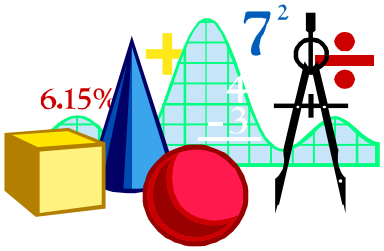
WORKING WITH METRICS



English is the international language of business.
Metric is the international language of measurement.

OVERVIEW

The conversion to metrics in U.S. government construction has been discussed for many years. It has been fact in commercial facility construction for as many years. This chapter will provide you with some very basic information concerning the use of metrics to help you "get on the bandwagon". Some of our bases have already made the switch while some have not. For those that have not, this chapter will give you a starting point. For those that have, the chapter provides a basic review. Remember, we still have many overseas locations. The system of choice overseas, and very soon in the CONUS is ***METRIC***. So, whether you are stationed in the states or "across the pond" really makes no difference. Metric is here!

Outline

The main topics covered in this chapter are:

References
Working Drawings
Specifications
Floor Loads
Construction Materials
Summary

References

Here is a list of some of pertinent references:

Construction Metrification Council of the National Institute of Building Sciences, *Metric in Construction* newsletter, May-June 1994, Vol 3, Issue 3, Washington, D.C.

National Institute of Building Sciences, *Metric Guide for Federal Construction, First Edition*, Publications Department, 1201 L St., N.W., Suite 400, Washington DC, 20005.

R.S. Means Company, Inc., *Means Building Construction Cos Data, Metric Version*, 1994.

WORKING DRAWINGS

Working drawings are the *detailed instructions* given to a contractor. The contractor uses these drawings in concert with specifications to construct our facility projects. Anyone who has "constructed" a child's toy at Christmas has worked with working drawings. Facility working drawings are more complex, but the idea is the same.

Using the metric system for working drawings means that *feet and inches* are gone. *Meters and millimeters* are the new players in the game. All building dimensions are expressed in *millimeters*, while large site plans and civil engineering drawings use *meters*. Unit notations such as M or mm are not necessary. If there's no decimal point, such as the number 300, it's *millimeters*. If there is a decimal point carried to one, two, or three places, such as 300.55, it's *meters*. It's important to remember that *centimeters* ***are not*** used in construction.

Remember that you should **never** use a combination of U.S. and Metric system units on the same drawing. Combining both inch-pound and metric units increases dimensioning time, increases the chance for error, makes drawings difficult to read and delays the learning process.

Scales For Working Drawings

Working drawing scales are now ***true ratios*** rather than inch-fractions-to-feet. The following table outlines the preferred metric scales.

TRUE RATIO	***INCH-FRACTIONS-TO-FEET***
1:1	Full size
1:5	Close to 3" = 1'-0"
1:10	Between 1" = 1'-0" and 1-1/2" = 1'-0"
1:20	Between 1/2" = 1'-0"and 3/4" =1'-0"
1:50	Close to 1/4" = 1'-0"
1:100	Close to 1/8" = 1'-0"
1:200	Close to 1/16" = 1'-0"
1:500	Close to 1" = 40'-0"
1:1000	Close to 1" = 80'-0"

Sizes Of Working Drawings

The International Organization for Standardization (ISO), "A" series drawings are the *standard* for working drawings. The designation and corresponding sizes are:

"A" SERIES	***SIZE***	
A0	**1189 x 841 mm**	46.8 x 33.1 in
A1	**841 x 594 mm**	33.1 x 23.4 in
A2	**594 x 420 mm**	23.4 x 16.5 in
A3	**420 x 297 mm**	16.5 x 11.7 in
A4	**297 x 210 mm**	11.7 x 8.3 in

SPECIFICATIONS

Your specifications will not be much different than they are now. You will use *millimeters* for linear dimensions, *square meters* for area, and *cubic meters* or *liters* for volume. All other inch-pound units should also be converted to metric units.

Again, **do not** use a combination of units from both systems. Stay with metric units at all times.

At times however, it may be advisable to indicate two sets of units for the same item. This is done only when you want to clarify an otherwise unfamiliar metric unit. For example, a 10 horsepower motor could be shown as:

7.5kW (10 horsepower) motor

Be sure that the *metric* unit is given first, followed by the U.S. designation in parenthesis.

FLOOR LOADS

Engineers and designers will most likely remember using the metric system in their study of Statics, Dynamics, Thermodynamics, and in various design courses. However, most of us that were educated in the United States promptly set the metric system aside upon graduation. Here's a review of the metric system as it pertains to "floor loading" and design.

Floor load is typically designated in pounds-per-square-foot (psf). This has now changed to *kilograms-per-square-meter* (kg/m^2). This is because most live and dead loads (furniture, construction materials, etc.) are measured in kilograms. The only variation is the use of *kilonewtons-per-square-meter* (kN/m^2) for structural calculations. The equivalent unit of measure for a *kilonewton* is the *kilopascal*.

CONSTRUCTION MATERIALS

Construction materials which are "modular" in nature such as brick, block, drywall, plywood, etc., will undergo a hard conversion. In other words, the dimensions of these products will be changed to reflect *rounded metric* numbers. This is being done so that the materials will fit the universal planning grid of 600 x 600 mm (2' x 2'). Remember that the basic building module of 4" has also changed to 100 mm.

Other products such as steel reinforcing bars and various fasteners are being converted to hard metric sizes.

Custom-fitted materials/products such as stairs, handrails, ductwork, windows, structural steel, etc., can be produced with equal ease in the U.S. or *metric* system. Therefore, for *metric* jobs (most of the jobs you will be working on) fabricators will simply provide a *metric* product.

Materials which are cut-to-fit on the jobsite such as framing lumber and wiring, and materials which are not "dimensionally sensitive" such as hardware and plumbing fixtures will be "soft" converted. For example:

A wall switch face plate;

Formerly: 2-3/4" x 4-1/2"

Now: 70 x 115 mm

A water tank;

Formerly: 30 gallon

Now: 114 L

Concrete

Strength designations will change from pounds-per-square-inch (psi) to megapascals (MPa). Megapascals will be rounded to the nearest 5 megapascals per ACI 318M. The following equivalents are provided:

PSI	***Mpa***
2500	20
3000	25
3500	25
4000	30
4500	35
5000	35

Pipe & Fittings

Pipes and fittings also come in "soft" decimal inch dimensions, but are identified in nominal inch sizes. Remember that a 2" pipe has neither an inside or outside diameter of 2". Again, there is no need to "hard" convert to rounded metric dimensions. Pipe and fittings will simply be relabled as:

Nominal	***Metric***	***Nominal***	***Metric***
1/8"	6 mm	1-1/2"	40 mm
3/16"	7 mm	2"	50 mm
1/4"	8 mm	2-1/2"	65 mm
3/8"	10 mm	3"	75 mm
1/2"	15 mm	3-1/2"	90 mm
5/8"	18 mm	4"	100 mm
3/4"	20 mm	4-1/2"	115 mm
1"	25 mm	1" 25 mm for all larger sizes	
1-1/4"	32 mm		

Electrical Conduit

Electrical conduit is similar to piping in that it is also produced in "soft" dimensions, but identified in nominal sizes. Conduit in the relabled metric version is as follows:

Nominal	***Metric***	***Nominal***	***Metric***
1/2"	16 mm	2-1/2"	63 mm
3/4"	21 mm	3"	78 mm
1"	27 mm	3-1/2"	91 mm
1-1/4"	35 mm	4"	103 mm
1-1/2"	41 mm	5"	129 mm
2"	53 mm	6"	155 mm

Wood & Metal Framing

Crossections commonly referred to as "2-bys" are produced in soft fractional dimensions. In other words, a 2 x 4 is not exactly 2" x 4", but rather a soft 1-1/2" x 3-1/2". This due to the inexactitude of lumber milling. Therefore, there is no need to convert inches to hard (exact) metric dimensions. A 2 x 4 (2-by-4) may keep its traditional name but can be relabled 50 x 100 mm or the more exact size of 38 x 89 mm.

Spacing will be indicated as 400 mm and 600 mm, from the traditional 16" and 24". Once again, this change maintains the standardized 600 x 600 mm planning grid. Related to this is the use of Batt Insulation. Batt Insulation widths will be changed to comply with the 400 mm and 600 mm spacing.

Sheet Goods

Drywall, plywood, and other "sheet" goods will be changed as follows:

Widths: 4'-0" to **1200 mm**
Heights: 8'-0" to **2400 mm**
10'-0" to **3000 mm**

Metric sheet goods are becoming more and more readily available.

Doors

For custom applications, doors can still be ordered in any size. However, standard door sizes are changed as follows:

Widths: 2'-6" to **750 mm**
2'-8" to **800 mm**
2'-10" to **850 mm**
3'-0" to **900 or 950 mm**
3'-4" to **1000 mm**

Heights: 6'-8" to **2050 mm or 2100 mm**
7'-0" to **2100 mm**

Various Materials

Door thicknesses, materials, and hardware will not change. The following table is a compilation of various materials, and their dimensions in U.S. and Metric measurements.

Material	***U.S. System***	***Metric***
Ceiling Tile	2' x 2'	600 x 600 mm
	2' x 4'	600 x 1200 mm
Raised Floor Tiles	2' x 2'	600 x 600 mm
Brick	Standard	90 x 57 x 190 mm
Mortar Joints	3/8" and 1/2"	10 mm
Block	Standard	190 x 190 x 390 mm
Mortar Joints	1/2"	10 mm
Sheet Metal	Gage	Millimeters
Glass (cut sheets)	Feet & Inches	Millimeters
Structural Steel Sections	Inches	Millimeters
Weight	Pounds per foot	Kilograms per meter
Bolts	Inches	Millimeters

SUMMARY

Using the metric system to design and construct our facility projects is not difficult in itself. What may be difficult is the change in personal mindset. *"We've always done it the old way, the old way works, so why change?"* The change is a change for the better. The metric system simplifies, expedites, and clarifies the design and construction process. Once you ***"re-tool your thinking"*** you'll find the metric system quite user friendly. For example, to speak proper French a person must think in French. One cannot speak French properly or effectively while thinking in English. ***THINK METRIC*** and you'll find it easy to work with the metric system.