BMN
Building Metrication News

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This section appears in the fourth issue of 'Building' each month, and gives current news and information on metrication, as well as providing a forum in which the ramifications of the change to metric can be freely discussed. It is published in association with the Modular Society.

CONTENTS

METRIC MONTH

The Programme is Being Met

Since you are reading these notes the chances are that you are one of the many people closely concerned with metric change. That being so you will probably have considered, at one time or another, whether the programme for the construction industry is realistic. You will have come across pockets of resistance and of total ignorance. You will have wondered why the industry should have set its target at 1972 instead of 1975. Indeed you may have wondered why an industry, which has little interest in exports, should change in advance of those that apparently have more to gain.

In particular you may have been and may still be concerned at the tardiness of government in establishing an overall Metrication Board. In retrospect it is now clear that such a board should have been established at the start, or that BSI should have been given the responsibility, the authority and the money to plan the change for the whole country and not just for industry. As a result of the lack of co-ordination nothing can now prevent a prolonged period in which many of us will work in metric during office hours and will then revert to imperial measure at home.

It was obviously with this sort of situation in mind that BSI's main committee, concerned with metrication in the construction industry*, met earlier this month to review progress in the industry. In view of the imminence of the January 1969 start for metric design, the review was a substantial one as is shown in their report (see page 24). However, taking into account all the difficulties of a voluntary change and of the lack of funds, the conclusion can be described as being quietly optimistic. The committee emphasises the enormous progress that has been achieved, while identifying areas where progress has been disappointing, and concludes that the programme is being met.

It is clear that lack of decision on the decimal marker, which might have appeared to be a minor issue, in fact frustrated the publication of many metric versions of text books. It is also clear that unilateral action by one major organisation, in this case the Decimal Currency Board, lead to confusion and that this confusion will not be overcome, at least until BSI republishes its guide to metric; PD 6031. On the other hand it is also clear that a compromise needs to be reached between the natural desire of publishers to put off the preparation of metric editions until existing stocks have been exhausted, and the urgency of supporting metric change by providing basic information in metric terms. It would seem that the urgency is not fully appreciated by publishers. Similarly a survey undertaken by Barbour Index for BSI has shown a marked reluctance by manufacturers to add metric equivalents in their trade literature. In this case, however, perhaps time has shown their reluctance to be justified. Manufacturers naturally do not wish to reprint literature, which in fact shows imperial products. They prefer to wait until new metric products can be shown. Elsewhere the review shows rapidly increasing activity. Over 500 lectures have been given by the Pool of Speakers to an average attendance of 100 people. Press coverage by the Technical Press is described as being most meaningful and BMN is described as being a *notable example*. But coverage in the National Press, let alone television, is described as being occasional. Naturally the public sector is well to the fore in its preparations and has been and is continuing to issue policy statements and guidance.

However, one considerable change of emphasis is noticeable in this review. While the programme has always taken account of the need to co-ordinate dimensions when changing to metric measurement, this is now recognised as being of even greater importance than originally foreseen. Whereas the original programme envisaged a preponderance of early metric projects designed to incorporate mainly foot/inch components (described in metric equivalents) it is now felt that unless these projects can be related to BS 4330, that they should be actively discouraged. It is to be hoped that this advice will be widely accepted and if it is it will mean a more gradual start to metric design than originally intended. But it is a change of heart and does mean additional pressure on the BSI committees preparing dimensional recommendations.

* Construction Industry Metric Panel B/-/9

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BSI Metric Progress Report

A progress report on the change to metric has been issued by the BSI through its Construction Industry Metric Panel B/-/9. It analyses progress made by industry generally and the work of the BSI in particular in implementing the necessary steps for going metric. The Metric Panel considers that, taken as a whole, the Programme is being met and that it is therefore not necessary to recommend any delay or extension to the plan as set out in PD 6030. A summary of the report is given below.

The Programme

Promotion and Publicity: The Pool of Speakers set up by BSI and run by the London Building Centre has now been running for 18 months. It comprises over 100 voluntary lecturers who have already provided well over 500 lectures to an average audience of about 100. The MPBW, the NFBTE and the Institution of Municipal Engineers have also been particularly active in arranging talks on metrication.

Useful coverage has been provided by the various trade and technical journals in the construction industry and special mention is made of Building Metrication News and its regular news service. The journals of the RIBA, RICS and the Institute of Municipal Engineers are also singled out for providing guidance, 'n their own sectors, on implementing the Programme.

Training and education: The report emphasises the importance of retraining staff within individual firms and offices. In this respect the CITB has set an example to other training boards in its production of a series of programmed learning texts for metric instruction. These booklets range in subject from the reading of metric drawings to advices for clerical and secretarial staff regarding metric misprints. It may be necessary for some of these training aids to be revised in the light of experience gained as the result of pilot schemes in metric.

The Institute of Building, RIBA, RICS, National and Higher National Certificate in building courses and structural engineering courses in polytechnics and universities have now made plans for substantial teaching and examination in metric by 1970. In some cases courses are already predominantly in metric and in many instances alternative examination questions are to be set in metric by the end of this academic year.

Again emphasising the need for retraining and the large element of 'do-it-yourself' where metric familiarisation is concerned, a number of forward thinking offices and firms have instituted in-company training schemes. In some instances, these are being related to dummy metric jobs and even to pilot 'live' metric projects. MPBW is looking into the need here for mid-career training courses.

At least two schools of architecture are known to be preparing their own schedules of metric design data placing emphasis on 'metric thinking' as opposed to mere conversion. RIBA and the London Building Centre have produced various visual familiarisation aids for classrooms and offices.

Very little progress is reported on the metrication of text books. Approaches by BSI to publishers as early as 1966 brought little positive response except that initial responsibility lay with authors. Meetings were held with several large author departments such as MHLG, BRS and RIBA with some success but it still seems necessary to advise professional and trade organisations to make their own inquiries of authors and publishers according to their members' needs.

Preparatory Studies

Metric guide: Despite the two years from February 1967 originally allowed for experience in using metric to accrue, it was felt necessary to up-date PD 6031 'Guide for the use of the metric system in the construction industry.' This has now been completed and the revised publication should soon be on sale. The revision chiefly comprises expansion of coverage into specific and specialist uses within construction as well as general guidance. Other points of revision are:

i) limiting multiples of basic SI units to those of 10^3. Now well accepted for linear and mass measure (e.g. mm., m. and km. only for length), this principle is recommended for other quantities also where information is being communicated between different industry sectors in writing or on drawings. This does not prevent 'private' or 'personal' use of other mutiples (e.g. $cm.^4$ for engineering calculations).

ii) use of N (Newton) in engineering expressions of pressure and stress. In the specific form of kN/m^2 for loading and N/mm^2 for stress in steel, etc., this use of SI has been endorsed by the two Institutions of Civil and Structural Engineers. Although for other branches of science and technology, other stress units may be used, for information to be communicated to or within the construction field, only the above units should be used. Advice is given regarding the use of units of pressure and stress in non-scientific situations such as loading gauges on cranes.

iii) notation on drawings (see also revision to BS 1192 'Building drawing practice' also available this month). Advice here relates to the showing of metre expressions to three places of decimals when metre and millimetre expressions appear together on a drawing.

iv) the decimal marker now settled as the conventional decimal point. It is recommended that no thousands marker be used at all, only where legibility needs to be improved a space can be left in large groups of digits at every thousand point.

Controlling (key) dimensions: Although six months late as a published document, the data in BS 4330 'Controlling dimensions in building' were made known to the relevant committees working on dimensional co-ordination on Programme at the start of 1968. In effect, BS 4330 sets the broad dimensional framework for building in metric and reflects the decisions taken for public sector programmes as well as giving guidance for building types not covered by Government procurement.

This publication is an essential reference for achitects working in metric and for manufacturers of building components facing metric production. Included with BS 4330 is PD 6426 which describes the consequent process of working out and agreeing component sizes at BSI.

Essential References

An appendix to the report lists those publications classed as essential references in PD 6030 and earlier documents on programming metric change. Of about 70 items, only one half are already metricated (metric equivalents added) or should be by the end of this year.

Some of the metric versions of these essential references have been submitted to BSI for checking against the latest advice on the use of SI. It is often misleading to apply conversion factors of an excessive number of significant figures since this gives rise to misleading 'over precise' conversions which do not in fact convey the true order of accuracy of the original imperial value. Examples of this can still be found in the metric equivalents version of the Building Regulations (England and Wales).

Detailed advice on the interpretation of documents carrying metric equivalents is being given to building control officers by the Institution of Municipal Engineers. The Construction Industry Metric Change Liaison Group is also preparing a paper of advice on the same subject.

Dimensional Co-ordination

This is a four-five year period in PD 6030 of which one year has now elapsed. For those priority components very good progress is being made whereby it is expected that dimensional recommendations for external envelope and internal subdivision components should be out for comment early in the new year.

Technical Committee B/94/4 and the Functional Group Panels of BSI charged with making these dimensional recommendations are now to publish their component lists so that all sectors of industry can see at a glance which building products are to have co-ordinated metric sizes and which simply require sensible rational metric sizes.

BSI committees working on the parallel problems of building tolerances and joints and jointing have been asked to concentrate on those aspects of their work which relate to priority components for dimensional co-ordination. Despite

this concentration, however, it is anticipated that most of the work of determining 'work sizes' for metric components from the basic space recommendations of the Functional Group Panels will fall to the individual BSI technical committees dealing with specific products. These committees are therefore now being encouraged to start considering the metrication of their respective standards upon receipt of the earliest drafts of the broad dimensional recommendations. The use of accelerated procedures (known as Bowlby' at BSI) is advocated whereby initial revision is done outside committee.

Rational metric: Metrication work has already started on standards for many of those building products for which dimensional co-ordination is not required. In addition to this, wherever the Functional Group Panels indicate that the simple application of BS 4011 'Basic sizes for building components and assemblies' should suffice, this work too is immediately being put in hand.

An example of action of this sort can be seen in the publication of an agreed precise changeover plan for metric reinforcing bar to new sizes already reflected in the relevant BSs and due to be published shortly.

For some items, such as packaged quantities of cement and delivered loads of sand and ballast, permissive legislation is required to overcome the provisions of the Weights and Measures Act. Joint action by CBI and the Board of Trade is expected to rapidly remedy the situation.

New Metric Products

PD 6030 does not really predict any progress here for some 12 months. However, as BSI issues dimensional recommendations, it is reasonable to expect some product manufacturers to react quickly, not necessarily waiting for the full metrication of their relevant product standards. Also as metric projects get under way during 1969, demand for dimensionally co-ordinated metric components, albeit as 'specials,' based on BS 4330 and such dimensional recommendations as by then will have been agreed in BSI committees, will hardly be ignored by manufacturers.

International work: Many manufacturers have expressed concern that dimensional decisions to be made shortly for building products as a result of the work of the BSI Functional Group Panels may not accord with existing metric sizes already enjoying international recognition. In this respect, it is important to realise that international agreements are being taken into account in the BSI studies.

Measuring Instruments

Recent agreements in the BSI committee considering the calibration of building site measuring instruments have allowed manufacturers to plan their production to meet the expected demand for metric instruments in 1969-70.

The main feature of the work of this committee, B/98, has been to ensure that wherever possible the marking of instruments is in accordance with the recommendations of B/-/9 for metric dimensioning of contract drawings, i.e. metres or millimetres only and not in centimetres or other units of linear measure. Clearly the form of dimensioning on a drawing and the ease with which dimensions can be found on a measuring instrument are related.

Metric Contracts

Whereas PD 6030 clearly envisaged a preponderance of early metric projects designed to incorporate mainly foot/inch components but described in metric equivalent terms, it is now felt unless these projects can be related to BS 4330 'Controlling dimensions in building,' that they should be actively discouraged. This is not to say that foot/inch components should not be used if they can be made to fit within the metric dimensional framework set out in BS 4330. This advice, if widely followed, should have the effect of producing a fairly gradual start to metrication of projects from which feed-back of experiences might be made to have worthwhile value. Time should allow costs yardsticks to be reviewed more meaningfully and product manufacturers would get a chance to judge more accurately the potential markets for their newly-sized components. The bulk of the change to metric project design would therefore be concentrated into the latter half of the period 1969-71 when more newly-sized components should be available.

In offering this advice, the Metric Panel is aware that it puts even greater responsibility onto those with large scale procurement programmes since it is expected that it is from these programmes that the production of new products should be initially financed. Given effective feed-back to industry, the incorporation of newly-sized products in say a large Government contract should allow consequential specification of the same products in smaller private contracts, thus providing the manufacturer with continuity of production and the specifier with assurances of suitability and availability.

It is essential that the designer of the smaller project takes steps to verify the availability of the components he is specifying and to help him in this, MPBW and RIBA are to collaborate in the provision of a feed-back service on just what new components are being produced for large procurement programmes and in what quantities. It is hoped that this service might be linked with a general advice and information service at present before CIRIA as a proposal.

BSI is expecting to produce a simple guide to BS 4330 and the next MPBW Bulletin on metric will also deal with the subject of working to the metric controlling dimensions. Each Government department concerned with one or more building 'type' is producing guidance of a similar nature in design bulletin series. The BRS is to carry out feasibility studies on the degree to which foot/inch components can be fitted into the framework of BS 4330. Therefore, the designer should not lack for advice provided he takes the trouble to keep himself informed with regard to these various studies and makes good use of such central advisory and data services as are currently being developed.

Part of the design process is that of surveying land or existing buildings. The rate at which Ordnance surveys can be produced in metric is not greatly encouraging where next year is concerned. But there should be a sufficiency of metric surveying equipment to allow for much to be done by way of detailed surveying or resurveying. What else remains will have to be the subject of conversion from imperial to metric at plotting stage where surveys relate to metric projects.

Metric Contracting

Although not broadly scheduled to start site work until 1970, the contractor at national level is already considering metrication problems with which he will be faced. In one or two known instances, selected staff from all levels are being sent on metrication courses and some contractors are participating in joint pilot schemes with other sectors of industry. The running of 'dummy' metric procedures alongside of active foot/inch projects can establish a feed-back of experience within an individual firm which could lead to systems of checking and smooth running when metric projects build up.

The small contractor or sub-contractor who may not be able to afford participation in pilot schemes is certainly encouraged to the 'dummy' project approach—preferably in liaison with the project architects and local authority building control officers—if he is to prepare himself for metric working as the norm.

Further Action

At the end of the report a number of recommendations for further action are made by the Metric Panel. It is felt that the Pool of Speakers has now reached a point where it should be built up and this will require full-time organisation staff and, of course, more finance. Film strips are recommended as publicity media.

A more dynamic national education plan is called for. New entrants into the industry will be expected to work substantially in metric after 1970.

Perhaps the most urgent need, however, which is frequently borne out by the report, is the establishment of an overall Metrication Board. It is believed that some difficulty has been experienced in finding a suitable chairman, not surprisingly since the job will require an appointment in the top flight. Current hopes are that an announcement will be made very soon.

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A System of Tolerances

DRAFT BRITISH STANDARD FOR COMMENT

This draft BS is for comment only. Comments, or an indication of general acceptance, should be sent to the Committee Secretary, E. R. Crosher, BSI, 2 Park-street, London, W1, not later than 3 February.

RECOMMENDATIONS FOR A SYSTEM OF TOLERANCES FOR MODULAR BUILDING COMPONENTS

(Revision of BS 3626)*

FOREWORD

This revision is considered necessary to take account of experience gained since BS 3626* was published and of the recommendations of the Code of Practice for the Control of Inaccuracy in building† to be published shortly, especially the statistical method for combining certain tolerances contained in that code. It relates to the series of British Standards on dimensional co-ordination‡ now published or being drafted, and also to the revision of the Modular Co-ordination Glossary, BS 2900, Part 1§, to be published shortly.

The system described is for determining tolerances for modular components, limiting the term modular for the purposes of this BS[to those components whose sizes are multiples of the basic sizes of the descending order of preference of BS 4011‡. Components having such dimensions are those that must be capable of co-ordination with an unpredictable variety of other components, such as a door set with various adjacent walling components.

The system is not concerned with components that are always co-ordinated with the same sort of component, for example, a door leaf with a door frame, which are usually not modular. Neither is the system concerned with those items in building construction that are toleranced under the engineering system of limits and fits, such as the inside of a water tap.

For some modular components (such as sheet materials) the least of the three dimensions is a small submodular thickness that is more conveniently toleranced plus-or-minus a given dimension than by this system. The draft revision of BS 2900, Part 1§ has already been the subject of comment and the definitions therefore are included as an Appendix only for reference in considering this BS. Comments should not be made on those definitions, except as a part of a comment on this BS.

RECOMMENDATIONS: SCOPE

1. This British Standard recommends a system for tolerancing modular building components, that is to say (for the purposes of this BS) those whose sizes are in whole multiples of the basic sizes preferred in BS 4011‡.

*BS3626, 'Recommendation for a system of tolerances and fits for building'.

† Circulated as draft for comment 67/14337, September 1967.

‡ See BS 4011, 'Recommendations for the co-ordination of dimensions in building. Basic sizes for building components and assemblies', and BS 4330, 'Recommendations for the co-ordination of dimensions in building controlling dimensions'.

§ BS 2900, 'Modular co-ordination in building, Part 1, Glossary'. The draft revision 68/15938 was circulated for comment in July 1968. See Appendix.

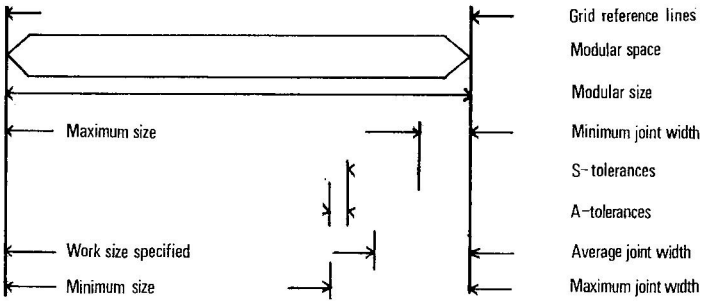
[This limitation should be defined appropriately in this BS (or in the revision of BS 2900, Part 1) in the light of the comments on this draft.

DEFINITIONS

2. For the purposes of these Recommendations the definitions of BS 2900 (revised)§ apply.

DIAGRAM

3. This is a conceptual diagram intended to establish the factors involved in tolerancing a modular component and their interaction. Owing to the random nature of the incidence of inaccuracy, no single diagram can offer a pictorial model of actual deviations in assembly on the site.



4. THE SYSTEM

4.1 The *Grid lines* represent the notional co-ordinating planes between any two modular components assembled together. For a single component the gridlines outside its co-ordinating faces are relevant: any within are disregarded. Similarly, for an assembly of components critical gridlines at a suitable spacing are specified by the design of the building. The actual positions of such gridlines are to be maintained to a specified accuracy. The assembly of components is related to these in preference to the gridlines occurring between them.

4.2 *Modular Space* and *Modular Size* are of the same dimensions, but regarded as a void and the size of a solid respectively.

4.3 The *Maximum Size* is the largest acceptable on the construction site. A larger component is rejected, a term that here, and below, covers not only discarding it, but also cutting or adapting it to fit on the site, or designing a special detail with more tolerance.

4.4 The *Minimum joint width* is specified according to the jointing method predicted or chosen. It may be nil. It may require reconsideration after the tolerances have been calculated.

4.5 *S-Tolerances* are those for size, shape and position. The incidence of inaccuracy in these respects appears, from all investigations carried out to date, to follow the normal probability curve. These tolerances are therefore to be combined statistically: the combined S-tolerance for a single component is the square root of the sum of the squares of the tolerances assigned for size, squareness, bow, position, plumbness A standard run of components between critical gridlines is then assumed. This shall be the nearest length to 6 metres or ten components, whichever gives the smaller dimension. This means that, for a component of 4m or more, there will only be one in the run; and that the run will be less than 6m for components of less than 600mm. A tolerance is assigned to the space between the critical gridlines, and the square of this is added to the sum of the squares of the combined tolerances of the several components. The square root of this is the total S-tolerance to be deducted. This total is divided by the number of components in the run and the quotient is the S-tolerance for one component. The calculation is done separately for length, width and height.

4.6 *A-Tolerances* are those for deformation, such as thermal or moisture expansion and contraction, creep, strain, chemical action and other predictable changes not subject to probability. These are to be summed algebraically, having regard to sign.

4.7 The *Work Size* is now specified so that, to an assumed degree of probability, the actual size of any component will lie between the limits and a predictable number too large or too small will have to be rejected or adapted.

4.8 The difference between the work size and the modular size is the *Average Joint Width*. The work size and the average joint width will have been established by combining tolerances over the standard run of components. They remain constant for longer or shorter runs of components. For longer runs than the standard one, there will be progressively less variation in joint width: the minimum joint will grow larger and the maximum smaller. For shorter runs than standard, there will be more variation. If a designer places critical gridlines closer together than standard, he must either expect that some joints will be smaller than minimum or larger than maximum (the amounts can be calculated) and design the joint to allow for this or expect more rejections and adaptations.

4.9 The *Minimum Size* is the smallest acceptable on the construction site.

4.10 The *Maximum Joint Width* is the largest to be expected on the site for the standard run of components. If it is too large, the critical gridlines must be spaced further apart, or the original tolerances before combination must be reduced, or the joint must be redesigned.

5. QUANTIFICATION

In the present state of knowledge the dimensions to be assigned to the original tolerances for size, squareness, bow, position and plumbness of any particular kind of component must be derived from guesswork and tradition. The words above, 'a predictable number too large or too small', anticipate a situation that does not yet exist. It will not exist until many thousands of manufactured components and their positions in actual buildings have been measured and their deviations from specified size, shape and position subjected to statistical analysis. Then the existing standard of accuracy will be known. This will allow a balance of advantage to be struck between the cost of fine manufacturing tolerances, fine position tolerances, special jointing details and the number of rejects or adaptations on the site.

6. QUALITY CONTROL

In spite of the present quantification of tolerances by guesswork, the combining of them statistically has the great advantage of allowing manufacturing tolerances to be realistically large for each aspect of size and shape, whilst at the same time allowing work sizes to be large in relation to modular sizes. The choice is not between expensively fine tolerances and impossibly large joints.

7. SPECIFICATION OF TOLERANCES

In British Standards and in manufacturers' catalogues the modular sizes for length, width and height should be stated and against each the maximum size, the work size and the minimum size should be shown.

Manufacturers should be prepared to show how the work size has been calculated for the standard run of components, and to state the amounts allowed for the several aspects of tolerance: size, shape, position and deformation.

APPENDIX

Definitions from the draft 'Dimensional Co-ordination in Building. Glossary of terms' (Revision of BS 2900, Part 1).

NOTE: These terms are still under consideration in the BSI Committee responsible; the draft for comment was circulated in July 1968. The definitions are included only as necessary references to the draft revision of BS 3626. Comment should not therefore be directed to these definitions.

NOTE: Words in italics in definitions are terms defined elsewhere in this Glossary.

101 DIMENSIONAL CO-ORDINATION

The application of a range of related *dimensions* to the sizing of *building components* and *assemblies* and the buildings incorporating them.

102 MODULAR CO-ORDINATION

Dimensional co-ordination using the *international basic module, multi-modules, sub-modules* and a *modular reference system.*

201 MODULE

A convenient unit of *size* which is used as an increment or coefficient in *dimensional co-ordination.*

202 STANDARD MODULE*

A *module* whose size is selected from the preference listed in BS 4011.

203 (INTERNATIONAL) BASIC MODULE*

A *module* with the size of 100mm.

204 MULTIMODULE*

A *module* whose size is an agreed multiple of 100mm.

205 SUB-MODULE*

A *module* whose size is an agreed subdivision of 100mm.

***NOTE:** 1. The following modules:

(a) multimodule of 300mm.

(b) international basic module of 100 mm.

(c) sub-modules of 50mm. and 25mm. are equivalent to the respective units of size recommended in BS 4011 for the derivation of co-ordinating sizes for building components and assemblies, generally subject to a maximum co-ordinating size of 300mm. based on the 50mm. and 25mm. sizes.

2. Multimodules of 300mm., 600mm., 1,200mm., 3,000mm., and 6,000mm.,

are agreed internationally for application to various categories of buildings.

206 MODULAR*

The *sizes* or spacing of which are multiples of the *international basic module, multimodules* or *sub-modules.*

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301 REFERENCE SYSTEM
A system of points, lines and planes to which *sizes* and positions of a *building component* or *assembly* may be related.
301.1 Reference point
A point of a reference system.
301.2 Reference line
A line of a reference system.
301.3 Reference plane
A plane of a reference system.

302 MODULAR REFERENCE SYSTEM
A *reference system* in which the distance between adjacent parallel planes or lines is a multiple of the *international basic module.*
302.1 Modular point
A point of a modular reference system.
302.2 Modular line
A line of a modular reference system.
302.3 Modular plane
A plane of a modular reference system.
302.4 Modular space
A space bounded by modular planes.

303 KEY REFERENCE PLANE
A *reference plane* which defines the boundary of a *controlling zone* or the axis of a load-bearing wall or column.
303.1 Controlling line
A line representing a key reference plane. A plane by reference to which a *building component* or *assembly* is co-ordinated with another.

305 BASIC SPACE
A space bounded by *co-ordinating planes,* assigned to receive a *building component,* or assembly, including allowance for joints.

306 ZONE
A space bounded by *reference planes* within which a *building component* or group of *building components* is arranged, or which may be left unfilled.
306.1 Controlling zone
A zone for a floor, roof, load bearing wall or column.
306.2 Modular zone
A zone bounded by *modular planes.*

307 NEUTRAL ZONE
A *zone* which interrupts the regular increments of a *reference system,* and which may be of *modular* or non-modular size.

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401 GRID
A network of *reference lines* in one plane, generally rectangular.
Associated terms:
401.1 Grid line
A line in a *grid.*

401.2 Modular grid
A *grid* in which the distance between adjacent parallel lines is a multiple of the *international basic module.*
401.3 Modular grid line
A line in a *modular grid.*

402 (INTERNATIONAL) BASIC MODULE GRID
A *grid* in which the distance between adjacent parallel lines is one *international basic module.*

403 PLANNING GRID
A *grid* applied to the plan of a building.
Associated terms:
403.1 Modular planning grid
A *planning grid* in which the distance between adjacent parallel lines is a multiple of the *international basic module.*
403.2 Planning module
The *module* of a *modular planning grid.*

404 STRUCTURAL GRID
A *planning grid* for locating structure.
404.1 Modular structural grid
A *structural grid* in which the distance between adjacent parallel lines is a multiple of the *international basic module.*
404.2 Structural module
The *module* of a *modular structural grid.*

405 SPACE GRID
A three-dimensional network of *reference lines,* generally rectangular.
405.1 Modular space grid
A *space grid* in which the distance between adjacent parallel lines is a multiple of the *international basic module.*

406 (INTERNATIONAL) BASIC MODULE SPACE GRID
A *space grid* in which the distance between adjacent parallel lines is one *international basic module.*

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501 (BUILDING) MATERIAL
Matter from which a building is made.

502 (BUILDING) SECTION
Building material formed to a definite cross-section but of unspecified length.

503 (BUILDING) COMPONENT
Building material formed as a distinct unit.
503.1 Modular building component
A *building component* whose *co-ordinating sizes* are *modular.*

504 ASSEMBLY
An aggregate of *building components* used together.

505 PROFILE
The outline or faces of a *building component* or *section.*

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601 DIMENSION
A distance (e.g. between two points, lines or planes).
NOTE: The definition relates to the geometric concept of a dimension.
In ordinary usage, the word 'dimension' is sometimes used to denote a specified *size*; thus reference is made to the 'dimensioning' of a drawing, when the meaning is to enter upon it the specified values of the dimensions.
601.1 Modular dimension
A dimension between *modular planes.*
602 CONTROLLING DIMENSION
A *dimension* between *key reference planes.*
NOTE: e.g. floor-to-floor height, centre-to-centre of columns.

603 CO-ORDINATING DIMENSION
1. A *dimension* of a *basic space.*
2. A *dimension* which is common to two or more *building components* to permit their assembly.

604 LENGTH
One of two horizontal *dimensions,* normally the greater.

605 WIDTH
One of two horizontal *dimensions,* normally the lesser.
BREADTH—deprecated

606 HEIGHT
The vertical *dimension* above a horizontal reference datum.

607 DEPTH
The vertical *dimension* below a horizontal reference datum.

608 THICKNESS
A *dimension* of a solid in any plane when its size is small compared to that of the other *dimension(s).*

609 FLOOR-TO-FLOOR HEIGHT
The *height* between the upper *key reference plane* of one floor and the upper *key reference plane* of the floor above.

610 FLOOR-TO-CEILING HEIGHT
The *height* between the upper *key reference plane* of one floor and the lower *key reference plane* of the ceiling above.

611 FLOOR-TO-ROOF HEIGHT
The *height* between the upper *key reference plane* of one floor and the upper *key reference plane* of the roof above.

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701 SIZE
The magnitude of a *dimension* in terms of a defined unit.

702 PREFERRED SIZE
A *size* chosen in advance of others for specific purposes.

703 BASIC SIZE
The theoretical *size* of a *dimension* on which the *limits of size* and the *work size* for *dimension* are based.
NOTE: In the construction industry, a basic size is a *size* of a *basic space.*
A basic size may or may not be a *co-ordinating size.* Where it is, it may be a *modular size.*
NOMINAL SIZE—deprecated

704 CO-ORDINATING SIZE
A *basic size* which determines the co-ordination of one *building component* or *assembly* with another.
NOTE: Recommendations for the derivation of co-ordinating sizes for *building components* and *assemblies* are contained in BS 4011.

705 MODULAR SIZE
A *size* that is any multiple of the *international basic module.*

706 WORK SIZE
A *size* specified for manufacture so that, allowing for *tolerances,* the *size* of the finished *building component* lies between the required *limits of size.*
NOTE: This term also applies to the cross-section of a *building section.*
NOMINAL SIZE—deprecated

707 ACTUAL SIZE
A *size* found by measurement.

708 LIMITS OF SIZE
The extreme permissible *sizes,* between which the *actual size* should lie.

709 TOLERANCE
The difference between the *limits of size* between which a *size* or position should lie.

710 DEVIATION
The distance between the actual position of a point and its specified position.

THE PATENT GLAZING INDUSTRY

The change to metric should not greatly affect the patent glazing industry. The kind of programme that is needed is outlined below by P. J. Peters, technical officer, Metal Window Federation of Great Britain.

The patent glazing industry is fortunate in having a product with only three principal related dimensions. Two of these are obtained by cutting to size from stock; they are length and breadth, which can just as well be metric as imperial without much extra effort or extra cost. The other principal dimension, depth, is unrelated to adjacent materials and hence can remain in the imperial system until die or roll re-cutting gives an opportunity to change to all-metric.

Re-training is a fairly simple matter being restricted mainly to familiarisation with length units, tapes and rules.

Small components in patent glazing are generally unrelated to adjacent materials and therefore may easily remain in imperial dimensions until specifications call for the change—little planning of such changes seems to be indicated.

As a result of these relatively simple dimensional relationships, the extensive programme of change issued by the BSI can be pruned to suit the requirements of the patent glazing industry. The following brief notes would appear to be all that is necessary to give guidance:

By December 1968 manufacturers should have product data available in SI units. Conversions will be quite adequate if rounded as follows:

overall dimensions	to 1mm.
thickness of materials	to 0.1mm.
diameter of fasteners	to 0.1mm.
section dimensions	to 0.1mm.
self weight loadings	1 N/m.^{2}
wind loadings	to 1 N/m.^{2}

Any contract likely to be finished before 1972 will probably be in imperial units. Much work by designers and quantity surveyors during 1969-71 will be in SI.

During 1970-1972 contractors will change steadily from imperial to SI systems, job by job. Mixing of units in one job is to be severely deprecated.

Dies and other tools designed after January 1969 should be in mm.

Bought-out components such as fasteners should be obtained in ISO metric sizes as the demand is felt. Maintenance work will demand stocks in imperial units.

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NEWS FROM THE INDUSTRY

Effects on Private House-builder

The financial impact of the building industry's changeover to the metric system on private house-builders could be heavy, Alan S. Ellett, chairman of the NFBTE Metric Committee, told the House-Builders' Conference held in London on 28 November. When this would be felt would depend upon the degree to which private house-building firms were involved in public sector work. Even if house-builders were not involved in the public sector they would sooner or later be affected by the changeover.

Mr. Ellett gave examples to illustrate the inevitability of this effect. First, the Government's decision that the public sector should go metric would obviously influence the private sector: manufacturers of materials and components would not supply half the market in imperial dimensions against an organised metric demand from the other half. In addition, as operatives and staff became exposed to the influence of the public sector, they would become increasingly accustomed to working in metric terms.

On the question of rod reinforcement, used by private and public sector alike, Mr. Ellett pointed out that from 1 June 1969, only seven months away, only metric sizes would be rolled as standard; in 13 months time (from 1 January 1970) metric sizes only would be supplied as standard.

Bylaws, of course, had already been published as metric equivalents which would have to be applied to public and private sectors alike.

The changeover, said Mr. Ellett, would involve the private house-builder in changes in measurement and measuring equipment, office machinery and stationery. Plant such as cranes and mixers would have to be recalibrated, and costing, estimating, work study and long-term planning regulations would be affected too. As well as regulations affecting safety and the building by-laws, computer programmes would have to be re-written. On top of all this, there was the change to decimal currency on 15 February 1971.

Mr. Ellett identified three main areas where visible costs would rise: in the training of staff and operatives; in re-writing, costing, bonusing and estimating; and in the purchase of new equipment. In addition, hidden costs would be incurred in administration, because of the slowing down of performance due to unfamiliarity with the system, and from the increased risk of errors.

Savings might possibly be made as a result of the dimensional co-ordination of components which would lead to variety reduction, rationalisation and large-scale production; in addition, there might be savings in design time.

Architects and other designers could help, said Mr. Ellett, by making themselves aware of the metric changeover programme and its implications, and by appreciating the problems of the other members of the building team. Architects could help too by providing clear drawings, by working strictly to the programme for the changeover as laid down by the BSI and by commenting and contributing to its progress through their professional bodies. Designers could do a great deal, in fact, to inspire confidence in the metric programme.

Timber Difficulties

At a south-west forum held by The Modular Society Standards Committee, it was recognised that designers and contractors would generally face a cleaner change-over, with less intermixing of imperial and metric materials, than manufacturers and merchants.

The change-over appeared a particular problem for the timber merchant. To hold a stock of sizes in both imperial and metric simultaneously would require double the present storage area. Skilled sorters usually grade timber into sizes by eye, but the new metric equivalents were likely to be so similar in shape to the imperial that confusion was almost certain to occur. It was predicted that a resistance to the change would be encountered amongst the older employees, ie, those whose families had been in the timber trade for generations. Manufacturers recognised the need to redesign their products to metric sizes rather than convert the dimensions of their present products from imperial. However, none was willing to become involved in expensive retooling without prior knowledge of the revised performance standards and dimensions required by the 'metricised' Building Regulations. Designers were being hampered by the lack of this same information. The forum urged that revised Building Regulations should be issued with the least possible delay.

Metrication of the Highways

Basic metric design standards applicable to highway design are set out in a Ministry of Transport Technical Memorandum now being issued for use in England, Scotland and Wales by all highway authorities and consulting engineers. The new design standards will be used from 1 January.

The Memorandum sets out recommended metric design standards for urban and rural roads. While it is not comprehensive and further memoranda will be issued from time to time, it contains most of the essential information about design and layout of roads. Design factors, such as design speeds, sight distances and curve radii, are given and also many details of more common interest such as widths for carriageways, footways and central reserves.

Under the metric system laid down in the Memorandum, the high design standards of highways used in Great Britain will be maintained without affecting costs of construction. The types of road dealt with range from dual four-lane roads with 14.6 metre carriageways to single-lane carriageways 3.5 metres wide used in the remoter parts of the country and as access roads in residential areas.

Metric for Rotherham College

The new two-storey craft block at the Thomas Rotherham College, now taken over by Sixth Form College students, is believed to be the first educational building in the metric modular system to be completed for a local authority. The education authority required the additional accommodation to teach housecraft, metal and woodwork.

After investigating available building systems, the Sheffield architects and engineers, Hadfield, Cawkwell, Davidson & Partners, members of The Hallamshire Architects Group, recommended the A75 metric modular system, embodying lattice steel beams and frame, of A. H. Anderson Ltd., of London. Cost, speed of erection, standard of finish, adaptability for inclusion of services and particularly for sound reduction qualities, were the more important considerations governing the choice.

The £29,200 block was built direct by the works department of Rotherham Borough in four months and classes were under instruction in the new block within five months of commencement.

Factory Built to Metric

Demag Hoists & Cranes Ltd., of Hemel Hempstead, Herts., subsidiary of Demag Zug of West Germany, is to build a factory and office block on the metric system at Banbury, Oxon. The Technical Division of P-E Consulting Group was retained as architects for the buildings, which will eventually consist of 7,000 sq.m. of production area and 2,400 sq.m. of offices on three floors, as well as service and welfare buildings on a landscaped site.

Construction will be phased over five years and all buildings have been designed to allow for each stage of expansion with the minimum of disturbance to the work carried on.

Getting to the Point

ICI is to adopt decimal pricing for certain products from 1 January. Individual invoice items will be shown in decimals only, total invoice amounts being presented additionally in £sd.

Three ICI Divisions will be involved. These are Mond, for all its products except lime, and the Agricultural and Nobel Divisions, for their chemical products. The plans of other divisions are also well advanced.

Learning Metric

With the approach of 1969, and the first designs in metric units being required for public sector contracts, a system called Metripack, which purports to overcome the hurdle of thinking and working in metric in something like 50 hours, has had a timely launching. It comprises some 40 separate lessons (or modules, which is given as a euphemistic alternative) which cover the whole range of metric knowledge that will be required in the construction industry. Provided, it is claimed, the nature of the trainee's job is known, by his answers to an adaptive test it is possible to tailor a programme that will exactly fit his learning needs, i.e. no metric tuition surplus to his needs is given.

The lessons appropriate to each person are made up in packs, complete with visual aids. These include a scale, thermometer, reference cards and everything else needed to help the individual acquire metric thinking. The course is designed so that each lesson is properly learnt before further advances are made.

In addition to the individual packages, the system includes a package for company training officers which contains a pre-recorded lecture tape, film slides and other aids. These should enable him to start his own staff seminar within the context of his company's operations.

Initial samples of the Metripack questionnaires surprisingly make frequent use of the centimetre—not an SI unit. It is explained, however, that early concentration was on getting the system right, and having done that there would be a general tidying up of the content, including identification in the BSI recommendations.

The cost of a Metripack system varies according to the number and types of staff to be trained but as a rough guide the order of cost is as follows:

Secretarial and junior staff: £12 per head; main grade technical staff: £25 per head; some specialist functions up to £35 per head.

Inquiries should be made to Northwood Metric Services Ltd., 258 Gray's Inn-road, London, WC1.

Weekend Course

A weekend course for their management personnel was held by J. M. Jones & Sons Ltd., building and civil engineering contractors, at Hartley Wintney, Hampshire, from 6-8 December. The 86 senior members attending were formed into syndicates to study the problems created by metric conversion.

'Going Metric' Exhibition

An exhibition called 'Going Metric' will be opened on Monday, 10 February, at The Design Centre by Anthony Wedgwood Benn, Minister of Technology. It will show what the metric system is and how industry may use the change to metric as an opportunity to improve products and production processes. The effect on exports, communications between scientists and engineers, international travel, sport and education will also be illustrated.

During the exhibition, which closes on 8 March, a programme of half-day seminars for senior management in the engineering industries is being arranged by the Council of Industrial Design.

Metrication for School Building

Local authorities are given guidance on the metric changeover, particularly as it relates to educational building, by the Department of Education and Science in an administrative memorandum (14/68 'Metrication in the construction industry'). It deals with the administrative arrangements needed to ensure that educational building projects conform to the agreed BSI programme. An appendix gives the metric analogues for the Standards for School Premises Regulations 1959. The metric equivalents of dimensions quoted in Building Bulletin No 7 'Fire and design of schools' are also given.

Concrete Pipes

The Concrete Pipe Association has put forward a recommendation that standard bore designations for concrete pipes should be 150mm to 900mm in 75mm increments and then 900mm to 1,800mm in 150mm increments.

Metric Bibliography

The MPBW is to publish, early in 1969, a comprehensive Metric Bibliography. This will be used by the BSI and Building Centre lecturers in the campaign of explaining the change to metric in the construction industry.

LETTERS

Metric Warehouse

Sir,—I have recently read the latest edition of BMN, and there are a number of small points which I feel I should draw to your attention.

(a) Bovis Metric Contract Article.

(i) There is no need for any builder to buy himself a so-called 'metric theodolite' with 400 grade circles. The grade or centesimal system is only used in some parts of Europe, and it is not part of S1.

I should have thought an editorial comment to this effect would prevent many of your less informed readers from dashing out to buy a particularly useless and expensive piece of equipment.

(ii) Mention is made of visualising 305mm as a foot—we have found that 300mm is an easily envisaged unit for students and is sufficiently close to the one foot rulers they are traditionally accustomed to handle.

(iii) The use of the comma as the thousand marker appears consistent throughout despite the past pronouncements by BSI and others—I would imagine BMN should set an example in presentation.

Since so much material was published recently using the comma as a decimal marker, it is a dangerous practice to reintroduce the comma for groups of three digits.

(b) Article on lamps.

The comma again!

(c) Footnote to Table 4.

(i) The comma again!

(ii) Surely, the last part should read 'i.e. 1000 kg/m^3=specific gravity of 1.000' and not a specific gravity of 1,000.

W. S. WHYTE [ARICS, AIAS, FRSA],
Senior Lecturer,
Leicester College of Art & Design.

(Until the official BSI date for designing in metric is reached, it is deliberate policy on our part not to comment on initial projects in metric working. We agree, however, that some comment on the Bovis metric contract would have been helpful. As regards the use of the comma as the thousand marker, a revised version of PD6031, which governs future notation, is shortly to be published and we shall then adopt its recommendations. This should eliminate any residue of confusion between the dot and comma which led to the error in specific gravity noted by Mr. Whyte—ED.)

PUBLICATIONS

Conversion for Machine Tools

Mintech has published a 22-page guidance booklet 'Machine tools for metric production' which deals with some of the factors to be considered by machine tool users in changing from imperial to metric production. The booklet, which is the work of the Machine Tool Industry Research Association, is based largely on the experience of the machine tool industry and on those of a number of other companies who have also made detailed studies of the problems involved in changing to the metric system.

In addition to the many aspects of conversion of existing machine tools, the booklet contains a full description of inch-metric feed screw indicators and lists the manufacturers of a range of dual-dial indicators and other dual-reading devices. Copies of the booklet are obtainable free of charge from the Ministry of Technology or the Machine Tool Industry Research Association.

Load/Span Tables

In readiness for the change to metric the Federation of Concrete Specialists are preparing revised span tables in SI units for precast and in situ floors. They can be used in conjunction with the metricated revision of CP 114, 115 and 116, and for the unified structural code when the latter is available. Further information can be obtained from the FCS, 13 Goodwin's-court, St. Martin's-lane, London, WC2.

BMN
Building Metrication News

Metrication, the Computer and SI

This is the third of a series of conversion tables compiled by R. M. E. Diamant and B. A. L. Hart which appears in this section each month. They are to be used like logarithmic tables, using a ruler to ensure clear distinction of the horizontal lines. The tables have been set with the help of the English Electric KDF9 computer at the University of Salford.

Table 5

Kilogrammes per metre to pounds per foot to pounds per yard.
Note: DIFF signifies units of two so that the reading for any number required is taken at the intersection of the appropriate horizontal 10 unit line and the vertical two unit column.

DIFF	0	2	4	6	8	0	2	4	6	8
kg/m			lb/ft					lb/yd		
0		1.3	2.7	4.0	5.4		4.0	8.1	12.1	16.1
10	6.7	8.1	9.4	10.8	12.1	20.2	24.2	28.2	32.3	36.3
20	13.4	14.8	16.1	17.5	18.8	40.3	44.4	48.4	52.4	56.4
30	20.2	21.5	22.8	24.2	25.5	60.5	64.5	68.5	72.6	76.6
40	26.9	28.2	29.6	30.9	32.3	80.6	84.7	88.7	92.7	96.8
50	33.6	34.9	36.3	37.6	39.0	100.8	104.8	108.9	112.9	116.9
60	40.3	41.7	43.0	44.4	45.7	121.0	125.0	129.0	133.1	137.1
70	47.0	48.4	49.7	51.1	52.4	141.1	145.1	149.2	153.2	157.2
80	53.8	55.1	56.4	57.8	59.1	161.3	165.3	169.3	173.4	177.4
90	60.5	61.8	63.2	64.5	65.9	181.4	185.5	189.5	193.5	197.6
100	67.2	68.5	69.9	71.2	72.6	201.6	205.6	209.7	213.7	217.7
110	73.9	75.3	76.6	77.9	79.3	221.8	225.8	229.8	233.8	237.9
120	80.6	82.0	83.3	84.7	86.0	241.9	245.9	250.0	254.0	258.0
130	87.4	88.7	90.0	91.4	92.7	262.1	266.1	270.1	274.2	278.2
140	94.1	95.4	96.8	98.1	99.5	282.2	286.3	290.3	294.3	298.4
150	100.8	102.1	103.5	104.8	106.2	302.4	306.4	310.5	314.5	318.5
160	107.5	108.9	110.2	111.5	112.9	322.5	326.6	330.6	334.6	338.7
170	114.2	115.6	116.9	118.3	119.6	342.7	346.7	350.8	354.8	358.8
180	121.0	122.3	123.6	125.0	126.3	362.9	366.9	370.9	375.0	379.0
190	127.7	129.0	130.4	131.7	133.1	383.0	387.1	391.1	395.1	399.2
200	134.4	135.7	137.1	138.4	139.8	403.2	407.2	411.2	415.3	419.3
210	141.1	142.5	143.8	145.1	146.5	423.3	427.4	431.4	435.4	439.5
220	147.8	149.2	150.5	151.9	153.2	443.5	447.5	451.6	455.6	459.6
230	154.6	155.9	157.2	158.6	159.9	463.7	467.7	471.7	475.8	479.8
240	161.3	162.6	164.0	165.3	166.6	483.8	487.9	491.9	495.9	499.9
250	168.0	169.3	170.7	172.0	173.4	504.0	508.0	512.0	516.1	520.1
260	174.7	176.1	177.4	178.7	180.1	524.1	528.2	532.2	536.2	540.3
270	181.4	182.8	184.1	185.5	186.8	544.3	548.3	552.4	556.4	560.4
280	188.2	189.5	190.8	192.2	193.5	564.5	568.5	572.5	576.6	580.6
290	194.9	196.2	197.6	198.9	200.2	584.6	588.6	592.7	596.7	600.7
300	201.6	202.9	204.3	205.6	207.0	604.8	608.8	612.8	616.9	620.9
310	208.3	209.7	211.0	212.3	213.7	624.9	629.0	633.0	637.0	641.1
320	215.0	216.4	217.7	219.1	220.4	645.1	649.1	653.2	657.2	661.2
330	221.8	223.1	224.4	225.8	227.1	665.3	669.3	673.3	677.3	681.4
340	228.5	229.8	231.2	232.5	233.8	685.4	689.4	693.5	697.5	701.5
350	235.2	236.5	237.9	239.2	240.6	705.6	709.6	713.6	717.7	721.7
360	241.9	243.3	244.6	245.9	247.3	725.7	729.8	733.8	737.8	741.9
370	248.6	250.0	251.3	252.7	254.0	745.9	749.9	754.0	758.0	762.0
380	255.3	256.7	258.0	259.4	260.7	766.0	770.1	774.1	778.1	782.2
390	262.1	263.4	264.8	266.1	267.4	786.2	790.2	794.3	798.3	802.3
400	268.8	270.1	271.5	272.8	274.2	806.4	810.4	814.4	818.5	822.5
410	275.5	276.9	278.2	279.5	280.9	826.5	830.6	834.6	838.6	842.7
420	282.2	283.6	284.9	286.3	287.6	846.7	850.7	854.7	858.8	862.8
430	288.9	290.3	291.6	293.0	294.3	866.8	870.9	874.9	878.9	883.0
440	295.7	297.0	298.4	299.7	301.0	887.0	891.0	895.1	899.1	903.1
450	302.4	303.7	305.1	306.4	307.8	907.2	911.2	915.2	919.3	923.3
460	309.1	310.5	311.8	313.1	314.5	927.3	931.4	935.4	939.4	943.4
470	315.8	317.2	318.5	319.9	321.2	947.5	951.5	955.5	959.6	963.6
480	322.5	323.9	325.2	326.6	327.9	967.6	971.7	975.7	979.7	983.8
490	329.3	330.6	332.0	333.3	334.6	987.8	991.8	995.9	999.9	1003.9

Table 5. Kilogrammes per sq. metre to pounds per foot to pounds per yard. This table is to be used for peripheral loading calculations, edge loading, as well as giving the weight/length particulars of such items as beams, rods, panels, etc.