EN ISO 16826:2025
Non-destructive testing. Ultrasonic testing. Testing for discontinuities perpendicular to the surface.

EN ISO 16834:2025
Welding consumables. Wire electrodes, wires, rods and deposits for gas shielded arc welding of high strength steels. Classification.

EN ISO 21952:2025
Welding consumables. Wire electrodes, wires, rods and deposits for gas shielded arc welding of creep-resisting steels. Classification.

EN ISO 26304:2025
Welding consumables. Solid wire electrodes, tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels. Classification.

PUBLISHED DOCUMENTS

PD CEN/TS 1994-1-101:2025
Eurocode 4. Design of composite steel and concrete structures. Double and single skin steel concrete composite (SC) structures.

CEN TECHNICAL SPECIFICATIONS

CEN/TS 1994-1-101:2025
Eurocode 4. Design of composite steel and concrete structures. Double and single skin steel concrete composite (SC) structures.

UPDATED BRITISH STANDARDS

BS EN ISO 8407:2021+A1:2025
Corrosion of metals and alloys. Removal of corrosion products from corrosion test specimens

AD 543: Deflection of composite slabs

Occasionally, SCI's advisory desk is asked about the simplified rules for controlling the deflection of steel-concrete composite slabs by limiting their span-to-depth ratios. The question relates to what one should do when these ratios are exceeded. The purpose of this note is to provide clarification.

Limiting span to depth ratio

Clause 9.8.2 (4) of BS EN 1994-1-1:2004 permits calculations of the deflection of composite slabs to be omitted if both the following conditions are satisfied:

- the span to effective depth ratio does not exceed the limits given in clause 7.4 of EN 1992-1-1:2004, for lightly stressed concrete, and
- the load causing an end slip of 0.5 mm in the (long span) tests (used to determine the level of shear connection) on composite slabs exceeds 1.2 times the design service load. In reality this is something that a designer is likely to just assume, as it is highly unlikely they will have access to the manufacturer's test results.

The span to depth limits of BS EN 1992-1-1:2004 are specified in Table 7.4N where the UK NA to EN 1992-1-1:2004 refers to Table NA.5. The ratios in BS EN 1992-1-1:2004 are based on the effective depth, which for a composite slab with steel sheeting as reinforcement, is the distance from the top of slab to the centroid of the profile. The limits for different span conditions are shown in Table 1.

Table 1: General rules for the slab maximum span-to-depth ratios in accordance with BS EN 1992-1-1:2004

	Normal weight concrete	Lightweight concrete
Single spans	20	18.8
End spans	26	24.5
Internal spans	30	28.3

It's noted that the second-generation of EN 1994-1-1 only includes a single value of 26 for the limiting ratio of the span to the effective depth for normal weight concrete. Whilst the second generation of EN 1992-1-1 have new span to effective depth limits with a wider range of applicability, the rules in EN 1992-1-1 are no longer referred to in the second-generation of EN 1994-1-1, which only gives one value presumably as a simplification.

Where the limits of Table 1 are exceeded, the deflections should be calculated.

Calculating deflections

In accordance with clause 9.8.2 (3) of BS EN 1994-1-1:2004 deflections due to loading applied to the composite member should be calculated using elastic analysis.

Although end continuity is ignored for ULS verifications, for SLS it may be taken into account. Clause 9.8.2 (5) of BS EN 1994-1-1:2004 states that for internal spans that this can be achieved by using an average of the cracked (concrete below the neutral axis is ignored) and uncracked second moments of area. We recommend that this approach may also be used for end spans. For single spans a more complex and accurate approach may be justified, although it is very unlikely to be a critical check.

For typical building structures, the effects of creep may be taken into account by replacing concrete areas, A_c by effective equivalent steel areas A_c/n, where n is the modular ratio. The value of n allows for a typical combination of short-term and long-term loading.

where:

$$n = 2\frac{E_s}{E_{cm}}$$

E_s is the modulus of elasticity of structural steel
E_{cm} is the modulus of elasticity for the concrete

Traditionally, the modular ratio has been taken as 10 for normal weight concrete and 15 for light weight concrete.

Although clause 9.8.2(3) of BS EN 1994-1-1:2004 states that deflections of slabs should be calculated neglecting the effects of shrinkage, the second-generation of EN 1994-1-1 now requires that the additional deflections caused by shrinkage are included, and provides simplified formulae for single span slabs and continuous slabs:

$$\delta_{sh} = 0.15\varepsilon_{sh}\frac{L^2}{h} \text{ for single span slabs}$$

$$\delta_{sh} = 0.1\varepsilon_{sh}\frac{L^2}{h} \text{ for continuous slabs}$$

where
ε_{sh} is the shrinkage strain of the concrete
h is the overall depth of the composite slab
L is the span length

Subclause 3.1(4) of BS EN 1994-1-1:2004 states that where composite action is taken into account in buildings, the effects of autogenous shrinkage may be neglected in the determination of stresses and deflections. For dry environments within buildings, Annex C of BS EN 1994-1-1:2004 states that the total final free shrinkage strain may be taken as:

$\varepsilon_s = 325 \times 10^{-6}$ for normal weight concrete
$\varepsilon_s = 500 \times 10^{-6}$ for lightweight concrete

Composite slabs are normally unpropped during construction and the sheeting alone resists the self-weight of the wet concrete and construction loads. So if/when checking total deflection the part of the deflection due to the self weight of the slab is determined based on the stiffness of the sheeting, whereas that due to imposed loads is based on the stiffness of the composite slab.

If the sheeting is propped, the deflections will be greater the earlier the props are removed due to the lower stiffness of the 'immature' concrete. This immaturity would need to be reflected in a higher modular ratio.

Eurocode 4 does not specify deflection limits for composite slabs. BS 5950-4 gives a limit of $L/350$ or 20mm for the deflection of a composite slab due to imposed loads. Deflection due to the total load (less the deflection due to the self-weight of the slab plus, when props are used, the deflection due to prop removal) should be limited to $L/250$. When considering whether the deflection is acceptable, it may be necessary to consider the deflection of the supporting beams.

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