DRAFT

TECHNICAL NOTE 1027
MixSim and Mixsim98- use of CEN test methods.

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MixSim and Mixsim98 software programs and the book 'Computer Modelling of Concrete Mixtures' refer to test methods in use in the UK at the time of research and preparing the software.

Since that time, CEN methods have been adopted in Europe, with certain permitted national modifications. It is assumed that the results of using the CEN tests will not make any significant differences to designs prepared using the software but there are some changes to terminology which may raise queries for users. It is not proposed to revise MixSim at the present time.

This Note identifies the appropriate CEN standard tests, together with changes in terminology and other aspects of relevance to users of the software and the reference book.

TABLE 1	**Common properties of materials**
TABLE 2	**Cement strength**
TABLE 3	**Concrete properties**

Further guidance with respect to EN 206 is provided in **JDD Technical Note 1022**, which is available on the MixSim website at www.mixsim.net.

Dr J D Dewar

TABLE 1 Common properties of materials

Material	CEN test method or other test method		
	Property for MixSim		
	Mean particle size	**Relative density**	**Voids ratio**
Generally	Measure particle size distribution (or other property deemed appropriate, e.g. fineness of cement) and calculate mean size on a logarithmic basis using 'Preliminary Calculations' options in MixSim	The term *relative density* is defined historically as the ratio of the particle density of a material to that of water. The CEN standardised units for particle density are g/cm^3 in cement test standards or Mg/m^3 in aggregate test standards. In both cases, the *numerical values are the same as the values for relative density* if the density of water is assumed to be $1g/cm^3$ or $1Mg/m^3$. Standards have usually included a range of definitions for particle density. CEN continues this practice and it is vital to use the most appropriate definition and test method.	Voids ratio is a non-dimensional measure used in MixSim. It is the ratio of the volume of voids between particles in a container to the *volume of particles* in the container determined in a *loose* bulk density test. The test may be made in air for larger particles but needs to be made in water for fine particles such as cement, additions and fine fillers. In CEN standards, the volume of voids is calculated as a percentage of the *container volume* used for the bulk density test. Thus, as used in MixSim Voids ratio = voids% / (100 – voids%).
Cements, additions type I & II and combinations.	There is no CEN test method. Use national or industry approved method for measuring particle size distribution, or use **EN 196 – 6** Fineness. It is necessary to introduce a value for particle density of the powder obtained using a national or industry approved test method. (see next column, but do not apply the adjustment) Calculate mean size using 'Preliminary Calculations' options in MixSim (See also JDD 2.1.2)	There is no CEN test method. Use national or industry approved method for particle density. For a Portland cement, if kerosene is adopted as the medium for measuring particle density add 0.06 to the measured value (g/m^3) to represent the probable value in an aqueous medium. (See also JDD 2.2.2) For other materials use water or kerosene as the medium without adjustment to the values.	Use the test for water content for standard consistence in **EN 196 – 3** : Setting times. This test enables voids ratios to be calculated for cements, additions, combinations and also fine fillers using the preliminary calculations screen in MixSim. (See also JDD 2.3.3) It is also necessary to use the relative densities of the materials (See previous column).

Material	CEN test method or other test method		
	Property for MixSim		
	Mean particle size	**Relative density**	**Voids ratio**
Aggregates and fillers	For aggregates, use **EN 933 – 1**: Particle size distribution- sieving method, using standard sieves and intermediate sieves in the sequence 'Basic set plus set 2' given in EN 12620 Aggregates for concrete. Note 1. For coarse or fine aggregates consisting of effectively monosized particles, it may be essential to use intermediate sieves to ensure that significant errors are not introduced in assessment of mean sizes and size ratios in MixSim because of the relatively large gaps between the sizes of standard sieves in **EN 933** (See also JDD 6.1.4, Appendix B and Note 6-1). **EN 12620** : aggregates for concrete, includes some intermediate sizes which may be used. The 'basic set plus set 2' is recommended for mixture design purposes. If problems of inaccuracy are to be avoided in research or comparative testing, consider the use of further intermediate sieves. Note 2. JDD Technical Note 1022 (draft) shows how to change the sieve series in MixSim but users should be aware that the screen views show the *basic set* not the '*basicset plus set 2'* now being recommended For fillers, use **EN 933 – 10**: grading of fillers (air jet sieving). Intermediate sizes (see Note above) should also be used as well as the standard sieves.	For aggregates, use **EN 1097 – 6**: Particle density or for fillers, use **EN 1097 – 7**: Particle density. For the Materials Database in MixSim use *particle density on a saturated and surface-dried basis.* For the Preliminary Calculations screen for Voids ratio in MixSim use *particle density on a saturated and surface- dried basis or on an oven- dried basis.* (See next column)	For aggregates and relatively coarse fillers, use **EN 1097 – 3**: Loose bulk density and voids, using the *3 litre container* irrespective of maximum particle size Note 3. The size of container deliberately simulates a moderately restrictive thickness (150 mm) of concrete in practice for general design of mixtures. (See also JDD 2.3.2) and for fine fillers, test as for cement in box above. Either calculate voids (%) as in **EN 1097 – 3** and then calculate voids ratio as Voids ratio = voids% / (100 – voids%) or use the Preliminary Calculations screen for voids ratio in MixSim using loose bulk density and the appropriate particle density depending on the aggregate moisture condition in the test (see previous column)

Notes

(See JDD x.y.z) refers to sections in J D Dewar, Computer Modelling of Concrete Mixtures, E & FN Spon 1999.

TABLE 2   Cement Strength

MixSim aspect	CEN test method
Cement strength at 28days	Use **EN196 – 1** Determination of strength NOTE. In MixSim, continue to use the EN 196-1 standard mortar prism test for strength of cement or combinations of cement and additions

TABLE 3   Concrete Properties

MixSim aspect	CEN test method
Slump	Use **EN 12350 – 1** Slump test NOTE. For other consistence test methods, establish relation to slump for use in Mixsim
Total air content	Use **EN 12350 – 7** Air content – Pressure methods
Density of fresh concrete	Use **EN 12350 – 6** Density
Strength at 28 days and at other ages	Use **EN 12390 – 1 to 4** for cubes or cylinders tested at 28 days and at other ages. NOTE. See also JDDTechnical Note 1022 (draft), available on the MixSim website, for further guidance.