

Movements that Affect Tolerance Measurements

The ACI-ASCC 117 Tolerances Committee has just established a subcommittee to consider the effect of movements on tolerances. The current ACI 117-15 does consider the effect of some movements on tolerance measurement. It considers time, within 72 hours, in measuring flatness and levelness either by F-numbers or a 10-ft. straightedge and also considers a construction operation, formwork removal, when measuring flatness and levelness and elevations of suspended slabs. The subcommittee, however, needs to consider movements caused by temperature, moisture changes, post-tensioning, backfilling, and other operations with respect to tolerance measurements.

As a preamble, to ACI-ASCC 117's efforts, I searched other countries' tolerance documents to see how they handle the effects of movements on tolerance measurements. Most of the tolerance documents didn't address the issue, but there were two that provided some information: the International Standards Organization (ISO) and the German national standards organization (DIN).

ISO 7976-1 Tolerances for Building

Methods of Measurement of Buildings and Building Products

Part 1: Methods and instruments

Influence of deviations from reference conditions

"Variations in the ambient conditions from the specified reference values can give rise to errors in the measured size of a dimension. Temperature, especially direct sunshine, is normally the most significant of these ambient conditions".

"Other reference conditions such as moisture content of timber and age of concrete components shall be taken into account where appropriate".

"The actual temperature of either the object to be measured or the measuring equipment may be difficult to determine in practice since it is unlikely that either will be at uniform temperature and because temperature differentials within the object to be measured or in the equipment will exist. The most satisfactory solution is to allow both the object to be measured and the measuring equipment adequate time to achieve a stable ambient temperature. This temperature can then be measured and allowance made for any variation from the specified reference temperature".

"Measuring straightness deviations with the aid of a wire should be avoided during rain and strong wind".

DIN 18202 Tolerances in Building Construction

- "Deformation as a function of time, loading and temperature shall be considered elsewhere".
- "Owing to deformations occurring as a function of time and loading, measurements are to be made as early as possible, by the time of acceptance by the subsequent contractor or final inspection of the building at the latest".

Possible Direction for ACI-ASCC 117

Neither the ISO nor DIN documents are very specific; however, they do alert the reader to some issues. ISO discusses specified reference values for ambient conditions. Thus it might be appropriate for ACI-ASCC 117 to specify that tolerance measurements shall be taken when the member temperature is between a range; such as 60 to 80F. This would help decrease the effect of temperature on tolerance measurements.

The DIN document indicates that measurements affected by loading should be made as early as possible. It would certainly be better to make tolerance measurements before deformations due to loading. Thus ACI-ASCC 117 could require that tolerance measurements be taken prior to backfilling walls and prior to post-tensioning.

One interesting suggestion made by ASCC contractor Frank Salzano of Ceko Concrete Construction is shown below:

Movement and Tolerance Measurements:

All tolerance measurements must be taken within 72 hours of placement of concrete (similar to F-numbers and straightedge measurements) and within 20° F of existing ambient temperature at time of placement.

I certainly think Frank's suggestion has merit. If other ASCC members have suggestions, please send them to Bruce Suprenant at bsuprenant@asconline.org. Thanks!