ULTIMATE SHRINKAGE (Sh) AND CREEP (Cr) COEFFICIENTS AS USED IN ADAPT-ABI

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Two of the parameters that define the material properties of concrete in ADAPT-ABI are "Ultimate Creep Coefficients, Cr" and "Ultimate Shrinkage Coefficient Sh." This Technical Note explains their interpretation by the program. Generally, both parameters are defined with respect to standard specimens, loaded and maintained in a controlled environment. The deviations from the controlled condition of the standard specimen to the actual environment of the prototype bridge or other structure being designed are implemented by factors that are defined in the applicable design code. An exception to this rule is when the material information is derived from laboratory tests devised specifically for the structure under construction. When a design code is specified, ABI uses the code's recommendations. When laboratory derived information is used, ABI uses the lab readings for its computation. The following explains the interpretation of the ultimate creep and shrinkage coefficients in each instance.

1 - ULTIMATE CREEP COEFFICIENT (Cr)

Refer to Fig. 1. When loaded, a concrete specimen undergoes instantaneous displacement shown by line AB in the figure. If the load is maintained on the specimen. The displacement continues with time, following reduce rate to a final value (point D). The time-dependent strain subsequent to the application of the load is creep strain (εc). In the general case, the ultimate creep coefficient is defined as:

$$Cr = \varepsilon c / \varepsilon e$$

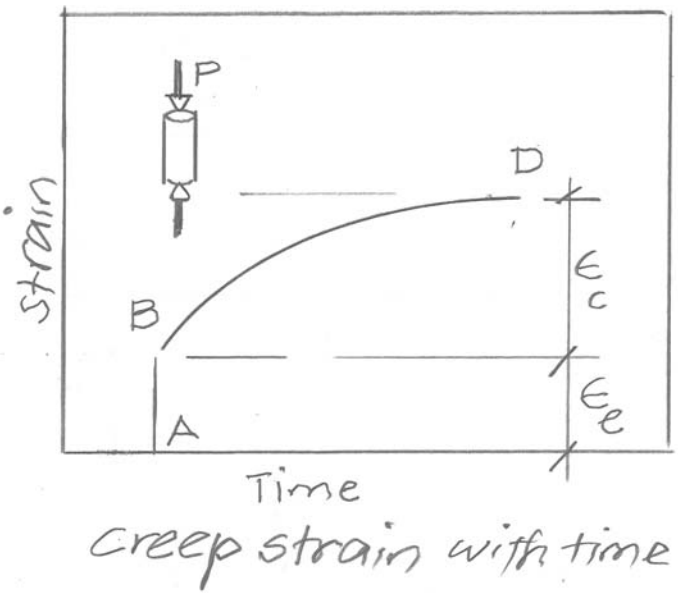


FIGURE 1-1

2 – ULTIMATE SHRINKAGE COEFFICIENT (Sh)

Subsequent to curing, once exposed to weather (point A in Fig. 2-1) concrete starts to shrink due to loss of moisture. The rate of shrinkage reduces with time. The final shrinkage is shown with point D in Fig. 2-1. The ultimate shrinkage coefficient (Sh) is generally defined as the value at point D in the figure.

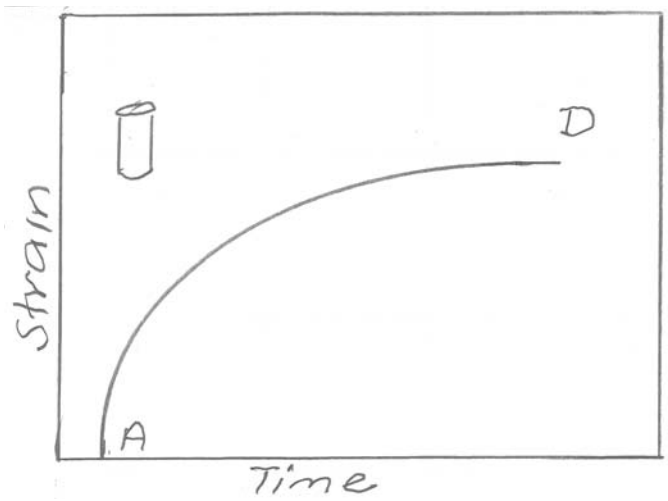


FIGURE 2-1

3 – TREATMENT FOR GIVEN CODES

When specifying American Codes: AASHTO; ACI, and European Code EC2, and FIP; CEB, and Indian codes: IS 1343-1980; IRC 18-2000

When one of the American codes, or one from the above list, is specified the program treats the material as shown in part A of Fig. 2. The value specified as input is considered to be the actual magnitude of creep or shrinkage for the material being used. The curves 1, 2, or 3 display the manner in which the ultimate value of creep and shrinkage are attained. Each curve relates to a design code specified by the user. In other words, the specification of a design code determines the progression of creep and shrinkage with time toward a final value specified by user as input.

When specifying Hong Kong Code

For Hong Kong 2004 code, the code specified values of creep and shrinkage are hard-coded in the program as “base curves” (part C of Fig. 2). Users, however, have the option to magnify or reduce the hard coded values (part C of Fig. 2) by specifying a value for Cr and Sh in input data different from unity. A value larger than 1 will maginfy the code specified numbers. Likewise, vallues less than 1 will lowers them.

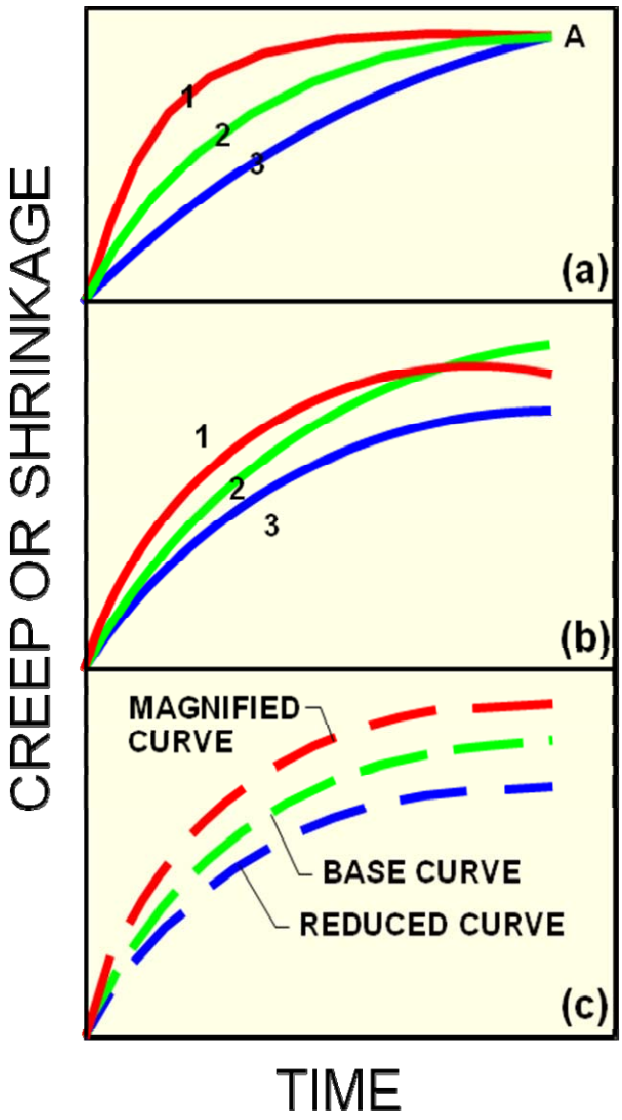
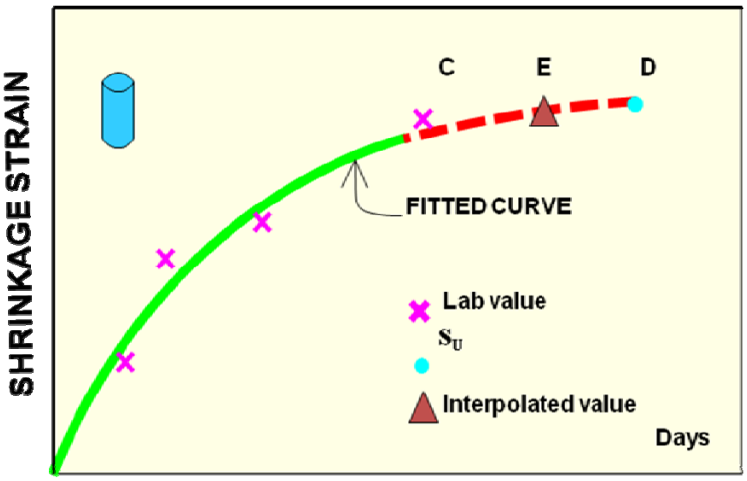


FIGURE 3-1 OPTIONS FOR TREATMENT OF CREEP AND SHRINKAGE WITH TIME

When specifying lab measurements

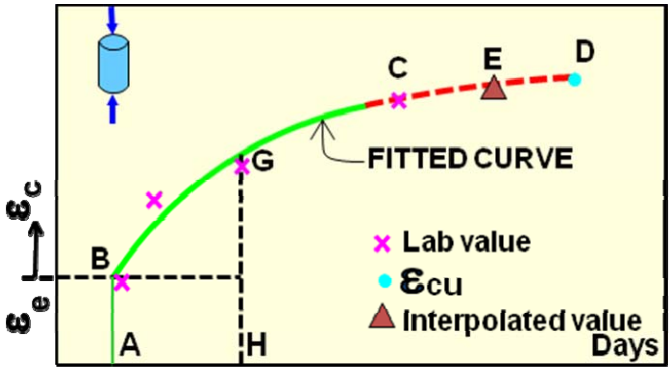
Figures 3-1 and 3-2 illustrate the readings from laboratory specimens used to determine the shrinkage/creep characteristics of a specific concrete material. The program allows the user to directly enter the laboratory measured values in a program specified format. In obtaining its solution, where needed, the program interpotales between the user specified values. The Cr and Sh parameters in input data of the program are used internally as coefficients to magnify or reduce the lab measured values entered.

When using lab values, for shrinkage response of a given concrete material, one test result is generally used (Fig. 3-2). However, to trace the creep of the structure, depending on the number of stages at which significant loads are likely to applied to the structure, two or more specimens need be tested (3-3),

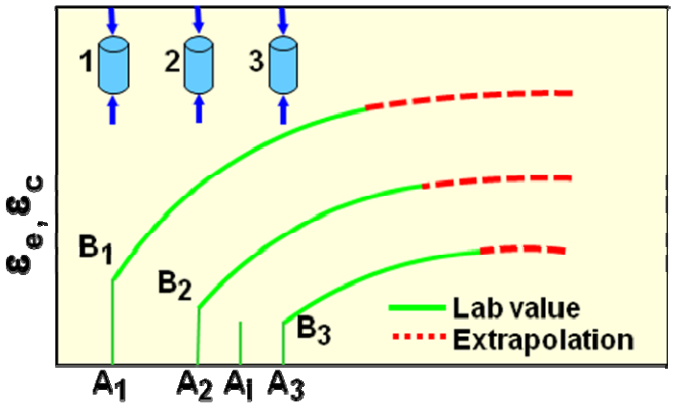


SHRINKAGE VALUES FROM LAB

FIGURE 3-2



(a) SINGLE SPECIMEN CREEP VALUE FROM LAB



(b) MULTIPLE- SPECIMEN CREEP VALUES FROM LAB

FIGURE 3-3