Foot versus Foot – Still Kicking the Can?

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The meter is the universal standard of length used by most countries of the world. The foot is a unit of length divided into 12 inches and fractions. The foot is also decimally divided and is the form used by most surveyors in the United States. According to the internet (which may or may not be wrong), only three countries in world do not use the metric system – Liberia, Myanmar, and the United States - see

https://www.zmescience.com/other/map-of-countries-officially-not-using-the-metric-system/

There are many reasons why the United States is not "metric" and many reasons why we should be. But that is not the point in this article. This article concedes that feet will probably continue to be used by many United States surveyors. **But the point here is that, if not meters, we should be using the International Foot.**

This issue is brought up for discussion now because the National Geodetic Survey (NGS) is attempting to avoid "kicking the can" again by stipulating that, with publication of the 2022 datum, the U.S. Survey Foot will no longer be included in the definitions of the various state plane coordinate system zones. Regardless of personal preferences, every surveyor should view the presentation by Dr. Michael Dennis from NGS. He lays out excellent arguments in favor of the International Foot but notes that NGS would much rather use persuasion rather than coercion. The U.S. Survey Foot is not being abandoned but will join the ranks of other previously used units such as chains, links, rods, and the *vara*. The historical significance of those previous units will not be diminished, but recognition and use of the International Foot will bring a desirable measure of standardization to what is now a confusing array of units.

https://www.ngs.noaa.gov/web/science_edu/webinar_series/fate-of-us-survey-foot.shtml

Please don't misunderstand, starting with its first Director, Ferdinand Hassler who brought his own standard meter with him to the United States in 1804, the NGS has always performed their work in meters. As described by Dr. Dennis with additional detail provided by Andro Linklater in "Measuring America," the timeline for the physical "standard" and the development of the legal status of the meter in the United States gets to be rather convoluted. The link to the NGS webinar (above) and the link to Linklater's work (below) both provide valuable insight and speak to the standardization issue.

https://www.amazon.com/Measuring-America-United-Greatest-History/dp/1400130905

Subject to additional detail as provided in the preceding links, a summary includes:

1. The length of the meter was established in the 1790s as 1/10,000,000 of the arc distance from the Equator to the North Pole as determined by a geodetic survey in France.

2. In the early 1800s, prototype meter bars were made and widely distributed.

3. Although the meter has been used as the standard of length for geodetic surveys in the United States since establishment of the federal agency Survey of the Coast (predecessor to the NGS) in

1807, the meter length unit was declared legal for trade in the United States in 1866. The relationship between the foot and meter was stated in 1866 to be 39.37 feet = 12 meters exactly.

4. Leading up to and during World War II; Canada, the United States, and Great Britain each used a slightly different relationship between the foot and the meter.

US:	1.00 meter = 39.37 inches or	1 inch = 2.540005 cm
England:		1 inch = 2.539997 cm
Canada:		1 inch = 2.540000 cm

5. Following WWII, machinists and aircraft mechanics, working under the auspices of NATO, discovered that parts of aircraft engines built according to the same blueprints were not interchangeable due to differences in unit definitions. The compromise reached adopted the Canadian relationship to be known as the International Foot (1 ft = 0.3048 m exactly).

6. However, to avoid recomputing and republishing thousand of existing state plane coordinates, the United States retained use of 12 meters = 39.37 feet and that long-standing relationship became the U.S. Survey Foot. As pointed out by Dr. Dennis, a 1959 Federal Register Notice stated that the U.S. Survey Foot should be used "until such time as it becomes desirable to readjust the basic geodetic networks in the United States, after which the ratio of a yard, equal to 0.9144 meter shall apply." Dr. Dennis also notes that NGS "kicked the can" when the NAD 83 was published and acquiesced to those states insisting on continued use of the U.S. Survey Foot with the NAD 83 datum. The U.S. Constitution clearly states that fixing "the Standards of Weights and Measures" is one of the powers granted to Congress.

7. In 1960, the Eleventh General Conference of Weights and Measures redefined the meter, but not its length. The Redefinition made it possible to duplicate a 1-meter distance in terms of wavelengths of Krypton 86 gas instead of duplicating the distance between two marks on a bar.

8. The definition for realizing the length of the meter was changed again in 1983 – this time in terms of the distance light will travel in a vacuum in a very short time interval, 1/299,792,458 seconds. That is equivalent to saying that, in a vacuum, light will travel 299,792,458 meters in one second.

When the NAD 27 datum was readjusted and published as the NAD 83, the legislative intent was for the International Foot to be used as an alternate to meters. Recognizing that, a number of states included the International Foot in the state plane coordinate legislation written and adopted to accommodate the NAD 83. Other states objected and ultimately won. A notice dated May 16, 1988 published in the Federal Register closes by saying, "The effect of this notice is to allow the U.S. Survey Foot to be used indefinitely for surveying and mapping in the United States. No other part of the 1959 notice is in any way affected by this notice." Was that "kicking the can?" Dr. Dennis notes that the 1988 Federal Register Notice is a request for feedback and that a decision on the matter would be made pending analysis of public comment. He claims that decision has never been made.

The upshot is that NAD 83 state plane coordinates in the United States may be meters, U.S. Survey Feet, or International Feet. In the webinar Dr. Dennis states clearly that the current dilemma is a direct result of inaction by NGS. In my opinion, NGS is to be commended for laying out the issue so candidly and resolving to make things better for the future. Publication of the 2022 datum is the ideal time to do that.