PART B

Technical Graphics is here regarded as a graphical language, and the approach to it is in some ways similar to that used for a language.

A finished presentation is called a **Graphical Statement**, and it can be presented in any of three different ways called **Modes of Expression.** Any graphical statement is made up of one or more **Basic Forms** which are gathered together in a **Vocabulary.** The smallest units from which any Basic Form can be constructed are called **Elements.**

1. **Elements** – the smallest units
   a) The point; the line; the plane; colour values; texture; shading;
   b) single plane space; multi-plane space;
   c) continuous space or perspective.

2. **Vocabulary** – the Basic Forms
   Orthographic Projection
   Pictorial Views
   Mapwork
   Schematics
   Graphs

   Under these headings all Basic Forms can be gathered, including any variations. See details in PART A, Nos 1-5

3. **Modes of Expression**

The various quantities, trends, etc. which can be presented graphically are not all 'concrete' nor are they always best presented realistically; and may not even be capable of realistic presentation. Therefore it is necessary to provide flexibility in the methods to allow for these variations. To this end, three modes of expression have been devised.

A. **Realistic Mode** – Realistic presentation of objects or organisms using shading. Such presentations should be drawn accurately, as in technical illustration, and not naturally as an artist would do.

B **Symbolic Mode**

(i) Representations of organisms or objects, reduced to their outline and structure; shading to be eliminated. (Thus an orthographic drawing would be in symbolic mode)

(ii) Presentations of material quantities such as money, numbers of manufactured items etc., where the quantity or value is more important than the object involved.

C. **Abstract Mode**

(i) Presentation of organisms or objects in a generalised way. For example; a 'matchstick' man representing Mankind; a circle representing Wheels. In other words, the reduction of anything to the minimum number of features or characteristics essential to recognising the class or group it is representing.

(ii) The representation of abstracts such as time, progress, growth, etc.

(iii) The representation of relationships.

4. **Graphical Statement** – the final presentation

The graphical statement is constituted of one or more Basic Forms, presented in one or more Modes of Expression. The final result in terms of clarity, impact and communication rests upon satisfactory conclusions being reached about the following.

a) The **relationship** between the Basic Forms in terms of the whole.

b) The ways of **differentiating** these Basic Forms.

c) The ways of **emphasising** those Basic Forms.

5. **Designing the Graphical Statement**

There are four questions which must be asked when designing a graphical statement, for between them they raise all of the points which must be considered in marshalling the information. They will not all apply always.