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Felt Tips

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Revenge of the M-Word

The metrication bandwagon rolled on during the last year. In this *Felt-Tip*, we follow-up on some recent developments discussed in last year's *Felt-Tip* on metrication. We also highlight how the steel industry is metricating.

Last year, GSA's headquarters said that they would accept soft-metric concrete masonry units instead of hard-metric concrete masonry. During the past year, due to Congressionally-mandated cuts in GSA's budget, the soft-conversion ruling has been usurped by some GSA regional offices and non-GSA agencies who now make their own construction decisions. Some projects anticipated to use soft-metric concrete masonry are being required to be hard metric. The result has been confusion for the masonry industry. In one project where hard-metric concrete masonry was used (Department of Veterans Affairs Regional Insurance Office in Philadelphia, PA), productivity dipped at the start of construction, but proceeded smoothly after the contractors, tradespeople, and suppliers became used to thinking in metric. Difficulties cited by the National Concrete Masonry Association regarding conversion to hard-metric concrete masonry units involve the cost of purchasing molds and maintaining stockpiles of hard-metric and soft-metric masonry units.[1] The action by NCMA contrasts with that of the Brick Institute of America, which supports conversion to hard-metric products, since existing non-metric brick sizes conform to hard-metric modules.[2]

In a related matter, Lehigh Portland Cement Company, is a fully-metricated company. In January 1995, Lehigh switched all of its activities (from purchasing to delivery) from inch-pound units to metric units.[3]

Last year, we looked at the metrication of the masonry industry. This year, we highlight the metrication of steel products.[4] Most structural steel products will not change size during metric conversion but simply will be relabeled ("soft converted") in metric units. Few such products are produced in even, round, inch-pound sizes now so there is no need to convert them to even, round metric sizes. The common ASTM specifications for structural steel products A36/A36M, A242/242M, A514/514M, A529/A529M, A572/A572M, A588/A588M, and A852/A852M, —include both inch-pound and metric units. Linear dimensions are converted to millimeters (mm) and mass is converted to kilograms (kg). Yield and tensile strengths are expressed in megapascals (MPa), where 1 MPa equals 1 N/mm^2 and 1 ksi equals 6.895 MPa. (Note that mass must be multiplied by the acceleration of gravity, 9.81 m/s^2, to determine force in newtons, N).

Structural Shapes (Series W, M, S, HP, C, and MC). Structural shapes are soft converted with actual dimensions rounded to the nearest millimeter and masses rounded to the nearest kilogram per meter. The *nominal* depth of each shape, however, is rounded to 10 mm. For example, a W14x90 shape is expressed in metric units as W360x134 where the nominal depth of 14 inches is converted to a nominal 360 mm and the mass of 90 lb/ft is converted to 134 kg/m. Some U.S. mills have implemented a dual unit marking system whereby each piece is marked with both inch-pound and metric designations regardless of the type of order. No mill has established stock metric lengths, however. Consult each mill to determine length, cutting, and shipping practices.

Angles. Angles are soft converted. Leg sizes are rounded to the nearest millimeter and thicknesses are rounded to the nearest tenth of a millimeter.

Hollow Structural Sections (HSS). HSS are soft converted. Side dimensions are converted and rounded to the nearest millimeter and wall thicknesses are converted and rounded to the nearest tenth of a millimeter. Unlike the common ASTM specifications for structural steels, HSS material specifications currently cover only inch-pound strengths and dimensions.

Steel Pipe. Pipe is soft converted with new designations based on ISO DN (diameter nominal) sizes where 1 inch equals 25 mm (see the September-October 1993 issue of Construction Metrication Council's *Metric in Construction).* Existing pipe strength identifiers remain unchanged. Thus, a 6-inch standard pipe will be relabeled as DN150 pipe, a 6-inch extra-strong pipe as DNX150 pipe, and a 6-inch double-extra-strong pipe as DNXX150 pipe. Alternatively, the DN size may be used with the identifiers "standard," "extra strong," and "double-extra-strong." A foolproof identification includes the DN size, the wall thickness in millimeters, and the mass in kilograms per meter.

Bar and Plate Products. Plates can be rolled to any thickness and width by simply adjusting the plate rolls, most mills have the capability to produce metric thicknesses should an order be large enough to warrant it. Ordering small quantities of bars in metric thicknesses, however, may be difficult for some time. When a project calls for metric bar material, reasonable solutions may be to: (1) order a plate product of the required metric thickness and burn or shear the plate to the required width (plate nesting will minimize scrap loss); (2) order bars to the closest available inch-pound thickness and width; or (3) use soft-converted metric bar dimensions.

High-Strength Bolts, Nuts, and Washers. The metric series of high-strength bolts, nuts, and washers is a true ("hard") metric series designated by an "M" prefix followed by the actual diameter in millimeters: M16, M20, M22, M24, M27, M30, and M36. See ASTM specifications A325M and A490M for high-strength bolts, A563M for nuts, and F436M for washers. Detailed information on hole sizes and bolt tensioning may be found in the AISC's *A Guide to Metric Steel Fabrication and Metric Conversion of LRFD Specification for Structural Steel Buildings* as well as the *Metric LRFD Specification for Structural Joints Using AS7MA325 or A490 Bolts.*

Welding. It is not anticipated that electrode strength levels will be changed for metric work. For instance, an existing E70 electrode will be used at a metric strength level of 480 MPa rather than 70 ksi. The metric strength equivalents of common inch-pound electrode strengths are presented in the chart below. Although various tables within American Welding Society documents convert 60 ksi to 415 MPa and 70 ksi to 485 MPa, the AISC recommends that the lower rounded values be used for design.

Electrode	Strength in ksi	Strength in MPa
E60	60	410
E70	70	480
E80	80	550
E90	90	620
E100	100	690

Fillet weld sizes are easily expressed in millimeters and should be designated in one millimeter increments up to 8 mm, two millimeter increments from 8 to 20 mm, five millimeter increments from 20 to 40 mm, and ten millimeter increments beyond 40 mm. Welding nomenclature is not expected to change.

Sources:

1. Carolyn Schierhorn, *Case Study of a Hard Metric Project*. Masonry Construction. May 1996, pp. 214 to 216.
2. Construction Metrication Council. Metric in Construction, March-April 1995.
3. Construction Metrication Council. Metric in Construction, March-April 1995.
4. Construction Metrication Council. Metric in Construction, May-June 1995.

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