HIGHWAYS

Federal funds help build and maintain almost 1.5 million kilometers (922,000 miles) of our nation's roads and highways--about a quarter of the U.S. total. Combined federal and state construction expenditures for this work are about $20 billion annually with 80 percent paid by the federal government and the balance paid by the states. After 1996, all federally aided and federally funded highway construction will be in metric as indicated in the following Federal Highway Administration (FHWA) timetable:

FEDERAL HIGHWAY METRIC TRANSITION TIMETABLE:

Prepare metric conversion plan - **October 1991**

Initiate revision of laws and regulations that are barriers to metric conversion - **1991**

Complete conversion of FHWA manuals, documents, and publications - **1994**

Complete conversion of FHWA data collection and reporting processes - **1995**

Issue construction contracts in metric units only - **September 30, 1996**

Although many federal agencies have set a goal of converting their construction to metric in January 1994, the 1996 date adopted by the FHWA allows the states, which perform the actual highway work except on federally owned land, sufficient time to prepare for metric conversion. This is particularly important in light of the long lead times that larger highway projects require.

Here, in abridged form, are the answers to commonly asked questions about highway metrication. Taken from a June 1993 FHWA metric fact sheet, the questions and answers illustrate the complexity of the conversion process and FHWA's firm commitment to meeting the 1996 deadline.

Q What is meant by metric plans, specifications, and cost estimates (PS&Es)? Do all measurements have to be in metric or can certain designated numbers remain in inch-pounds or can dual units be used?

A All PS&Es are to be in metric units exclusively after September 30, 1996. While special situations may be considered on a case-by-case basis, it is expected that the states are currently taking necessary actions in their project activities to ensure that projects advertised for construction after this date are being developed in metric. General exceptions will not be granted. Specific exceptions will have to be justified--for example, if circumstances are beyond the state's control due to unforeseen delays in right-of-way acquisition or environmental clearances, an exemption would be considered.

Q Will structural and hydraulic design calculations have to be in metric? These are not transmitted with the PS&E package.

A Eventually, all highway engineering and reference manuals will be in metric, so it seems reasonable to expect that calculations requiring the use of data from tables and equations in these manuals will be also in metric. Working in inch-pounds units and then converting to metric defeats the purpose of

learning the metric system and creates an environment that is prone to confusion and errors.

Q Have any states put out metric PS&Es? If so, can the other states be provided with examples and a description of problems and difficulties that had to be overcome? Does Canada have standard designs, computer software, and other aids we can use?

A The Florida Department of Transportation (DOT) will contract for a large metric project in August. The Kentucky DOT has a metric project 10.5 kilometers (6.5 miles) long to be let in the near future. The Federal Lands Highway Office completed several metric projects in the 1970s. The Puerto Rico Department of Public Works has been doing metric projects exclusively for a long time. Canada has been very helpful in providing information about metrication and we are consulting with a number of their highway officials.

Q Will the FHWA require certain items to be in hard metric units or will this be left up to the states?

A The FHWA expects states to follow metric standards adopted by the American Association of State Highway Transportation Officials (AASHTO), the industry, and the FHWA. To the extent practical, units should be hard converted.

Q Will dimensions have to be shown in metric for rehabilitation projects? How about replacement of inch-pound parts such as bolts?

A When reasonable and practical, all dimensions should be in metric. Showing two different methods of measurement only creates confusion. In the replacement of inch-pound parts such as bolts, common sense should dictate the action.

Q Will the FHWA insist on a hard conversion for all plans authorized for bids after September 30, 1996, including plans previously designed in inch-pound units, or can a state soft convert inch-pound plans on the shelf and those caught in unique circumstances just prior to September 30?

A The FHWA's implementation schedule calls for projects authorized after September 30, 1996, to be in metric units. While the use of rational metric units resulting from hard conversion is desired, it is not mandated. Due to the 5-year lead time provided, the FHWA does not expect states to have a significant number of inch-pound projects still to be let after September 30, 1996. If an exception is not warranted, as previously discussed, soft conversion will be acceptable.

Q What about research reports? Is there a policy on metrication for university-performed research?

A According to instructions issued by the FHWA's Office of Contracts and Procurement, contracts awarded by the FHWA after October 1, 1992, require that all technical reports provide metric units with inch-pound units in parentheses. This is consistent with the FHWA's Metric Conversion Policy, published in the *Federal Register* on June 11, 1992, which requires that, after FY 1992, all new and revised FHWA technical publications be in metric units and that, after FY 1993, the use of dual units should be avoided except in specific cases where such use is deemed beneficial.

Q Has it been determined that metric construction will cost more initially than inch-pound construction?

A No. Based on experience so far there has been no appreciable increase in costs due to metrication. The Services Administration has over $1.5 billion in design and construction contracts and they claim no cost increases due to metrication. Countries that have changed to metric in recent times (e.g., Canada, Australia, Great Britain, and South Africa) also indicate no appreciable increase.

Q Will the FHWA adopt the *Guide to Metric Conversion* published by the American Association of State Highway and Transportation Officials (AASHTO) or will changes be recommended? What is the timetable for acceptance of the *Guide*?

A The FHWA has representation on the AASHTO Metric Task Force and was provided the opportunity to review and comment on the *Guide* during its development process. We are unaware of any items in the guide that the FHWA disagrees with. The *Guide* is designed to help the state highway agencies responsible for implementing their individual conversion plans.

Q What is the length of a survey station in metric, 100 meters or 1 kilometer?

A The metric length of a survey station for highway purposes is 1 kilometer. The Federal Lands Highway Office is using 1 kilometer. The AASHTO *Interim Selected Metric Values for Geometric Design Guide* states that the AASHTO Geometric Design Task Force concurs with the AASHTO Subcommittee on Construction's recommendation of stationing on a 1 kilometer basis.

Q The FHWA Metric Conversion Plan shows that pavement design standards will be hard converted by the end of FY 1995. What does this mean? Does the state highway agency's pavement design program have to provide a metric design thickness? Does project design support documentation for PS&Es authorized after September 30, 1996, have to be in metric?

A The AASHTO *Guide for Design of Pavement Structures* was recently revised but the revision did not include metric units. Currently, there are no specific dates set by AASHTO for a metric version of the *Guide*. After September 30, 1996, however, plans must show pavement thicknesses in metric units.

Q Does the FHWA have a current estimated completion date for modifying or coordinating modification of the following software programs to metric: WSPRO, HEC2, TR-20, and TR-55?

A The WSPRO hydraulics program is being revised by a consultant to include metric and should become available in the summer of 1994. The HEC2 is a Corps of Engineers hydraulics program and already is available in metric. The TR-20 and TR-55 are Soil Conservation Service programs that are not scheduled for conversion at this time.

Q Will state highway agency and metropolitan planning organization air conformity models and analysis methods need to be in metric?

A Air conformity models and analysis methods are being revised to meet new air quality requirements. These programs should be available in both inch-pounds and metric units within a year or so.

Q Will the FAA's regulations governing airway-highway clearance be revised to metric to coincide with the FHWA's metric conversion dates?

A Currently, the FAA is revising their design guides for airport development. The guides include airway-highway clearances. All guides will be in dual units by 1997 and in metric-only units by 1999.

Q The notice of proposed rulemaking for the ISTEA (Intermodal Surface Transportation Efficiency Act of 1991) Management Systems does not have metric references. Are these systems required to be developed in metric?

A Each program office responsible for individual Management Systems has been reminded to issue specific instructions for metric implementation to the field offices as soon as possible.

For more information about the FHWA's metric conversion activities, contact Al Benet at 202-366-4631. To obtain a copy of the AASHTO *Guide to Metric Conversion* ($13.00, including shipping and handling), call AASHTO's publications department at 202-624-5809.

METRIC FACTS: DENSITY

Which is heavier, a pound of feathers or a pound of lead? This childish question probably marked the first encounter with the concept of density for many people. For engineers, the concept is one that is used almost daily.

Density is defined as mass per unit volume. There have been many ways of expressing this concept in different measurement systems over the years. Fortunately, in metric there is only one combinatio of units that should be used and that is kilogram per cubic meter, kg/m^3. For conversion purposes, there are 2.205 pounds per kilogram and 264.2 U.S. liquid gallons per cubic meter.

Problem:

A sample of No. 6 fuel oil has a density of 7.95 lb/gal. Express this in metric units.

Solution:

$7.95\ lb/gal \times kg/2.205\ lb \times 264.2\ gal/m^3 = 952.6\ kg/m^3$

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The National Institute of Building Sciences is a nonprofit, non-governmental organization authorized by Congress to serve as an authoritative source on issues of building science and technology.

The Council is an outgrowth of the Construction Subcommittee of the Metrication Operating Committee of the federal Interagency Council on Metric Policy. The Construction Subcommittee was formed in 1988 to further the objectives of the 1975 *Metric Conversion Act*, as amended by the 1988 *Omnibus Trade and Competitiveness Act*. To foster effective private sector participation, the activities of the subcommittee were transferred to the Council in April 1992.

Membership in the Council is open to all public and private organizations and individuals with a substantial interest in and commitment to the Council's purposes. The Council meets monthly in Washington, D.C.; publishes the *Metric Guide for Federal Construction* and this bimonthly newsletter; and coordinates a variety of industry metrication task groups. For membership information, call the Council at the above phone number.

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