

M2

Metric Design Guide

General Services Administration
Design and Construction Division
Region 3 Philadelphia

Third Edition

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Acknowledgements

Introduction

Since issuance of the last version of this guide, SI has taken firm root in the US construction community.

For almost all Americans, there is now a project being planned or designed which will be built in metric within 1-2 hours of their home.

Many of us are located close to some of the projects already being constructed in metric.

Some of the largest federal and state projects are now being planned or designed in metric, and significant activities have begun at local levels.

It is highly probable that the type of project you are starting has already been designed in metric by another region, or another federal, state or local government.

At a minimum, something similar has been designed in metric, to answer your questions. The trick is locating the proper source, and obtaining material you need.

Through strong communication this can be achieved.

Now managing major metric construction projects, we reject assertions that metric design and construction are not feasible.

After January 1994, all GSA renovation and new construction projects shall be designed in metric.

We thank the private firms, contractors, government agencies, and individuals who provided feedback.

This document may be freely copied and distributed.

Our goals for this edition have been:

1. Give lessons learned on use of metric.

2. Minimize impact on design firms, contractors, and producers, while complying with the national directive of complete metric conversion.
3. Use private sector guidance wherever possible.
4. Convert to a metric thought process.

Many regions have metric construction, and most others have done metric planning or designing, so basic material has been condensed or deleted.

We have avoided using old units wherever possible.

5. Improve page efficiency, getting more on fewer pages, making it feasible to insert the document into every AE and construction bid package. This also reduces costs and conserves resources.

Most guidance is consistent with the previous edition.

This document supplements national policies. If it conflicts with them, those documents ofcourse govern.

WARNING Sample drawings and data are from many sources and are for the explicit purpose of showing good metric practice. They are not represented as current design criteria. Applicable codes and criteria should be consulted prior to design on projects.

Sample drawings are from US projects in design and construction, so drawings may be preliminary. Some drawings are from project add alternates, thus actual construction may vary from details shown.

We admit selecting only details or portions of details showing good

metric practice. Some details have been modified to delete inconsistent practice. Due to graphic modification, details may not be to scale indicated.

Based on project knowledge, we feel confident to design and build any road, sitework, or facilities project in metric, anywhere on American soil, at little to no cost impact, using the compromise approach established in this document.

As is unfair to project that the information in this document is of our doing only. We have tried to credit other sources for their metric experience.

As our leaders in the recent past simply resolved to place an American on the moon, and attained this through the sheer willpower and resolve of the American people, let us simply resolve to conclude the issue of metric conversion, for the national good.

Let us make the firm choices and gladly accept the effort required. We are looking for partners to move boldly and decisively with us in a direction that is very clear at this point.

Doing this will level the playing field for the next generation, the children and grandchildren in our families, so they may compete head on with other nations, without hindrance of an outdated system whose time has come.

In this edition, we have focused primarily on hard metric products commonly used in construction.

For a listing of firms that can fabricate or install these products, ie, construction firms that feel comfortable working in metric, see M1.

Products listed are made in USA, unless noted.

This directory is open to firms making metric products commonly used in federal construction.

Firms interested in being included may contact us.

Some firms listed minimum orders for products. These minimums will get smaller as we constantly buy metric products. If your order is half the minimum listed or more, we recommend you contact the manufacturer to determine their current interest.

We have deleted some product categories where obtaining metric products has not been a problem, and have given overall guidance to assist specifiers.

America recently regained its status as the world's largest exporter, and our firms are improving market share for many products.

Momentum is building in the American industrial machine, and an important component is use of SI.

Over the past year, we have spoken with thousands of manufacturers, designers, project managers, personnel in education, and representatives of construction firms.

The mood of the nation has shifted. There is a significant and growing body of people that realize that metric is a smart move for this country, and these individuals support the movement toward this system. There is ofcourse resistance.

The American construction community specifically though has responded to the challenge. We now track which contractors have done metric construction, which can build in metric with little difficulty, and which firms have already bid metric projects in this country. These results will appear regularly in M1.

While metric receives mixed initial review, many tradespeople prefer it after some learning period.

We have also encountered metric capability where we did not expect it.

We must conclude that original estimates of extensive effort to convert did not materialize.

When partnering between government and private industry is meaningfully applied, conversion to metric, and realization of the benefits of this system, are no more difficult than the introduction of any new technology or policy.

As the Federal landlord, we have frequent contact with many federal, state and municipal agencies.

Another document, M1, was developed to keep abreast of their metric conversion activities.

Title: M1, Metric Activity in US Construction

M1 is separate because metric projects and activities within government are changing rapidly, needing more frequent revision than design information.

M1 will be updated every few months.

M1 can be downloaded by interested parties from the Region 3 Bulletin Board Service: 215 656 6465

All regional specifications will soon be upgraded to conform to this document.

We welcome comments on this text.

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Philosophy

These three pages give our ideas on successful conversion while minimizing any costs involved.

There are 5 priority actions, ranked by importance:

1. M60
2. Strong Communication
3. Professional Rounding
4. Metric Codes and Criteria
5. Partnering with the Construction Community

1. M60 M60 is the most important action necessary for metric conversion, and takes the most courage to implement.

In many documents read, we have not seen a simple definition of success, of when an agency is metric.

This formula mirrors our progress.

M60 means "metric on 60 % of design this year".

With 60 % of design in the current fiscal year being done in metric, we feel all necessary momentum will be generated to permanently sustain conversion.

Example: A certain region, in this fiscal year, has 300 design projects, total of about \$ 100 million.

If 60 %, or \$ 60 million, is designed in metric, the entire organization will move to metric, and rapid development of group confidence takes place.

We select design as we view it as a largely irreversible process, without significant cost after a certain point. 60 was used since it represents a majority of the work.

The implications of this statement are significant.

Fewer projects can be selected as metric projects As few as 10 or 20 projects could combine from the design program can meet this M60 threshold. Then it is possible to work with a small group of architects or engineers who will run comparatively few projects, yet this engine will convert the entire organization. These people should generally be willing to work in metric.

We recommend that the M60 program be made up of medium to large size projects, the larger the better.

Anchor Effect This 60% block formed an anchor for our conversion effort. With many major projects being designed metric, a galvanizing effect occurred to managers of small and medium sized jobs. They felt more confident to do metric projects, with x or y project going well in metric.

Combined Buying Power With major projects being done in metric, local suppliers are more willing to make changes to supply metric products. Some suppliers were reluctant to go metric without indication it would be worth it. With M60, this project block is often enough to show a sustained market.

This block can establish metric product availability, and lower order quantities. Ex, if a medium project needs 200 pieces of metric product x, some firms may not supply it. However, with 200 now, and another 4000 documented through M60 over a few years, views may change considerably.

To gain this same amount of buying power, an organization may have to select perhaps 50 or 100 projects of smaller construction value, by far the more difficult route to becoming a metric organization.

On The Job Training M60 can make the organization metric as it brings the best metric training to the

organization at about no cost. While only ten or fifteen staff run metric projects, we found many other people and divisions involved at stages (ex, reviewing designs or estimates, or in technical meetings). This framework introduces others to metric. Drawings, specs, estimates, appear in near finished format, developed by familiar faces, which enhances confidence.

A pool of metric experts is formed, the knowledge base grows quickly, and guides the organization.

Automatic Infrastructure When an group as ours simply decided to be metric, to meet M60, automatic needs were created for specs, criteria, codes, training devices, and other parts of metric infrastructure. Priorities are soon established. (ex, What specs to convert? This answered by seeing the 120 or 150 needed by the M60 program) A program becomes prepared for 100 % metric design. Items not needed by an M60 program may never have to be converted.

Partial Conversion Some will not wish to be a part of conversion. M60 allows projects to be developed in old units, for an interim period, if truly necessary.

In summary, we feel an organization can go metric almost surgically, highly successfully, by deciding to be metric, and meeting M60 in this fiscal year.

Related groups move after M60 action occurs. Design and construction firms trained workers. Builders and unions sought assistance. Suppliers made changes, and developed product literature.

In short, once an organization decides to be metric, all other activities fall into place.

Deciding to be a metric organization, ie M60, is by far the

most important activity in metric conversion.

This applies not only to government, but also to private and educational organizations.

Ex, Moving a college building program to M60 status would have more impact than courses in metric architecture alone. M60 creates a laboratory on campus, actual uses of SI. Many educators say if industry used SI, english would vanish from schools.

Rulers and posters create awareness, but M60 will move construction decisively to the SI system.

2. Strong Communication During much training, a major lesson learned, predictably, is that people feel much more confident to work in metric, when they know other projects nearby are being done in metric.

It makes a great difference to know in the next county, a \$15 million building, or a \$ 10 million interchange, is in design or construction in metric.

Most people know metric is here, but it galvanizes reality when projects, and exact locations, are known.

As metric coordinator, after starting the M60 program, the important task is letting those in and outside the region know the metric projects.

This can involve as little as a one page list, or a message on e-mail, as to what projects are being done.

The National Institute of Building Sciences (NIBS), Construction Metrication Council, manages conversion of US construction, involving agencies, producers, builders, and professional groups. The Task Force on Metric Projects is ideal to communicate your activities.

You can improve confidence of those around you to go metric by relaying your activity. New projects by nearby groups then enhance your ability to obtain metric products and may lower costs or minimum orders.

We recommend a 1-2 page Metric Project List, giving:

All metric projects being done in your organization or region, construction value of each, and the status (planning, survey, design, construction)

This is the most powerful information you can have at your disposal as a metric coordinator.

We would give this to staff and the Task Force. If interested, please fax to either task force co-chair:

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3. Professional Rounding Over 90 % of products in construction today will not physically change during metric transition. We simply show dimensions in metric, ie, soft conversion.

These two terms help explain how to use 90 % soft metric products and still use round dimensions on projects. Examples from varied areas follow.

Product Dimension: size of an item not easily modified

Design Dimensions (dds): dimension that can be varied, often through fabrication or installation

Airports Concrete and soil have no dimension. Structures of them are

often governed by dds. Width of runways and taxiways and dimensions of clear zones, can often be hard metric. Imaginary surfaces may also be dds, if the airport is frontal layout, finger system, split finger, or other variety. Product dimensions for lighted runway and taxiway lights, beacons, wind indicators, guidance signs and gangplanks, can often be soft converted.

Bridges Rolled steel wide flanges to construct simple steel bridges are soft converted products, yet beam, girder, and lateral bracing lengths are dds which can be varied. Vertical bridge clearances are dds.

Environmental In water supply and waste treatment, components (ex, clarifiers or centrifuges) could be soft converted, yet structures for sedimentation tanks, grit chambers, sand filters, activated sludge process facilities, oxidation ponds, sludge thickening facilities involve many dimensions which can be rounded.

Facilities Rooms are often from centerline to centerline or face to face, if studs are hard or soft metric. Light switches are soft, but mounting heights are easily rounded. Ceiling heights are dds. Bar placements and wall thickness are dds. Slab to slab heights (ex, 5 m) are dds.

Conduit, alarm systems, motors, receptacles, switchgear, air handlers, boilers, pumps and valves will have product dimensions soft converted, but installation dimensions (ie, dds) are hard converted.

Marine Mooring posts, cleats, piles, fender systems, buoys, and precast breakwater units have product dimensions which could be soft converted. Yet turning basins, breakwaters, freight terminals, bulkhead wharfs, dolphins, fixed mooring berths, rock moles and trestles, have dimensions that are readily rounded.

Rail 136 RE rail and standard joint and tie components may be used in elevated high speed rail, with products soft converted, yet center to center for support piers could be hard, such as 25 m. Top and subballast thickness are dds, as well as right of way, such as 20 m each side. Frogs, spikes, and wood ties could probably be soft converted.

Water Engineering Prefabricated components in hydroelectric facilities may be soft converted, such as impulse or reaction turbines. Yet a primary product is concrete, so the dds such as height, thickness, spillway and intake tower dimensions, could be hard metric.

100 % Rule Over 90 % of current products will be used, but strive for 100 % hard design dimensions.

Most drawings show installation dimensions, which can be varied, often independent of product sizes.

Thus drawings will be mostly hard metric and make installation by our partners in the trades easier.

4. Metric Codes and Criteria

Criteria We recommend new or revised criteria for design (ex, handbooks, specs) be issued in metric only.

People no longer debate if or when, but realization of permanence emerges, and metric thinking begins.

Directives to go metric, along with issuance of dual dimensioned criteria, appear contradictory.

If the new ceiling height is 2700 mm, those with any experience will not forget this is about 9 feet.

Old documents propagate for years, even decades, and will bridge the

gap from metric to english as needed.

Codes Grade A metric codes would make metric design simpler and more desirable.

Ex, a code might state 44" (1118 mm) minimum width. While it is very helpful to have metric included, rounded design might lead to 1200 or 1150 being used.

The greatest improvement would be new dimensions in 100 and 50 mm sizes. Could 1100 be the new size? This is of course a professional judgement.

However, since rounded metric sizes are not in codes yet, many still use english sizes during daily speech. Grade A codes would greatly assist metric transition.

Fortunately, many code sizes are lengths, which when converted usually get smaller, and offer many little cost savings. Ex, from above, if 1100 is possible, small savings would appear over many situations.

5. Partnering with the Construction Community Construction firms have little time to prepare bids for a project. This pressure increases on a metric project.

Prepare your community with:

- 1) Reference Material
- 2) Clarity on Hard Metric
- 3) Advance Notice

Reference material reveals what you obtained from months of metric design. This document may be a good first step. List other suppliers you have found.

At pre-bid meetings, identify the hard metric products. Explain most products are the same as previously used.

Advance notice means alerting local groups, unions and societies of forthcoming metric projects.

In summary, from our experience with metric, we feel we could design and build about any project in this country, completely in the metric system, using this compromise philosophy.

From discussions with builders nationwide and talks with managers on metric projects, we could provide 10 firms to bid any metric project over \$ 500,000, almost anywhere in the United States.

January 1994 is feasible for all construction in our country to be designed in metric, utilizing techniques established in this document.

The design and construction projects now being done in metric indicate to us this is possible.

Usage

Metric Slang From PCs, CAD and fax, from Seatac to the Keys, the Alcan, the Lone Star, the Bay Area, and the Beltway, slang is part of our vibrant culture.

Americans are efficient and we like things fast. Our people will brand the SI system with our personality and make it our own.

While perhaps controversial, we do not discourage this, as we feel a verbally modified system will be more quickly accepted in society at large.

Smooth and catchy words such as nada are easily incorporated into our daily speech.

The critical issue is that SI be implemented, and that everyone is clear what the new expressions mean.

Few are confused when five kilos, a non-SI term, instead of five kilograms, are referred to.

This information shows techniques from daily usage, but is not represented as preferred metric practice.

mmoc We have seen the term "mmoc" on drawings, to mean mm on center. (ex, Fasten every 600 mmoc)

The "x" can verbally represent "hundred millimeters".

(ex, "five x", vs "five hundred millimeters", 2 vs 7 syllables) This can be very efficient for lengths up to 10 meters (ex, 5 x, 12 x, 52 x, 78 x).

Even fractions can be verbally faster using x. (Ex, point five x, vs. fifty millimeters)

This also helps people to use 100 mm increments.

"x" does not conflict with any other SI symbols.

Modular Products such as ceiling tiles, access floor, light fixtures, and carpet tiles, have few standard sizes. We often use shorted names for 100 mm increments. 5 x 5 is 500 x 500, 6 x 6 is 600 x 600, etc.

Centimeters While not used in drawings and specs, they are used in other countries in day to day life. We sometimes call them "c's" (pronounced "seas"). (ex, the report was about 2 seas thick)

This technique was used earlier with cc's for volume.

Pascals "k-p-a" is often said instead of kilopascals, and "m-p-a" instead of megapascals.

Mass Megagram (Mg), equal to 1000 kg, is SI, and is our choice for large masses. (ex, rebar, steel, gravel)

We like to call them "meg". (ex, eighty meg of rebar)

This is already used by people in daily speech, such as a 25 meg hard drive.

We hear metric ton used, but we find it slow, and it can be confusing, since people often drop metric and say only tons, even when metric tons are meant. Micrometers are often shown as "um" since the micro character can be hard to use on many keyboards.

(ex, 25 um means 25 micrometers)

Superscripts can be cumbersome, and are often avoided in correspondence, using only the number.

2500 m³ means 2500 cubic meters.
1100 g/m² means 1100 grams per square meter.

Rule of 3's For Meters Many say, no matter how many classes attended, they will never have a feel for meters. The rule of 3's can help, and is fairly accurate.

Feet times three, move decimal left one digit.

50 feet, times 3 = 150, move decimal, 15 m
20 feet x 3 = 60, yields 6 m

Rule of 4's For Hectares This rule can help develop a general feel for converting commonly used acres to hectares (ha), or hecters, as many pronounce it.

Multiply acres times 4, move decimal left one digit.

30 acres x 4 = 120. Move decimal yields 12 hectares.
10 acres x 4 = 40, yields 4 ha.

Rule of 10's For Square Meters

Square Feet divided by 10 = Square Meters

500,000 SF divided by 10 = 50,000 m²

For diehard fans of the old system, who can not bring themselves to use meters, the ideal transition unit may be the metric foot, equal to 300 mm, or 0.3 m.

So the 8 foot ditch becomes 8 metric feet, or 2.4 m.

Drawings

Good drawing practice is demonstrated on the sample drawings in this document.

Centimeters shall not to be used.

Dual dimensions shall not be used.
Example, 200 mm (7-7/8")

Dual dimensions are a complete waste of time in construction documents. When english units are there, readers use them and ignore the metric.

Use preferred scales:
1:1 1:2 1:5 1:10 1:20 1:50 1:100 1:200
1:500 1:1000

Many state DOTs use 1:250 for urban plan sheets.

ISO Paper Sizes are the standard international paper sizes, and are often available within a few weeks, anywhere in our country, from domestic sources.

Many state and federal agencies, such as Army Corps, Huntsville Division, are now using them.

We are now generating designs in this region around A1 size. Designs are to now use ISO sizes, see below. The Government Printing Office now stocks A4 paper for purchase by other agencies.

Many state highway groups have adopted A1 as their standard drawing size.

A0 1189 x 841
A3 420 x 297
A1 841 x 594
A4 210 x 297

A2 594 x 420

Specifications

Several questioned our use of mm for large dimensions. In response, we have utilized both m and mm in specifications in the interim period, and have found little difficulty or confusion using either.

Our new general rule is to use m or mm, whichever you prefer. Examples:

Concrete to be 200 mm thick. (0.2 m could be used)

Clearance shall be 1500 mm. (1.5 m could be used)

This practice differs from drawing usage where mm are used exclusively in many areas.

In specifications, the unit (ex, m or mm) is almost always present. Little room exists for confusion. On drawings, using mm eliminates the need to write m or mm, and eliminates decimal usage for all but large scale civil and road design drawings.

Centimeters should not be used. A small class of items reference standards using cm or cm², such as fire ratings for some products. These areas only, which account for less than 2 % of specification references, should make reference to cm or cm².

It is recommended that each region establish a directory of pure SI specifications, as we have done, and not mix SI and english specifications.

It is also not recommended to have both metric and english in a guide specification section, as this requires spec writers to edit english out of the document.

Nominal Technique Many spec references can effectively use nominal mass, nominal volume, or nominal length technique. Ex, if 1 gallon of product x is required (or, 3.785 L) the spec could be rewritten using nominal volume, requiring 4 L (+/- 0.25 L). People can then say 4 L when referencing this item, yet still allow current product to be submitted.

Rounding

Having seen many metric drawings, and seeing the downstream effect, we feel rounding of design dimensions is a very high priority.

Too many review comments on metric projects state that we do not prefer bar spacings at 305 mm on center, or base plate dimensions of 460 x 460, and similar items.

The professional rounding concept helped, but we have developed a simpler, but firmer stance on this issue.

The Ratchet: 100 50 10 5 1

The ratchet is a five level priority system, 100 being highest priority, which requires justification to move down one ratchet. (ex, to move from 100 to 50)

Thus design dimensions, created in ones mind, should be increments of 100 mm, unless solid reasons exist to move down a ratchet to design in 50 mm increments.

Room sizes in new construction and renovation are ofcourse in 600 mm increments unless not possible.

The ratchet applies most directly to design dimensions, which are smaller than room dimensions, such as 3600 x 4800, but larger than product dimensions, such as 92 mm metal stud sizes, which are often fixed.

Examples: bathroom stall widths, bathroom component mounting heights, concrete wall thickness, window dimensions, base plate sizes, parking stall widths, cabinet widths, counter heights, slab thickness, door louver and window sizes, ductwork sizes, shelf spacing, railing heights and on center dimensions, landscape installation dimensions, etc.

Critics have indicated this is not always possible, which we know. But increments of 100 and 50 mm should now become the baseline for project design, with 10 and 5 mm increments used only as required.

Simple Mathematical Rounding shall not be used.

Ex, A design dimension simply converted to 3658 mm.

Professional Rounding shown below, takes simple mathematical rounding, adds professional judgment.

Step 1. Convert The Dimension Mathematically A pavement width in some codes becomes 914 mm.

Step 2. Select A Replacement Dimension (Use Ratchet)

1000 would be the preferred replacement.

950 would be used only with justification.

900 would offend the code and could not be used.

For non code dimensions, smaller dimensions in increments of 100 might be selected.

Ex, custom cabinets are to be built to a width that converts to 508 mm. 500 would be the probable choice, and would be permitted if this were not a code or exact required dimension.

Codes and Standards

About 90 % of codes and standards needed by us to do design are available today in metric.

Many not in metric are being converted now.

Codes and standards have not hindered renovation or new construction designs in metric to date.

Documents listed below are now being extensively used in metric design projects of every sort.

For codes or standards not in metric, rounding techniques have been proven sufficient.

The missing component to full metric conversion in United States construction is the implementation of metric design projects in the federal, state, local and private design communities.

Only this full implementation will create the need to continually improve metric codes and standards.

These are sample documents where most of the text, or the entire text, contain SI/english or pure SI data.

AASHTO Standard Specs. for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (1985), including revisions to 1991, have SI data.

Construction Manual for Highway Bridges and Incidental Structures has SI in many areas.

Standard Specs for Highway Bridges contain SI data and formulas in appendix E.

Standard Specs for Transportation Materials, now contain SI, in Parts 1 and 2. Many tests use SI only. Many standards are identical to ASTM standards, most of which now contain SI data.

ACI 318M, 318.1M available, which are SI versions.

ACSM Amer Congress on Surveying and Mapping Metric Practice Guide was recently reissued.

AFPA Amer Forest and Paper Assn First LRFD manual and next National Design Spec will have SI.

AIA Graphic Standards, has SI chapter. Masterspec will be available in metric shortly.

AISC LRFD Spec and Properties of Structural Shapes are in SI version. Metric Database for ASD and LRFD available. Manual of Steel Constr to be SI in 1994.

ASHRAE All handbooks available in SI.

ASME Most ASME standards contain SI data.

ASTM ASTM Standards in Building Codes contain SI in almost every standard.

AWS AWS standards contain SI data. BOCA National Building, Fire Prevention, Mechanical and Plumbing Codes have SI.

CSI CSI Spectext has SI. Other CSI publications contain SI or are being converted now.

CSSB Cedar Shake and Shingle Bureau WA, New Roof Construction manual comes in SI version. Michael Westfall (206) 453-1323

IES Illumination Engineering Society Handbooks contain SI data.

KCMA Kitchen Cabinet Mfrs Assn Al61.1, Recommended Performance and Construction Standards for Kitchen and Vanity Cabinets now has SI. KCMA reports exporting firms do so in SI units.

NEBB National Environmental Balancing Board Fundamentals, Air Systems, and Hydronic Systems guides available in SI.

NFPA Almost all standards now have SI.
Examples:

NFPA 13 Installation of Sprinkler Systems
NFPA 20 Installation of Centrifugal Fire Pumps
NFPA 24 Private Fire Service Mains
NFPA 70 National Electric Code
NFPA 101 Life Safety Code

SBC Standard Building Code has SI. 1994 versions of Fire, Plumbing and Mechanical will have SI.

SMACNA All SMACNA publications now being converted to contain SI data.

UBC 1994 versions of Building, Fire, Mechanical, and Plumbing will have SI.

UL Many UL standards contain SI units.

Architectural / Block

Hard metric block has 12.5 block per m².

Metric block has been installed on US projects.

Standard mortar joint for brick and block is 10 mm.

Sizes: 90, 140, 190 thick, 190 x 390 face

Some metric block are being supplied using molds borrowed from sources that already owned them, eliminating mold purchase costs.

See other national policy on this issue.

Architectural / Brick

75 modular metric per m², 50 metric jumbo per m².

BIA says most member firms can supply metric brick. Metric brick has been used on US projects.

Metric modular is most common:
90 x 57 x 190
Jumbo brick is also popular:
90 x 90 x 190

Three modular courses with 10 mm joints rounds to 200 mm. Two jumbo courses equals 200.

Brick should be specified in metric whether ASTM C216 or ASTM C62 / AASHTO M114 is used.
Weepholes mostly spaced in 100 mm sizes. (ex, 600)

Architectural / Carpet

Most firms have the dies and can or do make metric tile. It is usually not stocked. Minimum orders go from no minimum to several hundred square meters. Most said as industry goes metric, minimums would drop and premiums would shrink or be eliminated.

Most common sizes are 500 x 500 and 600 x 600.

Our projects are now specifying hard metric tile sizes.

Architectural / Ceiling Systems

Many design and construction projects, both renovation and new construction, are using the 600 x 600 system.

Many facilities with 2 x 2 grids are not adversely affected by use of new 600 x 600 grids, since coordination between grids, window mullions, and other architectural elements is often not maintained through years of renovation.

With hard metric ceilings, room dimensions can be multiples of 600 mm, giving clean, rounded dimensions

to construction personnel for layout.

Architectural / Doors

A popular size is 900 x 2100, especially in interior partitions. 1000 x 2100 is sometimes being used.

Public Works Canada often uses 950 x 2150, with a 50 mm frame, matching 2200 block coursing.

Based on project feedback, and ease of obtaining hard metric sizes, all of our projects are now using hard metric door and frame sizes.

Louvers and glass should be in hard metric dimensions, such as 300 x 300, 450 x 450, etc.

Thickness Most architects soft convert door thickness and are using nominal 45 mm as standard.

Frames Almost all door frame section dimensions are being rounded to the nearest 1 mm. (ex, 13, 25, 41, 50, 80 mm) Lengths and widths match hard metric door sizes and should be hard metric. (ex, 900 x 2100)

Architectural / Drywall

Sheet width is 1200. Standard stud spacing is 400.

Thicknesses are the same to minimize production impact. Most architects show these as 13 and 16 mm on drawings, instead of the exact 12.7 and 15.9 mm.

Minimum orders vary by firm. Partial truckload orders are available, but most firms indicated one truckload as a minimum order. We have now approved metric drywall submittals and will soon begin installation.

We feel many projects using 500-2000 m² should be able to feasibly obtain it. The range of 2000 m² or more should have no difficulty.

Architectural / Elevators

We propose capacities be specified to the next lowest 50 kg. (ex, 4000 lb = 1816 kg. Specify as 1800 kg)

Signage in the elevator would show 1800 kg only.

Most mfrs can make hard metric platforms. We feel it is not critical, and recommend allowing standard sizes.

Specifying 50 mm platform sizes is preferred, but allow standard english platform sizes to be submitted.

(ex, 5'7 x 7' platform = 1702 x 2134. Specify as 1700 x 2100, but approve the standard english size)

Note: Code and criteria requirements may restrict this approach and must be considered on each project.

Speeds should be in m/s, shown to 2 digits.
(ex, 0.64 m/s, 0.51 m/s)

Thus mfrs supply standard product, and rounded numbers appear in specs, drawings, and to the public.

Architectural / Glass

ASTM C1036 gives metric sizes for flat glass, heat absorbing glass, and wired glass. Glass shall now be specified in mm only. Thicknesses for Type 1, Transparent Flat Glass: 1, 1.5, 2, 2.5, 2.7, 3, 4, 5, 5.5, 6, 8, 10, 12, 16, 19, 22, 25, 32

Architectural / Landscaping

Products should be specified in rounded increments. We recommend the following, wherever possible:

Inches x 25 = mm (ex, 2 inch x 25 = 50 mm)

This should be used for description of existing landscaping, as well as new items.

Architectural / Lighting Fixtures

Most common sizes are 600 x 600 and 600 x 1200. Many firms say it is easier to supply 600 x 600, since U tubes do not restrict housing sizes from being made slightly smaller.

Architectural / Lumber

AFPA recommends the designations often used in Canada. Products are not changed. This chart gives actual mm-nominal inches.

(ex, 38 x 89 replaces 2 x 4)

38-2	63-3	89-4	114-5
140-6	165-7	184-8	210-9
235-10	260-11	286-12	
337-14	387-16		

Our experience shows people use mm dimensions in exact layout work only, such as layout of cabinetry, but verbally they still use 2 x 6, 2 x 10, etc.

Architectural / Plywood

Many firms often make metric plywood, and others can make many grades, thicknesses, and panel sizes.

Most firms prefer one truckload as the minimum order, which can generally include different thicknesses.

It generally takes 2-3 weeks for delivery. Costs will be comparable to english sizes.

Projects using plywood should specify metric sheets.

Thickness is the same to minimize production impact. Standard are 12.7 and 19.05 mm, commonly given nominal thicknesses on drawings (ex, 19 mm)

While it may sound contrary to the spirit of conversion, suppliers indicated they should decide the least costly way to supply metric sheets.

Many mills cut 4 x 8's to smaller sheets for furniture. They say 20-50 metric sheet orders could be cut locally from 4 x 8 to 1200 x 2400 for less than fabricating it and shipping it from a major mill across the country, until 1200 x 2400 becomes commonly available. We focus on specifying stud spacing and allow industry to innovate supply methods.

Architectural / Renovation

Renovation is more difficult than new construction, metric or english.

The difficulty of metric renovation can be minimized through use of the following and other techniques.

Examples are simplified to demonstrate the principles.

One Bad Rule This technique can be utilized to minimize awkward metric numbers. Any existing space dimension, no matter how awkward, can be developed as a series of clean, rounded metric numbers, combined with one awkward metric number.

Ex, if two existing walls are located 12 043 mm apart on a renovation project, this could be laid out as:

1400 + 3600 + 4200 + 1200 + one bad, or 1643

This is ofcourse simplified, but it is a noble goal in renovation, and if the majority of situations utilize this technique, the awkward numbers can be minimized.

Off The Wall Technique In addition, if the first four dimensions above are such that the spaces can be laid out off one wall, the 1643 will not be used, although it will probably be checked initially to confirm overall accuracy.

Ex, $1400 + 3600 + 4200 + 1200 = 10400$

With this approach the layout work is all done in rounded metric units off one wall, and the 1643 is a floating dimension. Layout is done to the maximum of 10400 only, all with clean numbers.

Metric Core Technique With the same example above, our space of 12043, we can use the metric core technique.

If either wall is to have stud and drywall applied, we can take up the slack to establish a hard metric core. If we use 92 mm metal studs, 16 GWB, and move the stud 35 mm out from the existing wall, we establish a 143 mm floating zone. A rounded, 11900 dimension is now established as the metric core.

Equal Technique If both walls are to receive drywall facing, we can use 92 studs and 16 GWB both sides, plus indicate an equal distance from each existing wall to the metal stud, to create a total metric core of 11800. The equal distance would be 13.5 mm equal on each side, making 121.5 each side, times 2 equals 243, leaving 11800. The 13.5 could be shown only as Equal on drawings.

Soffit Technique In some facilities, we utilize soffit ceiling techniques to take up the awkward difference around the edge, so we can utilize hard metric ceilings. In our example, 18 metric 600 mm ceiling tiles, plus a 100 mm border,

would give 11 m. An equal soffit space of 521.5 would work nicely as a border, and would equal our 12043 dimension.

The majority of dimensions involved with renovation or new construction involve new dimensions. Ex, no one is reconstructing a bay spacing in an existing building, since it already exists. The frequently utilized dimensions in renovation consist of dimensions which can be stated in rounded, hard metric dimensions to a large degree.

Architectural / Roofing

Use m2 for areas, instead of the 2 previous units.

State membrane thickness in mm only. Lap widths should be even mm. (ex, 100, 150 mm)

Architectural / Sheet Metal

We have found very little difficulty showing dimensions in mm thickness only in specifications.

While several people indicated it would be simpler to leave gage, we feel specifying mm thickness eliminates all confusion, and still allows standard products to be supplied, since specifications give minimum thickness.

Our projects are now moving toward showing minimum thickness in mm only.

We recommend specifying in even 1 or 0.1 mm thickness wherever possible. (ex, 1 mm, 1.6 mm)

Most overseas references we see also utilize either 1 or 0.1 mm increments.

From our research, hard metric sheet metal is obtainable, even in smaller quantities.

Architectural / Slope

There is benefit to using % for slope.

Rule: Percent x 10 = mm/m (mm per meter drop)

Ex: 2 % x 10 = 20 mm/m, 45 % = 450 mm/m

We recommend using % instead of ratios (ex, 1:12), wherever possible.

Architectural / Stone

Stone, such as granite and marble, should be specified in hard metric (ex, 30, 50 mm thick, or 100 x 300)

We have contacted many domestic companies able to produce required hard metric stone sizes.

Architectural / Studs

We have seen several conversion systems, and propose to call common metal studs by these nominal mm sizes, which closely align with the dimensions in the standard: 42 64 92 102 153 mm

A 22 mm hat channel for furring is also common.

Architectural / Woodwork

Custom casework, such as cabinets, built-in benches, shelves, security desks, and judges benches, should be developed in hard metric to the fullest degree possible.

Dimensions should follow the ratchet technique.

Cabinets Many cabinet widths we have seen are shown as increments of 50 mm. (ex, 450, 500 mm wide)

Lockers in childcare have been seen as 250 mm wide.

Civil / Concrete

Concrete is now being widely specified throughout the country in MPa. Strengths are stated in 5 MPa increments: 20, 25, 30, 35, 40, 45, 50, etc.

20, 25 and 30 MPa are the most common.

ACI 318 M, metric version, should now be used.

Slump Limits on metric projects always use 10 or 5 mm increments. (ex, 75, 80, 90 mm)

Some Canadian documents state increments of 10 mm are to be used. (ex, 80, 90, 100 mm)

Civil / Concrete Pipe

ACPA states concrete pipe can now be specified using hard metric ASTM and AASHTO standards, as is currently done in Canada.

Reinforced concrete pipe is now being specified on our projects as ASTM C76M / AASHTO M170M.

Current C76 RCP will meet the hard metric standard, as tolerances were set in the hard metric standard to accept current product.

Nonreinforced concrete pipe will be specified as ASTM C14M / AASHTO M86M.

C76M sizes: 300 375 450 525 600 675 750 825 900 1050 1200 1350 1500 1650 1800 1950 2100 2250 2400 mm

C14M sizes: 100 150 200 250 300 375 450 525 600 675 750 825 900

Civil / Geotech

Geotech reports shall be SI units only, and equally importantly, shall be in rounded SI units. Bearing and side frictions values shall be in MPa, rounded to 1 or 0.1 MPa increments wherever possible.

Failure to state bearing values in even MPa will cause english values to be utilized throughout the project.

Example: Conversion of an english value to 1.437 MPa will not cause people to use this number, whereas rounding to 1.4 or 1.5 MPa, if technically possible, produces a number easy enough to incorporate into common daily use.

Show anticipated settlements in even mm sizes. Location plans and boring plates shall be to metric scales, and shall have metric graphic scales only.

Soil profiles and boring logs shall show even meter depth increments only. Bearing value contours shall be in meters. Describe boring equipment, such as barrels and hammers, in SI units only.

Civil / GIS

Many Geographic Information Systems and AM/FM systems for mapping, gas, electric, and water distribution mgmt, wastewater systems, and other infrastructure elements, will operate in SI.

Delta Data MS, offers AGIS, Adv Geographic Informatn System, which runs in SI. (601) 799-1813

ESRI CA, produces ARC/INFO, a market leader in the GIS market as well as the utility market, which will work completely in metric. (909) 793-2853 x 1375

Facility Mapping Systems CA, produces several software packages that operate in metric:

FMS/AC Municipal
(DPW and Planning)
FMS/AC Public Works
(infrastructure mgmt)
FMS/AC Utility
(electric, gas, water systems)
Gregg Smith
(800) 442-3674
(415) 381-1750

Intergraph AL, produces GIS software that can run in metric. John Hacker
(205) 730-1705

Scott and Scott Systems WA, a prominent electrical utility GIS software producer, offers DMS/G, which can operate in a metric environment.
Susan Varga (800) 325-1494
(206) 441-1804

Our sources also indicate the Global Positioning Satellite (GPS) system is already in metric.

Civil / Infrastructure

We have had contact with many firms able to build infrastructure projects in metric. (ex, waste water and water treatment plants) We are placing this material in the next M1 version.

Civil / Reinforcement

Availability of metric rebar will be variable over the next 1-2 years. Minimum orders vary significantly.

All projects shall now specify hard metric rebar.

Projects let to construction during low supply periods shall, as a concession to our friends in industry, utilize the rebar substitution developed by the Reinforcing Steel Inst of Canada (RSIC), until the formal CRSI system is issued, which we will immediately adopt.

Claim of lack of availability should be backed up by a comprehensive industry product search.

RSIC used M suffixes (ex, 20M) to avoid confusion, which we will use. Recent CRSI material uses this.

Metric rebar is made by a few producers, and others indicated they will produce it. To assist US

firms, limit number of metric bars to the fewest possible per job.

Several DOTs (MO TX VA) and other engineers, were concerned over lack of a metric bar for the No 4.

Canadians had significant discussion on whether 12M should have been added. Through the years, it was decided to stay with the existing series.

Survey From an 8/93 survey of state rebar conversion and metric activity, 19 DOTs had incorporated metric bar into criteria (ex, standard drawings and specs) or would do so within 6 months. (AK AL CA DE FL IA IL KS KY LA MD MS NC OK PA TX VA VT WA)

Three states were not sure if it would be incorporated into criteria within 6 months. 14 states said it would not be incorporated within the next 6 months. 14 states did not respond.

Subsequent discussions have verified that many of the 6 month projections have been realized.

Size	Diam (mm)	Area (mm ²)	Size	Diam (mm)	Area (mm ²)
3	9.52	71	10M	11.3	100
4	12.70	129	15M	16.0	200
5	15.87	200	20M	19.5	300
6	19.05	284	25M	25.2	500
7	22.22	387	30M	29.9	700
8	25.40	510	35M	35.7	1000
9	28.65	645	45M	43.7	1500
10	32.25	819	55M	56.4	2500
11	35.81	1006			
14	43.00	1452			
18	57.32	2581			

Welded Wire Fabric WRI is currently developing a series of hard metric wire diameters. Many firms make their own dies and can make any size diameter. Some firms, mostly those with newer variable step spacing equipment such as EVG, Schlotter, or BSG, are able to produce metric spacing (ex, 150 x 150), but minimum orders are significant, ranging from about

15 Mg to much higher minimum orders. Look to WRI for shortly forthcoming metrication guidance.

Civil / Roads

Road Design States are roughly divided on use of km or 100 meter stations. AASHTO recommends km stations. Projects may use either at this time.

Use AASHTO Standard R1, equal to ASTM E380, for metric practice.

Federal Highway Administration directed that all construction using federal funds after October 1996 must be designed using the metric system.

The state response has been decisive in many areas, as many states have established dates earlier than that, setting dates in 1995, after which their highway construction will be metric.

Many major state and local highway projects starting now or in the near future are being done in metric.

Federal, state, and local agencies are already doing metric road and bridge design, with some already in or near construction.

Most states have begun converting standard drawings and specifications to metric. See M1 for details.

See the Road Design Data section for more detail.

Right of Way (R/W) Critical issues appear to be public response to SI, and legal acceptance. Our site acquisitions, ie r/w purchases, should use technique 1 below, unless not possible, then use technique 2:

- 1.Hard Metric Only: 100 m
- 2.Hard Metric / Soft English: 100 m (328.08')

With method 2, when SI is used exclusively, english can be deleted and numbers will be even metric.

This ofcourse applies only to site acquisitions of uniform geometry (ex, long stretches of 100 m wide r/w) For site acquisitions of uneven geometry, SI and english dimensions will often involve uneven numbers.

We use AASHTO 1993 Guide To Metric Conversion, for geometric design values, lane and shoulder widths, curb heights, sight distances, curvatures, other material. Phone Orders: AASHTO (202) 624-5800

Civil / Sitework

Sitework, such as location and placement of utility feeds, is among the easier portions of work to do in metric. Surveyors already work in decimal units, and most field personnel indicated switching to metric involved little if any effort.

Our regional electronic surveying and mapping equipment provides data in metric. Many states also utilize electronic data measurement (EDM) equipment which almost always can work in metric units.

Civil / Surveying

Two primary agencies producing survey data are National Geodetic Survey (NGS) and US Geological Survey (USGS). SI database information is available.

NGS horizontal and vertical control point network has been SI since 1983. Benchmark elevations are meters.

UTM and State Plane Coordinates Systems are metric.

Almost 40 states have adopted metric in their state plane coordinate systems.

Project Data Most engineers are now using meters for survey elevations, contour intervals, and large scale site drawings. Feel free to use m or mm.

Convert benchmarks from feet to m or mm.

Ex, 314.15 feet becomes 95.753 m (95 753 mm)

Smart Technique We have seen large mapping scales use SI symbols.

1:2000 was written as 1:2k,

1:5,000,000 as 1:5M.

Electrical

Conduit will not physically change by switching to metric. It becomes classified by a nominal mm size.

There has been significant discussion among our partners at NEMA and in the conduit manufacturing field regarding designations of various conduit types.

Most important is these products will be physically identical. Look to NEMA for future guidance.

Wire Size Almost all cable firms contacted make metric sizes for export, or can make them. Minimum orders vary.

Projects with medium and larger wire requirements may wish to start using international sizes, where permitted by governing codes and criteria.

Many projects have begun to refer to existing sizes by mm² dimensions, to become familiar with mm² scale.

These are mm² equivalents with detailed rounding. In some cases, rounding to nearest 0.1, 1, or more mm² may be feasible. Use professional judgement.

<u>AWG-mm²</u>	22-0.506	20-0.517	18-0.82
16-1.31	14-2.08	12-3.31	10-5.26
9-6.6	8-8.37	7-10.6	
6-13.30	5-16.8	4-21.15	3-26.66
2-33.63	1-42.41	1/0-53.48	2/0-67.44
3/0-85.03	4/0-107.2		

kcm-mm2 250-126.68 300-152.01 350-177.35 400-202.68 450-228.0 500-253.4 550-278.7 600-304.0 650-329.4 700-354.7 750-380.0 800-405.4 900-456.0 1000-506.7 1100-557.4 1200-608.1 1250-633.4 1300-658.7 1400-709.4 1500-760.1 1600-810.7 1700-861.4 1800-912.1 1900-962.7 2000-1013.4

ASTM B682 gives metric sizes. Common sizes are:

0.5, 0.75, 1, 1.5, 2.5, 4, 6, 10, 16, 25, 35, 50, 70, 95, 120, 150, 185, 240, 300 mm2

Fiber Optics It was falsely reported in the last edition that fiber optic cables would be soft converted. Most cables are made to metric dimensions, so these will be specified in hard metric. (ex, 125 um fiber cable)

Illumination levels are in lux (lx). Specify lux values using the ratchet technique, where feasible and allowed by criteria. 1 FC ~ 10 lx; thus rounding a few lx may have little impact.

Environmental

The environmental field has been progressive regarding SI. Many regulations have been metric for years.

Based on review of commonly used environmental data, projects shall now specify metric only.

Estimating

Time We find metric design and construction take the same number of months as english projects. No adjustments have been made to time expectations.

Cost Estimating shall be done in metric units only.

Design Costs There will be no change to the standard design fee charts used to calculate design costs.

Now that 1) specs are SI 2) SI estimating tools are offered 3) criteria is SI 4) most codes and standards have SI 5) sample drawings exist for most items, we cannot justify uniform premiums for metric design.

Construction Costs Bids to date have not shown detectable premiums for metric. No additional funds are being allocated for metric construction.

We would welcome comparing detailed cost analysis which yields results contrary to this conclusion.

Estimating Tools are offered by many prominent firms.

Building System Design GA, offers metric estimating software. Larry Hendrix (404) 876-4700

Cost Engineering Technologies NJ, offers a metric database. Kenneth Browne (201) 335-1707

MCASES Gold, DOD database, operates in metric.

MC2 (MC Squared) TN, offers a metric database. Billy Telford (901) 346-9880

R.S. Means MA, (800) 448-8182, offers metric estimating handbooks. Database available in late 1993.

Timberline OR, offers a metric database.

Ann Kenkel, Curtis Peltz (503) 626-6775

US Softcost GA, offers their Success metric database.

Louis Parkins, John Williams (800) 955-1385

Mechanical / General Fasteners

With major sectors of US industry now using metric fasteners extensively, there is virtually no

fastener that is not obtainable in mm sizes.

It is hard to imagine a well known manufacturer that does not stock, regularly make, or have the capability to produce metric products.

Thomas Register has hundreds of firms under Metric Fasteners, Metric Screws, and Metric Bolts.

IFI offers guides of fastener types and producers. Most firms in the division 4/5, covering some common construction fasteners, indicate metric ability. IFI Metric Fastener Standards (530 pg) has technical data, selection hints. IFI, (216) 241-1482

Many pieces of mechanical and electrical equipment already use both metric and english fasteners.

Metric fasteners use M numbers. (M10 x 40 is nominal 10 mm diameter, 40 mm length)

Some states already stock some metric nuts and bolts. (ex, Colorado Department of Transportation)

To conserve paper, we will not list the over 150 firms that stock or produce general metric fasteners. We will list suppliers only for fasteners often used in construction, which are not stock items yet.

The following two charts provide information on fasteners. Our source cautioned that the material is several years old and is soon to be revised, so standards references should be confirmed prior to specification of products.

Conclusion Our projects are now using metric socket head cap screws, set screws, hex bolts, and similar items, whenever needed, in any quantity. These have been stock for years and available at about the same cost.

Mechanical / Anchor Bolts

All new projects are specifying metric anchor bolts (ex, L, J, and U bolts). ASTM F568 gives metric chemical and mechanical data for carbon steel anchor bolts and studs, and references ANSI dimensional standards. No metric version of A307 is planned.

ISO Metric Grades as given in ISO 898 and ASTM F568, should be used. Many anchor bolts are made from low carbon steel grades, such as ISO classes 4.6, 4.8, and 5.8.

Many firms indicated no minimum order quantity, but some stated there would be premiums related to set up costs for very small orders.

Preferred Diameters From material we have seen, it appears preferred nominal diameters for items such as anchor bolts and threaded rod, would be as shown below.

Reference individual standards prior to specification.

Sizes are given between M5 and M45, as these are commonly used sizes in construction.

1: = 1st preference, 2: = 2nd preference, etc.

Fastener Data 1 Fastener Data 2 Mechanical / HVAC

Air Flow out of grilles and diffusers should be rounded to even increments of 5 or 10 L/s, wherever possible.

Ductwork (Round, Rigid) Most designers are showing hard metric diameters. (ex, 250, 300)

Ductwork (Round, Flexible) Many designers are showing flexible round duct in hard metric sizes, but accepting soft metric during construction. (ex, 200, 250)

Ductwork (Rectangular) Use 50 and 100 mm sizes, (ex, 500 x 1000, 250 x 350) unless not possible.

Equipment We regularly receive updated catalogs from producers that have added metric data to their catalogs or literature. Where this did not exist, we have had no difficulty receiving modified data on a project, or obtaining a bond paper supplement.

Schedules To think metric, flow rates, pressures, thermal powers, and other criteria on schedules should be rounded wherever possible.

The 1 % Analysis provides a useful technique.

Ex 1, A fan flowrate converts to 8,022 L/s.

1% is +/- 80.22 L/s. This fan could possibly be shown as minimum 8000 L/s (8 m³/s) and is easier and faster to say.

Ex 2, A pump flow converts to 75.7 L/s. 1 % of this is 0.757 L/s. 75 L/s could possibly be used.

It is important to note that in some cases codes or design criteria may not allow this liberty. In other cases however, 2 or 3 % analysis may be feasible, and could lead to rounded, easily spoken numbers.

Temperature People will rarely speak in decimal degrees. (ex, 23.8 degrees C). All mechanical schedule temperatures, design temperatures, leaving and entering temperatures, and others shall be stated in even Celcius (ex, 5, 12, 25, and 40 degrees C) unless not possible.

New construction projects shall use Celcius only.

Renovation projects where new control systems are being installed, should use Celcius.

HVAC calculations shall be in SI to the fullest extent possible.

Thermal Ratings for boilers and chillers should be specified in even nominal MW or kW increments to the largest degree possible: (Ex, 500 kW, 0.9 MW, 3.5 MW)

Pipe Steel pipe (ASTM A53) and copper tube sizes (ASTM B88) will not physically change by switching to the metric system. They are now classified by new nominal mm sizes.

ASTM B88M, hard metric copper tube sizes, should not yet be utilized.

Schedule designations remain the same (example: Schedule 40, and type K,L,M)

The Mechanical Task Group, under leadership of ASME, recently recommended use of 18 mm for 5/8, instead of the 16 stated in the last guide. All other designations remain the same.

Metric pipe designations are:

15 18 20 25 32 40 50 65 80 90 100
125 150 mm

Over 150, inch x 25 = mm (24 " x 25 = 600 mm)

Units Use units from the ASHRAE SI Guide.

Structural

The primary lesson learned is design dimensions must be rounded dimensions. Bar spacing, wall and slab thickness, and similar dimensions, shall be even mm (100, 250, 400 mm) not conversions. (ex, 305 mm)

Calculations End results of structural calculations, and all summary data shall be SI. Calculations shall be SI to the fullest degree feasible.

Cambers State in even mm. (ex, 20, 22 mm)

Floor Load capacity is specified in kPa.

Significant hinderance to use of kPa has been allowing dual dimensions. No feel for kPa is acquired unless kPa only are used.

Our typical office rating is 5 kPa: with 4 kPa and 1 kPa components. Drawings and calculations should reflect these numbers only.

In existing facilities, it is preferred to convert values to exact kPa and round to next lowest 0.1 kPa, unless strong reasons exist not to use this method.

Ex 1, A load capability exactly converts to 9.58 kPa. Round to 9.5 kPa. This is rounded, easy to remember, less than 1 % error.

Ex 2, at Richmond VA Federal Building renovation:

"Existing Structure Allowable Live Load Per Original 1959 Building Plans Are As Follows:

Lobbies, Stairs, and Corridors- 4.8 kPa, Toilets-2.9 kPa, All Other Areas 3.8 kPa"

Situations needing mass loading might use the following rounded, slightly conservative, rule:

kPa x 100 = kg/m² (5 kPa x 100 = 500 kg/m²)

Steel Deck thicknesses are being soft converted (ex, 38 mm).

Structural Steel shall be specified in SI only, such as 250 MPa. Shapes shall be specified according to the millimeter sizes and dimensions in ASTM A6M.

Welds are shown in even mm sizes. (ex, 5, 6 mm)

Wind Pressures are given in Pa.

Wind Speeds are most frequently given in m/s.

Preparation

Standard regional procedure is as follows:

Internal Preparation Project managers starting a metric project receive:

- 1)
- 2)
- 3) 1 hour metric design orientation course
- 4) Metric / english tape measure (if needed)

Most people (except field inspectors) use tape measures infrequently after a few months of daily metric usage.

Metric training cannot have the same training effect as immersion into metric design or construction.

We did not purchase metric conversion calculators.

External Preparation For Design Firms, Construction Managers, and Real Estate Developers

1. Provide this design guide to staff members
2. Metric experience can only be a plus, as federal, state, and local government projects increasingly go metric. To obtain experience, consider using metric for other government or private projects.
3. The architectural and engineering communities have in general responded favorably to metric conversion. We have not provided wholesale training to all firms that commonly do business with us. We provide detailed consultation (~ 2 hours if needed) once firms sign contracts and are about to start design.

External Preparation for Product Manufacturers Contacts with product manufacturers should now always discuss available metric products and

literature, although many have been exposed through projects.

Submissions have unfortunately been returned for resubmittal based on lack of understanding of the firmness of this requirement. This can be avoided by thorough communication.

This design guide
Metric scale
Construction Firms, Construction Personnel Agencies like New York State Department of Transportation are working with local AGC chapters to alert contractors of upcoming metric activities. Our construction management firms have helped us by also contacting AGC, unions, other construction related groups, to advise of upcoming metric projects.

Design Policy

Selection of pilot projects is an important factor in whether a metric project will be successful. All projects need not be done in metric now.

National policy requires all projects be in metric after January 1994. Our regional policy, in place since January 1992, shall remain prior to that time.

As our major capitol project designs have been metric for some time, the vast majority of all major project construction dollars in 1994 will be metric.

Regional Design Policy All renovation and new construction projects of \$ 500,000 or more, shall be done completely in metric.

All specifications for new construction lease projects shall be metric. The same firms that provide construction services to developers on lease projects perform construction for us in direct federally funded projects.

Projects under \$ 500,000 may be done in SI, based of feasibility. About half of our projects under \$500,000 are currently selected for metric design.

Feasability of doing projects below \$ 500,000 is based on the number of hard metric products used. Small projects using mainly soft metric products can usually be easily done in metric.

Very small projects under \$50,000 are generally not being done in metric yet.

Timeframe To Convert Projects To Metric
Our past year reinforces earlier policy: It is fully feasible to convert medium and large projects to metric up to about 25-30 % design completion. This can be up to about 40 % for smaller projects.

For CAD drawings, it is usually easy to convert to SI and select similar metric structure dimensions.

Many projects nationwide, at the federal, state, and local levels, have now been converted to metric up to the 30% design stage, with success.

CAD While regional policy requires all projects be 100 % CAD, projects are being done nationwide in metric in freehand format with little difficulty.

AE / CM Advertisements

As required for the past 2 years, advertisements for Architectural/Engineering (AE) or Construction Management (CM) services shall be as follows:

1. State areas in m2 only. (ex, The new building will be approximately 40,000 net square meters)
2. Each announcement shall state: "This project will be designed and built entirely in metric units."
3. For A/E firm announcements, including term contracts, this is a required evaluation factor:

"Familiarity with SI and ability to design in SI units." This will typically be 10-15 % of the evaluation.

Each responding firm must continue to submit a one page summary of their SI experience, familiarity with SI, and ability to design in SI units.

Metric experience though is not mandated.

Almost half of the 500 largest US design firms, which design many of our medium and large scale projects, did overseas work last year, much of which was SI.

Based on our experience though, size of firm has not been a determining factor. Many small, medium, and large firms are producing high caliber metric designs.

4. For CM (Construction Manager) ads, including term CMs, this remains an evaluation factor:

"Familiarity with SI and ability to perform required services in SI units." A one page summary must also be submitted. (similar to above)

5. Each CBD announcement shall state:

"The GSA Region 3 Metric Design Guide is available free to bidders upon request.

Construction Advertisements

Advertisements for construction projects shall:

1. State project area in m2 only.
2. State "This project was designed in metric. Inspection will take place in metric. Submittals must be provided in metric units.

3. State: "The GSA Region 3 Metric Design Guide is available free to bidders upon request.

Note: The Metric Design Guide can be a good orientation document, which can contribute to the overall project success. Bidders will be able to ask better questions at the prebid conference if this guide is available to them in advance."

AE / CM Scope Guidance

AE scope guidance can be stated as follows:

Design on this project shall take place in conformance with M2, The GSA Region 3 Metric Design Guide.

Submittals

To assist manufacturers with metric conversion, we recommend the following submittal classes be utilized.

Classes should be supplemented for each project.

Please contact us regarding detail of items listed here.

There is gray area in this classification system.

Our guiding principle is that if a construction firm makes an honest, good faith effort to comply with metric guidance, then we should work with them and allow minor variations where needed to promote the greater goal of smooth, overall transition.

We would generally encourage project managers to push non-essential submittals into class 3 wherever feasible.

Class 1. Drawings That Must Be Metric Only English units are not permitted on these submittals. Drawings must use metric scales. In general, any drawing that is job specific, and is custom

generated for this project, must be in metric only. These are some samples:

- .All Floorplans
- .Reflected Ceiling Drawings
- .Stairwell Erection Drawings
- .Foundation Wall Drawings
- .Concrete / Rebar Installation Drawings
- .Sitework Drawings
- .Sheeting and Shoring Plans
- .Steel Erection / Fabrication Drawings and Details
- . Precast Manhole Drawings
- . Door Schedules
- . Wall Paneling Drawings
- . Caisson Details
- . Millwork drawings
- . Cabinet Work Details
- . Toilet Room Details
- . Ductwork Submittals
- . Pipe Installation Drawings
- . HVAC Schedules
- . Switchgear Drawings
- . Electrical Component Layout Drawings
- . Signage Drawings

Class 2. Data That Must Be Metric Only Following types of items must be submitted in SI only.

Primarily, any data generated specifically for this project must be submitted in SI only.

- . Concrete Design Mixes
- . Concrete Test Data
- . Core Bore Depths and Data
- . Aggregate Mixes Must Show Metric Sieves
- . Mechanical Air and Water Flow or Balancing Data
- . Environmental or Hazardous Material Data
- . Most Test Data of various natures
- . Other data generated for this project, not in bound, preprinted catalogs or publications.

To absolutely minimize the time and cost impact of metric conversion, we have recommended an additional class of submittal data.

This allows us to meet the national mandate of complete metric conversion, while allowing the extensive body of technical information to be fully converted over a period of a few years.

We understand that the time and cost associated with sudden conversion of handbooks and product literature can be significant, and have attempted to avoid that.

Class 3. Metric Supplement Required
Requires existing pre-printed literature to be supplemented to show conformance with requirements stated in the specification or on drawings.

Supplements can be:

1. Bond Paper Supplement
2. Handwritten Or Typed On Existing Literature
3. Other Approved Method

Examples:

Steel Deck Data The entire product literature does not need to be converted, only those numbers sufficient to show that the sizes submitted are those sizes required (such as 38 mm, etc). The bond paper supplement would state the 1.5 inch deck is equal to 38 mm.

Epoxy Adhesive Literature must only show conformance with requirements specifically shown in the specs.

Preprinted Mechanical / Electrical Equipment Catalogs need not be converted. However, conformance with specified and scheduled flowrates, pressures, temperatures, thermal output rates, etc, must be demonstrated.

Physical dimensions of mechanical and electrical equipment shown on project specific installation drawings are Class 1, and must show metric only.

Typical eqpmt: Boilers, AHUs, Chillers, Terminal Units, Pumps, Exhaust Fans,

Switchgear, Pumps, Transformers, UPS systems, Fire Alarm Eqpmt, etc.

.Elevator Component Data
.Bathroom Component Details
.Mini-Blind Data
.Roof Hatch Sizes
.Metal Ceiling Grid Data
.Access Floor Tile Data
.Plumbing Fixture Data
.Metal Stud Data
.Structural Bolt Data
.Paint Literature
.Formwork Release Agent Data
.Valve, Pipe, and Fittings Data

We have found that a major portion of firms supplying submittal data already have their data available in either metric only or dual dimensioned format.

We can provide sample acceptable submittals to government agencies for virtually any product.

01 Tools

Metric tape measures are available.

Some construction firms are using metric only tapes.

Federal agencies can buy 10 ft/3.3 m tape measures on GSA schedule. Product # 5210-00-086-4988, under \$5.

Lufkin Tools NC, makes metric tape measures. (919) 362 7511

Stanley Tools CT, makes metric measures.

32-156 (5 m)
33-443 (10 m)

Carl Lickwar, Alan G. Martin (203) 225-5111

Metric framing squares have also been ordered from Stanley by the US Public Health Service.

Stanley Hand Tools CT, (800) 262-2161

US Tape VA, makes metric tape measures, steel tapes, and derrick tapes.
W. S. Spotswood (703) 256-1500

Scales Metric scales are available:
Staedtler-Mars Model 987-18-1
Alvin Model 117 PM
Charvoz Model 30-1261

Contact your local graphic arts supply store to order.

NOTE: These metric scales are made overseas, as are most inch size Architect scales available today.

03 Rebar

Atlantic Steel GA, can make A615M bar.
R.S. Mellum (404) 897-4505

Birmingham Steel AL, produces metric bar in their Salmon Bay Steel subsidiary, and can produce it in their IL, AL, and MS facilities.
Robert Wilson, H.A. Hilton (205) 985-9290

Salmon Bay Steel stocks rebar in 10-35 mm. Minimum order is about 20 Mg, or one truckload, which can consist of different sizes, and can be shipped anywhere in the country. Facility ships rebar overseas regularly.
Chuck James, Paul Cmorey
(800) 677-1012

Cascade Steel OR, currently makes 10-35 mm. 45 and 55 mm might require some lead time. When sizes are in stock, minimum order is about 20 Mg, or one truckload, which can be mixed sizes.
Glen Peterson (503) 472-4181
x3307
Dennis Lauber (503) 434-3275

Florida Steel FL, can produce A615M bar.
Has production in FL, NC, and TN.
Don Ballard, Don Haney
(813) 251-8811

Marion Steel OH, can make A615M but is not able to make 45 and 55 mm.

Gerry Lehrke, Michael Johnson (614) 383-4011

New Jersey Steel NJ, has made metric rebar, can make A615M rebar.
Gary Giovannetti, Elaine Skiba
(908) 721-6600

North Star Steel MN, has made metric before, can produce A615M sizes in their MN and IA facilities.
Michael Hanson (612) 688-1719
Wm Pepper (612) 731-5644

Nucor Steel UT, can make A615M rebar.
R. Wayne Jones (801) 458-3961

Parker Steel OH, can supply A615M rebar. Plans are being made to provide stock to handle any size order.
Paul Goldner (800) 333-4140

Thomas Steel IL, has made metric bar, can make A615M.
Edward Koper, Jerry Wenzel
(708) 257-7701

04 Block / CMU

Many firms can supply hard metric block. Unless otherwise stated, there will generally be lead time and cost impact to this product. See GSA national policy on this issue.

Adams Products can make metric block. Several hundred block orders are acceptable.

Adams Products NC,
Buddy Ray (919) 467-2218

Adams Products NC,
Cheryl Gaw (919) 488-4120

Adams Products NC,
Betty Hughes (919) 523-5136

Ancor Block UT, can make metric block.
Gayland Smith (801) 295-5470

Basalite CA, can supply.
Jim Mayer (916) 678-1901

Betco Block is supplying metric block to GSA. Minimum order is 150 m2. Current project Betco is supplying is using about 1600 m2 (20,000 block)

Betco Block MD,
Scott Harper (301) 654-2312

Betco Block NY,
Steve Nagel (518) 756-2125

Betco Block VA,
Robert Carmody (703) 591-2770

Buehner Block UT, can supply the metric block.
Ron Hoffmann, Kent Mortensen
(801) 467-5456

Burns and Russell MD,
Michelle McVey (800) 638-3188

Clarkes Block GA, can supply.
L.E. Wells (912) 234-3436

Colorado Concrete Mfg CO, can supply metric block.
Karl Dolder, Thor Kaumeyer

(719) 390-5477

Concrete Mold Components CA, can supply molds.
Maurice Alhadeff (213) 636-7534

Dagostino Building Blocks NY
Ken Dagostino (518) 374-3116

Elco PA, can produce metric block. Several hundred block orders acceptable.
Walter Albright (717) 274-3661

Featherlight Building Products TX, can produce metric block. Wade Albritton, H.V. Moss
(512) 472-2424

Fizzano Masonry PA, has indicated ability to supply for VA project in Philadelphia.
(215) 833-1100

Goria Enterprises NC, can make metric block.
Ken Mayo (919) 375-5821

Grand Blanc Cement MI, can supply metric block. Can supply metric molds, all shapes.
Michael Hicks, Ron Hunt
(800) 875-7500

Hagerstown Block MD
(301) 733-3510

E.P. Henry NJ, can supply hard metric block.
Stephen Reale, Mariane Anzaldo
(609) 845-6200

Adolph Jandris MA,
Tony Raila (508) 632-0089

Jewell Concrete Products TX, can make metric block. Several hundred block orders are acceptable.
Walter Grisham (817) 772-3440 Tom Call (903) 592-0752

Marquart Block IA, can supply hard metric block.
John Thiele, Scott Shimp

(319) 233-8421

Miller Materials MO, can make metric block. Several hundred block orders are acceptable.

Charles Kreutzer (816) 444-2244

Mission Masonry CO, supplied metric block to the GSA Denver facility.
(303) 841-6089

Phoenix Inc MD
John Cissel, Don Bowers
(301) 698-4010

Plasticrete CT,
Joe Rescigno (800) 243-6934

Proudfoot Corp CT, has made metric molds in the past, can supply metric sizes.

Michael Thompson, James Loseth
(203) 459-0031

Reading Rock Inc OH
Stan Bass (513) 874-2345

Sherman Int'l AL,
Dannie Rodgers (205) 252-6900

Southern Brick & Block VA,
Ron Peters (804) 353-6681
Superlite Block AZ, can make. Several hundred block orders acceptable.
John Graves (602) 352-3500

Trenwyth Industries PA, makes many metric block sizes.
Linda Adcock (800) 233-1924

Tricon Enterprises MA
Monica Maracaccio (508) 697-6112

04 Block / Glass

Pittsburgh Corning PA, makes metric glass block. Several patterns. 190 x 190 mm (80 or 100 thick)
Robert McMarlin (412) 327-6100

05 Anchor Bolts

These firms can provide metric anchor bolts, threaded rod, and similar material.

Archer Engineering IL, no minimum quantity.

Ron Lanie (312) 247-3501

Atwood Industries OH, no minimum order. Premium on smaller quantities.

Jeff Mueller, James Mraz
(800) 362-2059

Fansteel Mfg IA, lists metric threads can be obtained on their anchor bolt products.
(800) 394-7091

High Point Fasteners NJ, no minimum quantity.

Ted Brace (201) 293-3411

Hilti OK, offers their HSL metric expansion anchors in M8, M10, M12, M16, M20, and M24.

XXX Dick Wollmenshauzser
(800) 879-6000

Kenneth Lilly Fasteners DE, no minimum quantity.

Gary Lilly, Roland Sharp
(800) 433-1815

Midstate Bolt and Screw MI, no minimum quantity.

Herb Sommers, Kevin Bloss
(800) 482-0867

O'Brien Iron Works CA, no minimum quantity.

Richard Schulba, Richard Kotalik
(510) 685-5300

Piping Technology TX, \$ 35 minimum order.

Marion McKnight, Aundrela Durham
(713) 731-0030

R and R Engineering IN, minimum 500 pieces.

Mike Melott, Ralph Amos
(317) 536-2263

Richmond Screw Anchor TX, no minimum order, premium on orders of 100 bolts or less.

Leroy Caldwell (817) 589-2091

Stanley Industries MI, can supply metric anchor bolts and threaded rod.
Mr. Cash (800) 253-BOLT

Steel Products/Massillon OH, minimum \$ 50 order. Colin Petrovich, Dan Alvarez

(800) 874-2658

Sullivan Bolt CA, can make metric anchor bolts.
(800) 423-4287

Threadline Products NC, no minimum quantity.
Lenore Lemmond, Larry Stanley (704) 523-5870
Vulcan Threaded Products AL, minimum order is 10 bolts.
Jim Murdock (800) 633-3432

Wayne Bolt MI, no minimum quantity.
Joe or Mike Wojcik
(800) 521-2207

05 Nuts

These firms can supply nuts for anchor bolts and common construction fasteners.

Century AL, can supply metric nuts. \$50 minimum order.
Lynda Oakley (205) 772-7300

Coloc TX, can makes up to M60 nuts. Many grades. \$50 minimum order.
Dick Ingram (903) 848-8411

Fasteners and Metal Products MA, can supply metric nuts. No minimum.
Tom Hatzis (617) 489-0414

Midwest Bolt and Supply MO, can supply metric nuts.
\$ 25 minimum.
Bill Thate (816) 842-7880

North Texas Bolt & Nut TX, a distributor, can supply metric nuts, \$ 35 minimum order.
John Ricard (214) 647-0608

Quality Bolt LA, can provide orders in the \$ 200-300 range. Pat McGrail
(504) 465-0297

Samson Industries AZ, can supply. \$ 25 minimum. Brian Saxton, Christine Gruice
(602) 581-8082

05 Steel Plate

Metric steel plate is available from US mfrs, and is being specified in hard metric on our projects.

Most firms indicated metric plate is usually not stocked, and would require some additional lead time. Many of these firms could also be consulted for hard metric sheet metal purchase.

Many firms indicated however that no order would be too small to supply, such as an order for 5 or 10 base plates, however premiums would apply to smaller orders. Many grades can be supplied.

Many of these firms also fabricate.

We can provide data on what standard sizes of plate are being specified in government projects.

Sample firms that stock metric thickness plate, or are able to supply or produce it:

Accro-Met NC, can supply in 6-150 mm. Steve Ferguson (800) 543-4755

Alloy and Carbon Steel Co NJ, no minimum quantity. Gail Ferranti (908) 613-9150

Concord Steel OH, no minimum order. Paul Vesey (216) 372-2030

Excel Bridge Mfg CA, can obtain steel plate and fabricate products in any metric dimension. Craig Vasquez (310) 944-0701

Gulf States Steel AL, has made metric plate before. No minimum order. Lester Bridges (800) 423-0004

Hardox Corp PA, no minimum order, but small orders would have longer lead times. Tom Sullivan (800) 666-0092

High Steel Structures PA, one of the largest heavy plate steel fabricators

in the nation, can provide plate, bearings, structural shape lengths and geometries, bolts, and other items, fabricated in hard metric. No minimum order. Doug Winner (717) 293-4099

Hub Inc, Energy and Process Div GA, can handle small and large orders, has full cutting and milling capability. Marc Capallo (404) 723-7531

Johnston and Jennings IL, has supplied metric plate before, can supply maximum 600 mm thickness. No minimum order. John Violet (708) 757-5375

Leeco Steel Products IL, stocks some A572M metric plate. Can supply any size/thickness in A572M or other grades. Sales Department (800) 621-4366

Metalmart CA, has supplied metric plate. Stocks some, can supply many other thicknesses. Hank Morin (800) 888-7766

Mills Alloy Steel OH, can supply metric plate. Dave Gilbert (800) 326-6455

Parker Steel OH, can supply metric plate and many other structural shapes, as well as bar and sheet stock. Paul Goldner (800) 383-4140

Pioneer Steel MI, no minimum order. Facilities in AL, MI, and TN. Rob Beves (800) 999-9440

Skorr Steel NY, stainless steel plate only. Joe Piela (718) 386-9577

Stainless Specialties TX, no minimum quantity. Supplies carbon, stainless and nickel alloy plate. Has supplied metric plate before. Robert Caudillo (713) 840-0444

Universal Fabricators WV, can supply metric plate.

Mike O'Connor (800) 394-1385

United States Steel can provide a chart showing their standard metric plate thicknesses (6-160 mm). They indicate their mill prices are generally the same as their prices for equivalent english sizes.

05 Structural Bolts

Many firms can produce A325M/M164M, and A490M/M253M bolts. Some can make ASTM A394M, galvanized metric transmission tower bolts.

Metric bolts may now be utilized on all projects.

Some firms indicated they could supply metric bolts at small quantities, but premiums primarily related to set up costs, would be associated.

See also bolt data in Road Design Data / Louisiana.

Aetna Screw Products IL, can make A325M and A490M. Frank or Joe Valerio (708) 647-9555

Atwood Industries OH, can supply A325M and A490M, as well as other metric bolts.

James Mraz, Jeff Mueller
(800) 362-2059

Bennett Bolt Works NY, \$ 100 minimum order.

Ron Merrill NY (315) 689-3981
Vince Ruggerio OH (216) 979-9813

Cold Heading Co MI, can make metric bolts.

Bill Deason, Tom Paull
(313) 923-7800

CWR Manufacturing NY
Fay Cluett (315) 437-1030

Detroit Heading MI, can also make A394M.
Roger Palmer, Kevin Stanisiz

(313) 925-8138

Haydon Bolts PA (215) 537-8700
Richard Giusti (215) 537-8700

Holo-Chrome CT Skip Gallo

Huck Int'l TX, makes A325M and A490M product. Larry Chipman, Chuck Schultz (800) 388-4825

Kenneth Lilly Fasteners DE, can supply A325M and A490M. Gary Lilly, Roland Sharp
(800) 433-1815

Lake Erie Screw OH
Steve Vass (216) 521-1800

Metric and Multistandard Components NY, can supply A325M and A490M bolts. Also supplies other metric bolts.
Roger Stilman (800) 431-2792

Mid-West Fabricating OH
Vaughn Doss (614) 969-4411

National Bolt NY, minimum order is 500 bolts.
M.D. Strauss (800) 992-6587

Nucor Fastener Div IN, minimum order is one keg per size.
Cecil Couch, Peter Kasper
(800) 955-6826

Ohio Rod Products IN, states that metric is available upon request.
(812) 689-6565

Steel Products/Massillon OH, \$1000 minimum order.
Colin Petrovich, Dan Alvarez
(800) 874-2658

Sullivan Bolt CA, is able to make metric bolts.
(800) 423-4287

United Steel and Fasteners IL, no minimum quantity. Premium on smaller orders.
Perri Guerino, Bob Fiorio
(708) 250-0900

Wayne Bolt MI, no minimum quantity.
Joe or Mike Wojcik
(800) 521-2207

06 Lumber

Oregon Overseas Timber OR
currently manufactures metric lumber
sizes for export, thickness 27-76 mm,
width 75-280 mm
Jim Curran (503) 347-4419

Vanport Mfg OR
90% of production is in hard metric for Japanese and other export markets.
Thicknesses 27-120 mm Widths 45-360 mm
Wayne Geist (503) 663-4466

06 Plywood

Metric plywood can now be used for items like housing, barracks, sheathing or formwork applications.

Amer-Ply NJ, can supply metric sheets. No minimum order quantity.
Mr. Matthew (908) 352-8111

Boise-Cascade ID, has made metric before, can supply metric.
Jan Blechsmidt (206) 572-8300

Champion International WA, makes metric sheet sizes and thicknesses. Metric available for underlayment, sheathing, and sanded products. Metric concrete form panels can be ordered. Minimum order is 1 truckload. Jim DiStefano (206) 572-8300 (form panels)
Steve Williams (206) 572-8300 (plywood, western)
Jim Clark, TN (901) 731-4550 (plywood, southern)

Furman Lumber MA, can supply metric from their usual suppliers.
Chris Hemingway (508) 670-3800
Offices: CT FL GA MD NJ NY PA TX VA

Multnomah OR, can supply 50-100 piece orders.
Paul Brooks, Anne Snyder
(503) 297-4738

Murphy Plywood OR, can make metric plywood.
John Murphy, Mark Gryzic
(503) 459-3225

Oregon Strand Board OR, can make metric engineering panels, similar to plywood, at no additional cost. Minimum order is one truckload.
Joe Maliszewski (503) 466-5177

Potlatch WA, has exported metric, can make metric sizes. C.D. Whitney, Mac Ryerse
(509) 328-0930

Roseburg Forest Products OR, makes 6-19 mm thick plywood, can make metric sheets. Makes other metric wood building products. Min. order is 1 truckload.
Dave Adams, Kevin Barry
(503) 679-3311

Stone Forest Industries, OR, currently produces both metric dimensional and thickness plywood. This firm could produce about two pressloads minimum order (about 60 sheets) but premiums would apply to small orders of this size.
Lain Osborn, Tom Clow
(800) 541-6906

Vancouver Standard has made metric sizes, can make metric sizes. Generally makes AC and higher grade.
Ken Trimbell, Bill Sparks
(800) 367-0038

Other firms indicated on the telephone they were able to make metric plywood, but we did not receive detailed data from them in time for publication.

07 Curtainwalls

These are obtainable in hard metric. This means panel length and width can be any size. Panel extrusions may be hard to change, and may need to be specified in soft metric.

Howard Industries, FL, a major windowall mfr, has done foreign work, can make metric sizes.
Bob Voigt or Joe Sixto
(305) 888-1521

Profile Systems, MO, subsidiary of the Maune Company, can make hard metric sizes.
Grant Maune (800) 962-8100

Kalwell Corporation, NH, a major curtainwall producer, can make hard metric sizes.

Bruce Keller (800) 258-9777

Kawneer Company, GA, a major manufacturer, has been making metric for overseas for years, and can make any metric size.

Enrique Morales, Int'l Sales Mgr (703) 433-2711

Edward Bugg, Asst Engrg Mgr (703) 433-2711

07 Insulation

Several firms indicated ability to fabricate insulation board in hard metric sizes. Our projects are now specifying these.

08 Doors / Metal

Acme Steel Door NY

Jack Teich (718) 384-7800

Allied Steel Products FL, no minimum.

Bill Desin (305) 624-3333

American Steel Products NY

can make any size metric door.

Hank (516) 293-7100

Anweld Building Products OH

Has made metric before, can make metric sizes.

Mike Scott, Fred Bloom Jr (216) 527-4385

Ceco Door IL, a major mfr, can make any hard metric size.

Norb Bruzan (312) 242-2000

Duolock OR, major aluminum products mfr, can make any metric size.

Clem Grant (800) 678-0566

SW Fleming CA MA PA SC

William Strong (800) 263-7515

Howard Industries FL, has made

metric, can make metric sizes. Bob Voigt, Joe Sixto

(305) 888-1521

Republic Builders Products TN

Jim Jackson (901) 352-3383

Stanley Door Systems MI

Mark Goldstein (313) 528-1400

Steelcraft Mfg Co OH, no minimum order.

Makes metric sizes now, exports to many countries.

Bill Ball, Claud Frederick (513) 745-6400

Tex-Steel Corp TX, no minimum order.

George Maldonado (512) 423-0912

08 Doors / Wood

Many other door manufacturers indicated ability to supply metric doors but did not respond with detailed information prior to publication.

California Millworks CA, \$10,000 minimum.
Dave Gerken (805) 294-2345

Eagle Plywood and Door Mfr NJ, no minimum.
Tony Schifano (908) 769-7650

Marlite OH, can produce.
Donald Sweitzer (216) 343-6621

Michigan Birch Door MI, minimum order is 6 doors.
Roger Eger (313) 949-2020

Mohawk Flush Doors PA, no minimum.
Don Enigk (717) 473-3557

Vancouver Door WA
Gary Geppert (206) 845-9581

08 Windows

Alenco Commercial Group TX, major window mfr, can make metric sizes.
Harold Chilton (409) 823-6557

Andersen Windows Commercial Group MN, exports, has SI literature available.
Craig Johnson (612) 439-5150

Caradco IL, can make any size metric window.
Roy Szyhowski (217) 893-4444

Desco Company Desmet SD, can produce metric sizes.
Cindy Albrecht (605) 854-9126

Marmet Corporation WI, can make any size metric window.
Brent Schepp (715) 845-5242

Marvin Windows MN, has made and can make metric sizes.
Dan McKinnon (218) 386-1430

Optimum Windows, Bronx NY, can produce hard metric sizes. Candido Perez (212) 991-0700

Peerless Commercial Window Division MO, can make any metric size.
Tony Grossi (913) 432-2232

Pella Windows IA, can make any size metric window.
Cheryl Waits (515) 628-1000

09 Carpet

Collins and Aikman, is able to supply metric size tiles.

Interface GA, has dies to supply metric tiles. No minimum, but premiums on orders from 1 to 100 m2 orders. Scott Landa
Kathy Kerby (800) 336-0225

Milliken GA, has dies and makes metric size tiles.

Shaw PA, makes 500 x 500 and 600 x 600 for overseas clients. Can supply to US for 25 m2 minimum orders.
David Vita (800) 424-7429 x 8459
Russ Riehm x 2064

09 Ceiling Systems

Armstrong World Industries PA, makes metric. Usually no added cost or lead time for metric sizes.
Dan Kennard (717) 396-2684
Deb Kantner x 3045

Capaul Architectural Acoustics IL, can make metric sizes.
Tom Stanton (distributor) (410) 234-0010

Celotex Corporation FL, a major tile mfr, offers an entire product line of hard metric sizes.

George Mitchell (813) 873-4027

Chicago Metallic Corp IL, makes metric grids.

Craig Trotier (800) 323-7164

National Rolling Mills PA, makes metric sizes.

Rich Mattioni (215) 644-6700

Steel Ceilings OH, can make metric perforated and unperforated accoustical metal ceiling panels in steel, aluminum, and stainless.

Lou Heil (614) 622-4655

USG Interiors IL, makes metric sizes.

William Nelson (312) 606-5358

David Vanosdall (312) 606-3804

09 Drywall

Celotex FL,

George Mitchell (813) 873-4027

Centex American Gypsum NM, minimum order is generally one truckload (~2000 m2) dependent on job location and production status at time of order.

Lex Dominey (800) 545-6302

Domtar Gypsum MI, has made, and will supply in less than one truckload increments if premium is paid. George Shortreed

Jim Hanser (313) 930-4700

Georgia Pacific GA

Bronwyn Dawkins (404) 521-4000

James Hardie Gypsum NV, can supply in 2000 m2 minimum orders.

Todd Thomas (310) 787-6950

Alex Beaman (800) 995-0950 x210

National Gypsum NC, can make, has not yet fixed their minimum order.

Kurt Withrock (704) 365-7475

David Drummond (704) 364-7474

Temple Inland TX, can make.

Jim Rush (800) 231-6060

USG Interiors IL, can make. See USG names above.

09 Floor Tile

Burke CA, makes 500 x 500.

(408) 297-3500

Freudenberg MA, makes 1000, 500, 250 mm tiles.

Joe King (508) 689-0530

Gerbert PA, makes 300 x 300.

(717) 299-5035

Roppe OH, makes 500 tile.

(800) 537-9527

10 Access Floor

Following firms make 600 x 600 access floor.

C-TEC Inc MI,

Don Heeney (616) 243-2211

Interstitial Systems IL,

Bill Collier (708) 691-8600

Tate Access Floors MD, Lida Poole, Victor Sainato

(410) 799-4200

USG Interiors / Donn IL

William Nelson (312) 606-5358

David Vanosdall (312) 606-3804

Interface GA, commonly known for carpet, also makes access floor domestically. Only size is 500 x 500. Heights are lower than traditional heights, and are intended for wire management applications.

Lew Engle, Peter LePage

(800) 336-0225

14 Elevators

A recent elevator project bid, requiring submittals and construction in metric, was bid by several well known producers. Project is now in construction.

The ability of US producers to provide drawings and data in metric is essentially unanimous. We have discussed metrication with both US firms and many of their Canadian operations, and find consistent practice.

Dover NC, can provide metric drawings for US work.

Montgomery IL, has done metric for overseas, most Canada jobs are metric, can do metric for US work.

Otis Elevator CT, can do US work in metric. New designs are often hard metric and have have started to use hard metric fasteners.

Schindler NJ, can provide drawings in metric for elevator, escalator, and moving walk equipment. Escalator products made in NC are produced in metric.

15 Air Diffusers and Grilles

Acutherm CA, mfr of VAV air distribution devices, can make metric sizes.
Jim Kline (510) 428-1064

Aireguide FL, a large air products mfr, can make 80-90 % of its products in metric sizes.
Daryl Gray (305) 888-1631

Carnes WI, a large mfr, often makes metric sizes.
Dick Laughlin (608) 845-6411

Donco Air Products IA, can make light troffer, slot, and lay-in diffusers up to 1500 mm long.
Ron Jansen, Marc Vanedgrift (515) 488-2211

Duralast LA, can make its diffuser product in
600 x 600. Ron Vinson (distributor)
(504) 837-2346

J & J Register TX, can make hard sizes.
Chris Smith (915) 852-9111

Juniper Industries NY, has made, and can make metric size diffusers and grilles.

Steve Liebermann (718) 326-2546

Krueger Inc AZ, can make metric sizes.

Steve Bowser (602) 622-7601

Reliable Metal Products AL, part of Hart & Cooley, can make 90 % of its products in metric sizes.

John Bowers (205) 684-3621

Rock Island Register IL, can make its diffuser in

600 x 600.

John Howarth (309) 788-5611

Sommerville Metalcraft IL, can produce metric grilles and diffusers.

Paul Moehling (800) 654-3124

Thermo Kinetics SC, can make metric grilles and diffusers. No extra cost. Terry Rutledge
(803) 277-8080

Titus Products TX, major mfr of grilles and diffuser products, indicates a number of products now available in metric sizes. Dave Loren (214) 699-1030

Trane has begun to offer metric data on their VAV products.

15 Mechanical Equipment

Many major manufacturers of mechanical equipment already have metric literature on their products, are converting literature and product data to metric, or have committed to do so for US metric projects.

American Standard
Ansul Fire Protection
Aurora Pump
Baltimore Air Coil
Carrier Corporation
Central Sprinkler

Dunham-Bush
 Hurst Boiler
 ITT Bell Gossett
 Landis and Gyr Powers
 Liebert, current catalog has metric.
 Loren Cook Company
 Marley Cooling Tower
 McQuay
 Trane Company
 York

16 Conductors

These firms either have made metric conductors before, or are able to make them.

Americable AR, produces mm2 sizes, and can supply for US projects. (sizes 0.5 to 300 mm2)
 Noubar Sarkissian (800) 643-1516

American Flexible Conduit MA, has made metric before, can produce mm2 sizes.
 Glenn Stewart (800) 225-8588

Kerite Company CT, can produce mm2 sizes. (203) 888-2591

Okonite Company NJ, can produce.
 Jim Kushner (201) 825-0300

Pacific Electricord CA, stocks some 0.75, 1, and 1.5 mm2 product. Can produce other sizes.
 Donna Tovey (310) 532-6600

Pirelli Cable NJ, has made mm2 sizes, can produce.
 Tony Tremonte (800) 845-8507

Rome Cable NY, has made mm2 size, can produce.
 Jan Visser (315) 337-3000

Triangle Wire RI, has made mm2 sizes, can produce.
 Hilliard Huggins (401) 729-5400

Southwire Company GA, has made mm2 sizes, can produce.
 Sid Ticker (404) 832-4242

16 Lighting Fixtures

We recommend that selection of fixtures be limited to the high volume, commonly used lay-in fixtures, since industry is concerned that the effort associated with converting all products to metric over a short period of time would be difficult, as tooling requires resources and time to construct.

Allan Lighting NJ, can supply lensed and parabolic 600 x 600 and 600 x 1200 fixtures. Electronic ballasts or other are available. 10-20 fixture orders are acceptable.
 Howard Komish (908) 964-6885

ALP Lighting IL, which supplies louvers and lenses to many major US mfrs, can produce these products in any required metric size. ALP has supplied louvers to Germany and England in metric sizes.
 Don Michels (312) 774-9550

American Fluorescent IL, can produce the 600 x 600 and 600 x 1200 fixtures. Electronic ballasts available. Parabolic and lensed available. Minimum order is about 500 fixtures. Gary Stabelfeldt (708) 249-5970

Bieber Lighting Corporation CA, can make both 600 x 600 and 600 x 1200 hard metric fixtures. 18 cell parabolics, electronic ballasts, are available. Minimum order will be about 50 fixtures.
 Bob Bieber (800) 243-2375
 (213) 776-4744

C.W. Cole & Co CA, can make both 600 x 600 and 600 x 1200 hard metric light fixtures. Parabolic and lensed. Electronic ballasts are available. Minimum orders are about 20 fixtures.
 Frank Dayley, Jose Lopez
 (818) 443-2473

Day-O-Lite Manufacturing RI, can produce the 600 x 600 and 600 x 1200 fixtures. Electronic ballasts available, parabolic and lensed available. No minimum order quantity.
Arthur Goldstein (401) 467-8232

Hasco Electric Corp CT, can produce both the 600 x 600 and 600 x 1200 fixtures. Parabolic, lensed, and electronic ballasts available. Minimum order is about 20 fixtures.
Anthony Varbaro (203) 531-9400

H & H Fixture MO, can produce both the 600 x 600 and 600 x 1200 fixture. Electronic ballasts available. 5-10 fixture orders acceptable.

H.E. Williams MO, is currently making plans to be able to produce the hard metric fixtures. The firm is interested in hearing project inquiries, and may be able to supply these products in the near future.
Ron Snyder, Gary Fagg

Holcor IL, can produce 600 x 600 and 600 x 1200 fixtures. Electronic ballasts or other are available. 5-10 fixture orders acceptable.
Mark Nelson, Kathy Dykstra (312) 376-9780

Holophane OH, can provide the 600 x 600 and 600 x 1200 fixtures. Parabolic or lensed available. Electronic ballasts available. Holophane has quoted hard metric inquiries before. Minimum order is probably about 100 fixtures.
Bob Catone (614) 345-9631

Lithonia GA, one of the largest US lay-in mfrs, produces hard metric fixtures in its SP, SP(air), Paramax, and Optimax products.
West Coast: Marcus Cone
(818) 965-0711

Louisville Lamp Company KY, is able to supply both the 600 x 600 and 600 x 1200 fixture. Electronic ballasts, parabolics, lensed fixtures available. No minimum quantity.

Mike Davidson (502) 964-4094

Lumispec PA, can produce both 600 x 600 and 600 x 1200 hard metric fixtures. Parabolics, lensed, and electronic ballasts available. Minimum order is about 30 fixtures.

Eric Papougenis (215) 228-3830

Mark Lighting NJ, has made metric fixtures before, can supply both the 600 x 600 and 600 x 1200. Minimum order is about 50 fixtures.

George Miller (201) 939-0880

Midwest Chandelier KS, is now supplying hard metric 600 x 1200 parabolic and lensed fixtures to GSA projects. Prices are generally comparable to english size costs. Minimum order is 50 fixtures.

Tom Lefkovitz, Doug Pasternak (913) 281-1100

Morlite Equipment PA,
(814) 774-9631

Prudential Lighting CA, can make both the 600 x 600 and the 600 x 1200 fixture. Company only produces lensed products, such as lensed troffers. Parabolics are not offered. Electronic ballasts available. Minimum order about 75 fixtures.

Tammy Swaim (213) 746-0360

Simkar Lighting PA, has produced and can supply 600 x 600 and 600 x 1200 fixtures. Parabolics, electronic ballasts, are offered. Premiums on small orders such as 10-20 fixtures.

Robert McCully (215) 831-7700

Solar Kinetics TX, is able to provide the 600 x 600 and 600 x 1200 fixtures. Electronic ballasts available.

Sandy McCrea (214) 556-2376

USI / Columbia Lighting WA, the second largest fluorescent fixture producer in

the country, often produces hard metric sizes, can supply 600 x 600 and 600 x 1200, and can make almost any size metric fixture. Lead times would not normally exceed 8-10 weeks.

Mark Johnson, Fred Smith
(509) 924-7000

Wellmade Metal Products CA, is able to produce both 600 x 600 and 600 x 1200 hard metric fixtures. Parabolics or lensed are available. Electronic ballasts are available. Minimum order is about 100 fixtures.

Bernie Shane (510) 562-1878

Acknowledgments

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 Holmes and Narver CA
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 Simpson Gumpertz Heger MA
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Others who have assisted us, and who we have negligently, but unintentionally, failed to mention. Standard Graphic Design Data:

1. Titles for drawings shall be 25 mm from top edge.
2. Left and right margins shall be 30 mm.
3. Text should preferably start 40 mm from top edge.
4. Bottom margin should be minimum 20 mm.