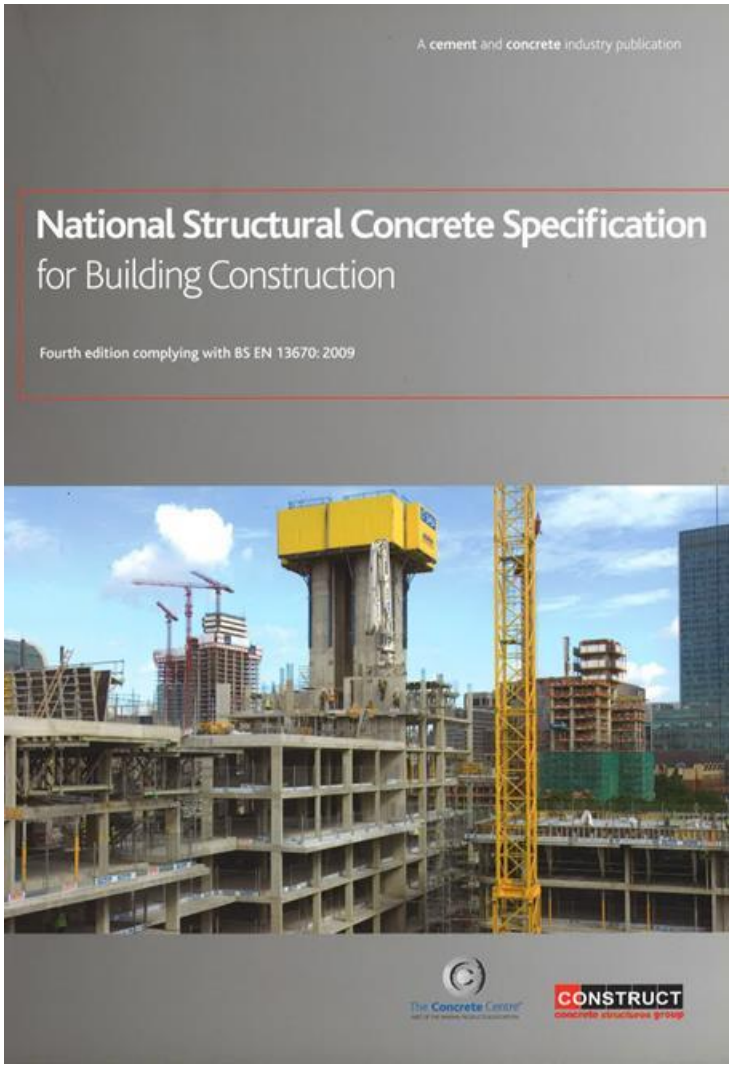
Specifying Cast In Situ Frames to the NSCS

Jenny Burridge

Head of Structural Engineering

National Structural Concrete Specification



- Definitive, simple and straightforward
- Agreed with designers and builders
- Follows the current codes and standards
- All the information collected together in one place
- Can be used with NBS

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BRITISH STANDARD

BS EN 13670:2009

Execution of concrete structures

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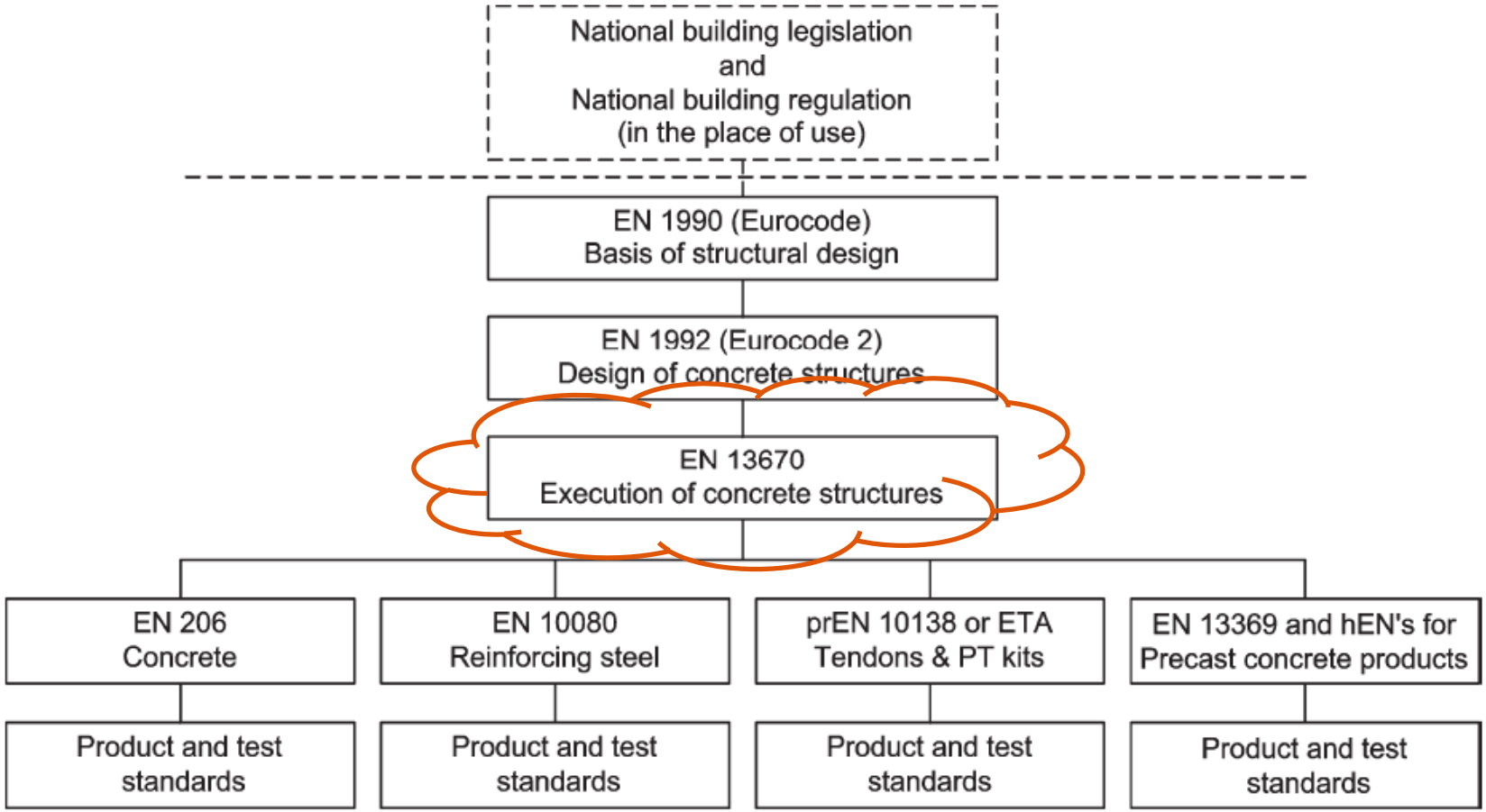
National building legislation
and
National building regulation
(in the place of use)
EN 1990 (Eurocode)
Basis of structural design
EN 1992 (Eurocode 2)
Design of concrete structures
EN 13670
Execution of concrete structures
EN 206
Concrete
EN 10080
Reinforcing steel
prEN 10138 or ETA
Tendons & PT kits
EN 13369 and hEN's for
Precast concrete products
Product and test
standards
Product and test
standards
Product and test
standards
Product and test
standards

Execution Specification for Concrete

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From the Design Team's point of view:

- What is wanted – functional or a beautiful, long lasting building
- How do you get there? What do you ask for?
- Construction – fresh concrete properties
- Construction – formwork, location and tolerances
- Strength – concrete and reinforcement properties
- Durability – concrete properties
- Appearance – while having the right fresh properties, strength and durability

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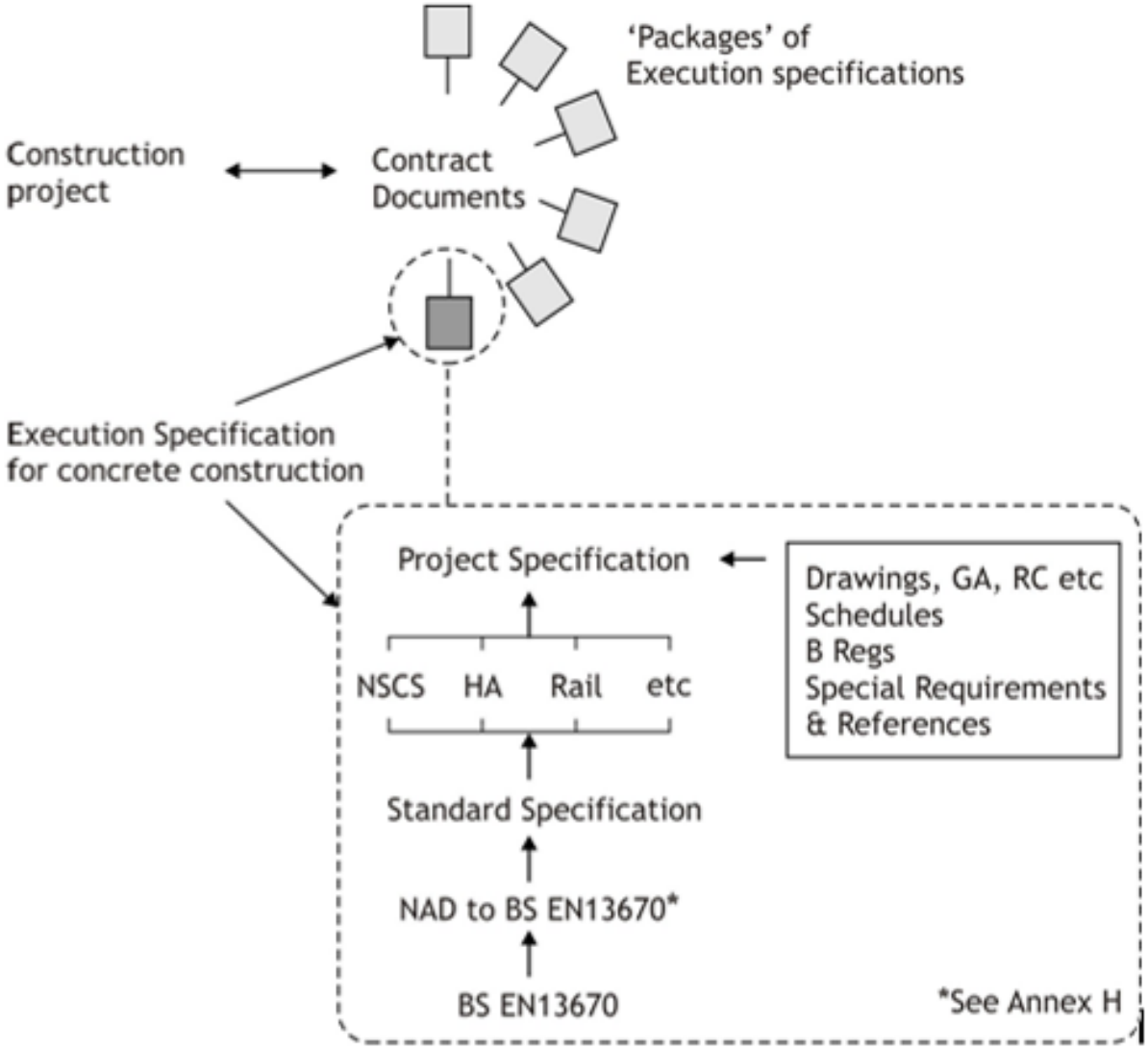
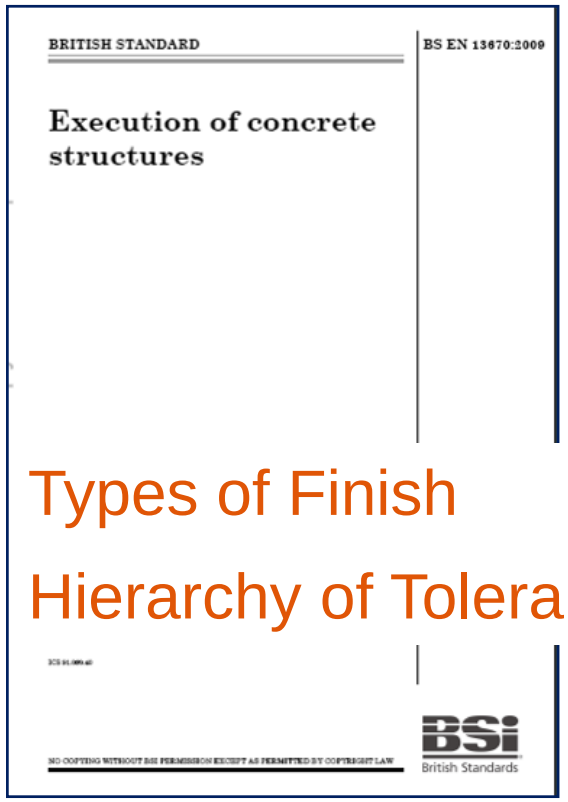
Execution specifications:

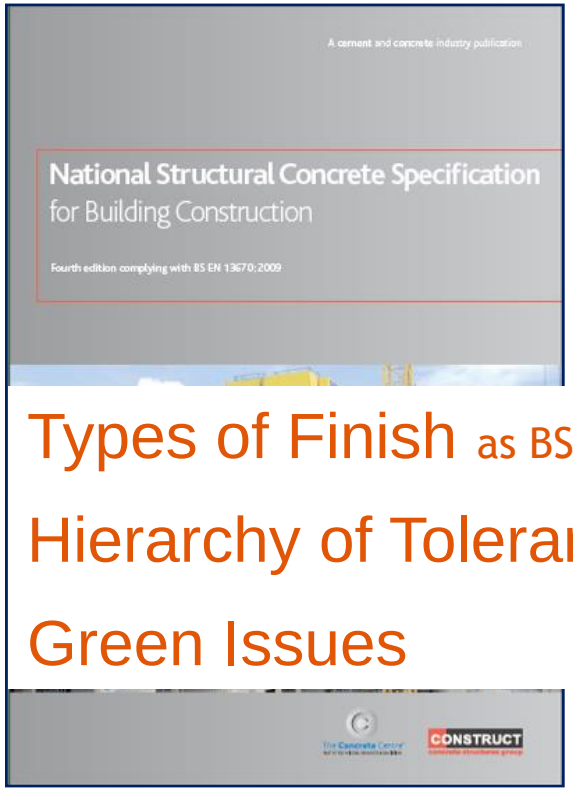


BS EN 13670 & NSCS



Types of Finish

Hierarchy of Tolerances



Types of Finish as BS EN 13670

Hierarchy of Tolerances

Green Issues

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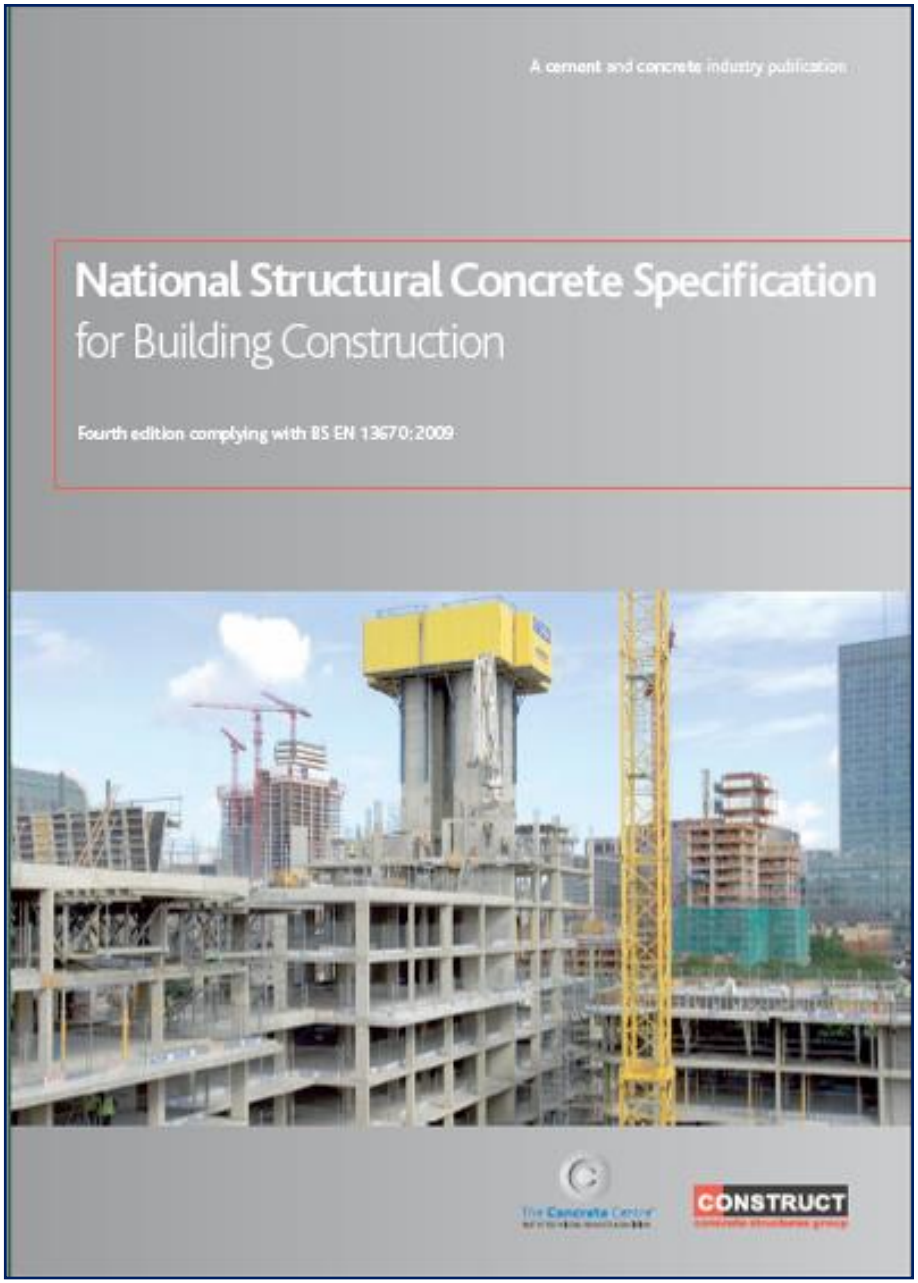

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- Part 1 Standard Specification (10 sections)
- Part 2 Project Specification: (2 sections)
- Part 3 Guidance

- Colour co-ordinated!

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NSCS Part 1

This part contains the standard specification clauses

BS EN ISO 14001: 2004	*Environmental management systems – Requirements with guidance for use.*
BS EN ISO 15614	*Specification and qualification of welding procedures for metallic materials – Welding procedure test.* (13 parts). BSI, 2002–2008.
BS EN ISO/IEC 17025: 2005	*General requirements for the competence of testing and calibration laboratories* (AMD corrigendum 16767).
BS OHSAS 18001:2007	*Occupational health and safety management systems.*

2.2 General

BAMFORTH, P. B. *Early-age thermal crack control in concrete*, C660. CIRIA, 2007.

CARES and European Technical Approvals:

CARES Post-tensioning systems, Part 2 – *The supply and/or installation of post-tensioning systems.* November 2007.

CARES Post-tensioning systems, Part 9 – *CARES Registration scheme for post-tensioning operatives.* November 2007.

CARES Steel for reinforced concrete, Appendix 6 – *Quality and operations assessment schedule for the cast welding of reinforcing steel.* January 2006.

CARES Steel for reinforced concrete, Appendix 10 – *Quality and operations assessment schedule for pre-assembled welded fabrications using welded semi-structural and/or structural joints.* January 2006.

ECTA. ETAG 013 *Guideline for European Technical Approval of post-tensioning kits for prestressing of structures.* Brussels, ECTA, 2002.

fib. *Corrugated plastic ducts for internal bonded post-tensioning*, fib Bulletin 7. fib, 2000.

HARRISON, T. A. *Formwork striking times – criteria, prediction and method of assessment*, R136. CIRIA, 1995.

ICE. *ICE Specification for piling and embedded retaining walls*, 2nd edition. Thomas Telford, 2007.

INSTITUTION OF STRUCTURAL ENGINEERS. *Standard method of detailing structural concrete. A manual for best practice*, 3rd edition. IStructE, 2006.

PALLET, P. F. *Guide to flat slab falsework and formwork*, CS140. The Concrete Society, on behalf of CONSTRUCT, 2003.

THE CONCRETE SOCIETY. *Formwork – A guide to good practice*, CS030. 2nd edition. The Concrete Society, 1995.

THE CONCRETE SOCIETY. *Post-tensioned concrete floors – Design handbook*, TR43. 2nd edition. The Concrete Society, 2004.

Section 3 Definitions

The following definitions, in addition to those given in BS EN 13670: 2009, apply for the purpose of this Specification.

3.1 Agreement, acceptance

When by or of the CA, agreement or acceptance shall have the following limitations.

3.1.1 Samples

When given in respect of samples of materials, execution or proposals for methods of construction submitted in accordance with this Specification, shall not be interpreted as denoting any degree of satisfaction with the materials used in, or the execution of the Works.

Section 4 Execution management

4.1 General requirements

4.1.1 Standards

Execution shall be in accordance with BS EN 13670 as supplemented by the Project Specification and all statutory requirements.

Where there is a difference between the requirements of BS EN 13670 and the Project Specification, the Project Specification takes precedence.

4.1.2 Materials

4.1.2.1 General

All materials used in the structure shall comply with the Project Specification and current versions of standards referred to therein. The CA may specify samples for testing and the Constructor shall arrange for such samples to be supplied, identified, stored and tested and the results delivered to the CA in accordance with the relevant standards and the Project Specification requirements.

4.1.2.2 Proprietary products and materials

These shall be used in accordance with the manufacturer's written instructions and relevant European Product Standards where available.

4.1.2.3 Third-party inspections

Allow reasonable access to the site for technical inspection by third parties at all times.

4.1.2.4 Water-resisting construction

Where water-resisting construction is specified, submit to the CA for agreement: details of the materials used and the execution, which are to be in accordance with BS 8102; and written confirmation from the supplier of the water-resisting materials that they will not be adversely affected by the proposed environment, concrete, curing and release agents, placing methods, joints, finishes, reinforcement and its support details, or loads.

4.2 Documentation

4.2.1 Quality plan

Operate an agreed quality management system to BS EN ISO 9000 unless otherwise agreed with the CA. The system shall be accessible for audit.

If it is agreed that a quality management system to BS EN ISO 9000 is not required the Constructor shall prepare a quality plan for the project.

The Quality Plan shall be given to the CA for acceptance at least five working days before the works start.

4.2.2 Execution documentation

Produce the documents as required and provide one copy to the CA at the time stated in the NSCS Project Specification or no later than five working days after each is prepared.

4.2.3 Information coordination and availability

4.2.3.1 NSCS Project Specification

When NSCS Project Specification is revised all changes must be clearly identified.

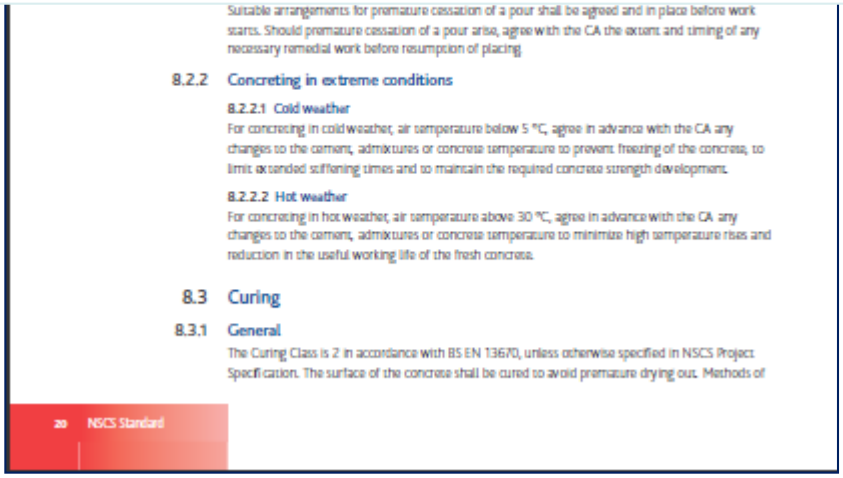
8.2.2 Concreting in extreme conditions

8.2.2.1 Cold weather

For concreting in cold weather, air temperature below 5 °C, agree in advance with the CA any changes to the cement, admixtures or concrete temperature to prevent freezing of the concrete, to limit extended stiffening times and to maintain the required concrete strength development.

8.2.2.2 Hot weather

For concreting in hot weather, air temperature above 30 °C, agree in advance with the CA any changes to the cement, admixtures or concrete temperature to minimize high temperature rises and reduction in the useful working life of the fresh concrete.



Suitable arrangements for premature cessation of a pour shall be agreed and in place before work starts. Should premature cessation of a pour arise, agree with the CA the extent and timing of any necessary remedial work before resumption of placing.

8.2.2 Concreting in extreme conditions

8.2.2.1 Cold weather

For concreting in cold weather, air temperature below 5 °C, agree in advance with the CA any changes to the cement, admixtures or concrete temperature to prevent freezing of the concrete, to limit extended stiffening times and to maintain the required concrete strength development.

8.2.2.2 Hot weather

For concreting in hot weather, air temperature above 30 °C, agree in advance with the CA any changes to the cement, admixtures or concrete temperature to minimize high temperature rises and reduction in the useful working life of the fresh concrete.

8.3 Curing

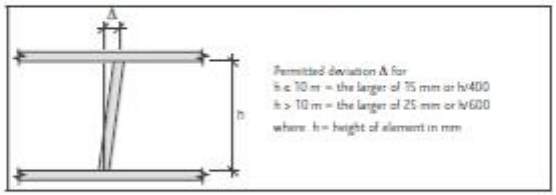
8.3.1 General

The Curing Class is 2 in accordance with BS EN 13670, unless otherwise specified in NSCS Project Specification. The surface of the concrete shall be cured to avoid premature drying out. Methods of

20 NSCS Standard

10.5.2 **Verticality by storey of the structure**

Inclination of a column or wall at any level in a single- or multi-storey building.

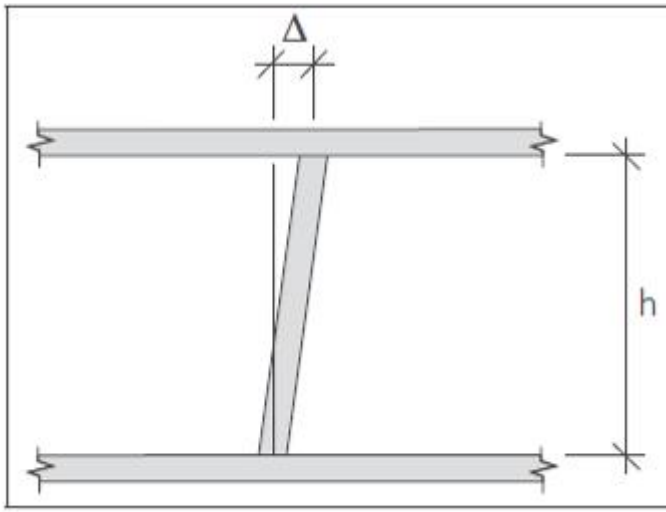


10.5.3 **Offset between floors**

Deviation between centrelines at floor level.

10.5.2 Verticality by storey of the structure

Inclination of a column or wall at any level in a single- or multi-storey building.



Permitted deviation Δ for
$h \leq 10$ m = the larger of 15 mm or h/400
$h > 10$ m = the larger of 25 mm or h/600
where h = height of element in mm

Edition 4 NSCS

1 Scope

2 Bibliography

3 Definitions

4 Execution Management

5 Falsework and Formwork

6 Reinforcement

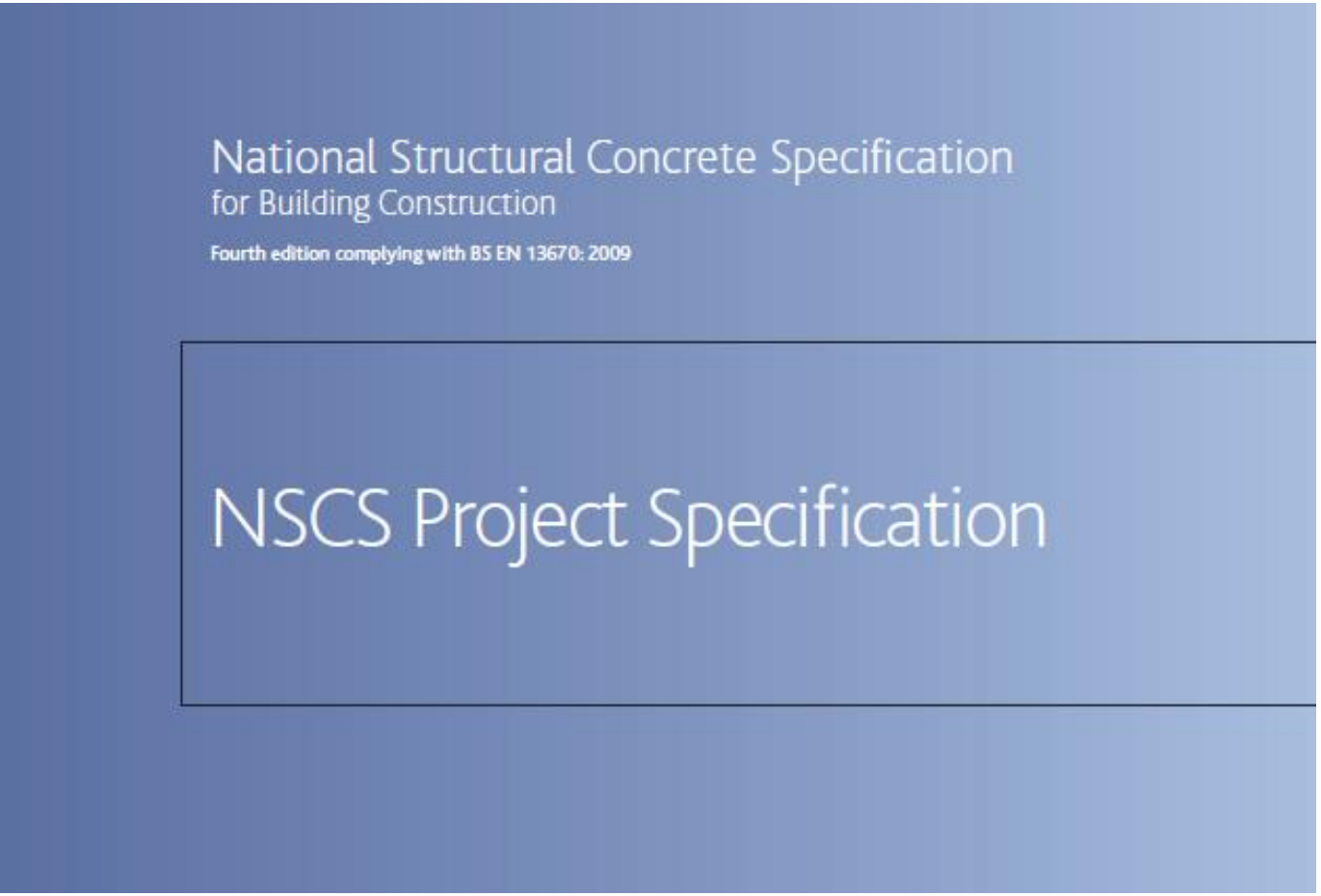
7 Prestressed Concrete

8 Concrete and Concreting

9 Precast Concrete

10 Geometric Tolerances

NSCS Part 2



This part should be filled in for each project.

The following can be specified:

- Concrete types
- Concrete finishes
- Formwork
- Other materials
- Responsible sourcing

Section P1	**Information to be supplied TO the Constructor**
P1.1	General information
P1.2	Design
P1.3	Drawings and calculations
P1.4	Execution management
P1.5	Materials
P1.6	Project requirements
P1.7	Water-resisting construction
P1.8	Concrete
P1.9	Surface finishes
P1.10	Precast concrete
P1.11	Prestressed concrete construction
P1.12	Deflection allowances
P1.13	Further information
Section P2	**Information to be supplied BY the Constructor**
P2.1	General information
P2.2	Design
P2.3	Drawings and calculations
P2.4	Execution management
P2.5	Materials
P2.6	Project requirements
P2.7	Water-resisting construction
P2.8	Concrete and concreting
P2.9	Further information

NSCS Part 3

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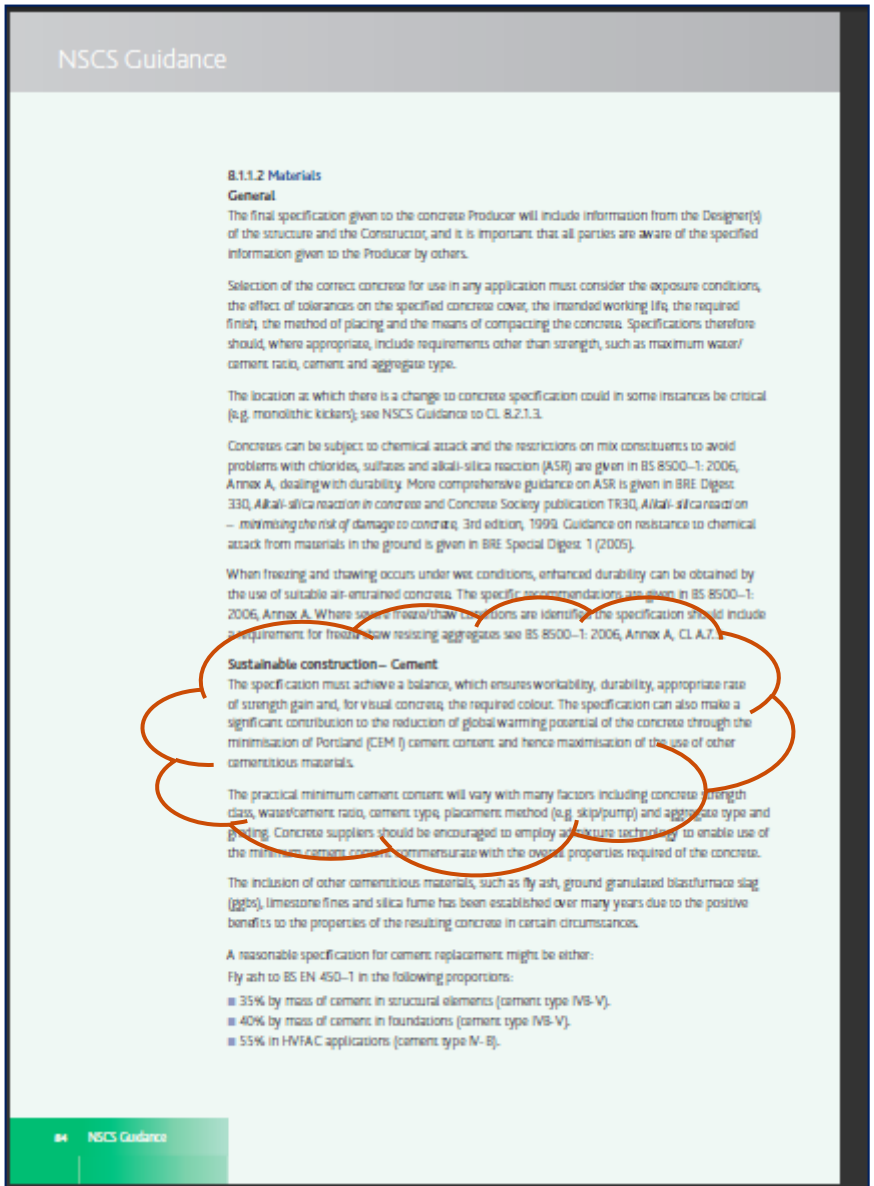
National Structural Concrete Specification
for Building Construction

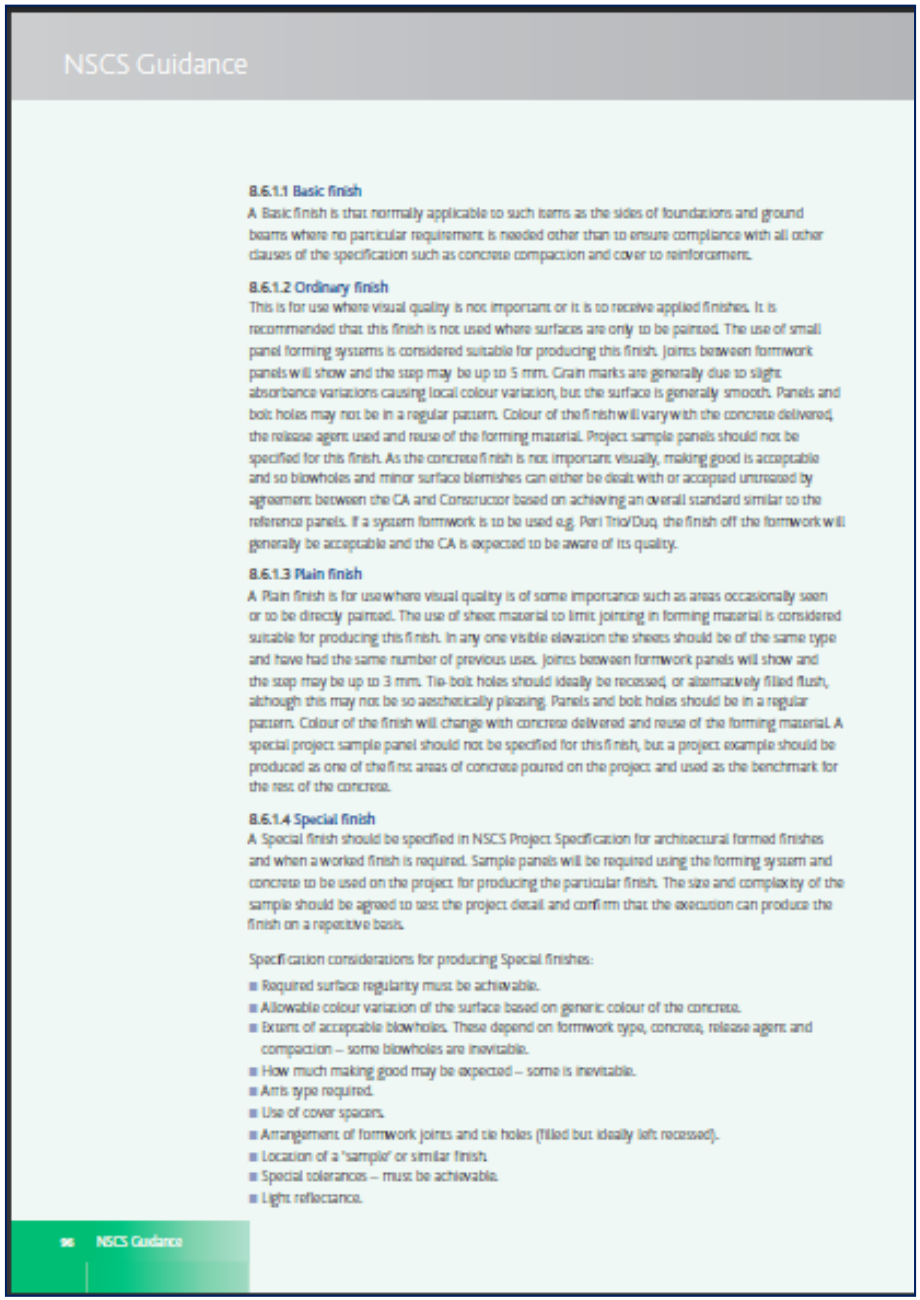
Fourth edition complying with BS EN 13670: 2009

NSCS Guidance



“Sustainable construction - Cement

The specification must achieve a balance, which ensures workability, durability, appropriate rate of strength gain and, for visual concrete, the required colour.”



NSCS Guidance

8.6.1.1 Basic finish

A Basic finish is that normally applicable to such items as the sides of foundations and ground beams where no particular requirement is needed other than to ensure compliance with all other clauses of the specification such as concrete compaction and cover to reinforcement.

8.6.1.2 Ordinary finish

This is for use where visual quality is not important or it is to receive applied finishes. It is recommended that this finish is not used where surfaces are only to be painted. The use of small panel forming systems is considered suitable for producing this finish. Joints between formwork panels will show and the step may be up to 5 mm. Grain marks are generally due to slight absorbance variations causing local colour variation, but the surface is generally smooth. Panels and bolt holes may not be in a regular pattern. Colour of the finish will vary with the concrete delivered, the release agent used and reuse of the forming material. Project sample panels should not be specified for this finish. As the concrete finish is not important visually, making good is acceptable and so blowholes and minor surface blemishes can either be dealt with or accepted unmade by agreement between the CA and Constructor based on achieving an overall standard similar to the reference panels. If a system formwork is to be used e.g. Peri Trio/Duo, the finish off the formwork will generally be acceptable and the CA is expected to be aware of its quality.

8.6.1.3 Plain finish

A Plain finish is for use where visual quality is of some importance such as areas occasionally seen or to be directly painted. The use of sheet material to limit jointing in forming material is considered suitable for producing this finish. In any one visible elevation the sheets should be of the same type and have had the same number of previous uses. Joints between formwork panels will show and the step may be up to 3 mm. Tie-bolt holes should ideally be recessed, or alternatively filled flush, although this may not be so aesthetically pleasing. Panels and bolt holes should be in a regular pattern. Colour of the finish will change with concrete delivered and reuse of the forming material. A special project sample panel should not be specified for this finish, but a project example should be produced as one of the first areas of concrete poured on the project and used as the benchmark for the rest of the concrete.

8.6.1.4 Special finish

A Special finish should be specified in NSCS Project Specification for architectural formed finishes and when a worked finish is required. Sample panels will be required using the forming system and concrete to be used on the project for producing the particular finish. The size and complexity of the sample should be agreed to test the project detail and confirm that the execution can produce the finish on a repetitive basis.

Specification considerations for producing Special finishes:

- Required surface regularity must be achievable.
- Allowable colour variation of the surface based on generic colour of the concrete.
- Extent of acceptable blowholes. These depend on formwork type, concrete, release agent and compaction – some blowholes are inevitable.
- How much making good may be expected – some is inevitable.
- Arris type required.
- Use of cover spacers.
- Arrangement of formwork joints and tie holes (filled but ideally left recessed).
- Location of a 'sample' or similar finish.
- Special tolerances – must be achievable.
- Light reflectance.

96 NSCS Guidance

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Finishes:

- Basic
- Ordinary (equivalent to Type A)
- Plain (equivalent to Type B)
- Special

- Reference Panels for Ordinary and Plain finishes are located around the country

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Execution Management

- The flow of information is essential on any construction project. A good project needs well managed information
- Table P1.3 has been retained to cover issue of drawings and documents
- Table P1.4.2 has been added – indicating when certification and checking information is to be provided

Drawings & calculations (P1.3)

Item		Preparation		Tender issue		Acceptance issue				Construction issue			
Type[1]		Prepared by	Format[2]	Number of copies		Number of copies		Period before construction (weeks)		Number of copies		Period before construction (weeks)	
			Project	Default	Project	Default	Project	Default	Project	Default	Project	Default	Project
General arrangement drawings	RC	CA		2		[redacted]				5		11	
	PCP	CA		2						5		11	
	PCE	CA		2						5		11	
	PSC	CA		2						5		11	
Design Information drawings	RC	CA								5		11	
	PC												
	PC												
	PS												
Construction sequence info	All												
Design calculations	RC												
	PC												
	PC												
	PS												
Specialist drawings	RC												
	PC												
Enter details as required	PC												
	PS												
Reinforcement detail drawings and schedules	RC												
Precast concrete elements	PC												
	PC												
	PS												
Builders' work information	All												
Coordinated builders' work drawings	All												
Temporary works and erection drawings and/or calculations and method statements	All												
As-built drawings	All												

Footnotes

1 Types of construction:
RC: Reinforced concrete
PCE: Precast concrete e
PCP: Precast concrete p

Item		Preparation		Tender issue	
Type[1]		Prepared by	Format[2]	Number of copies	
			Project	Default	Project
General arrangement drawings	RC	CA		2	
	PCP	CA		2	
	PCE	CA		2	
	PSC	CA		2	
Design Information drawings	RC	CA			
	PCP	CA			
	PCE	CA			
	PSC	CA			

Execution documentation (P1.4.2)

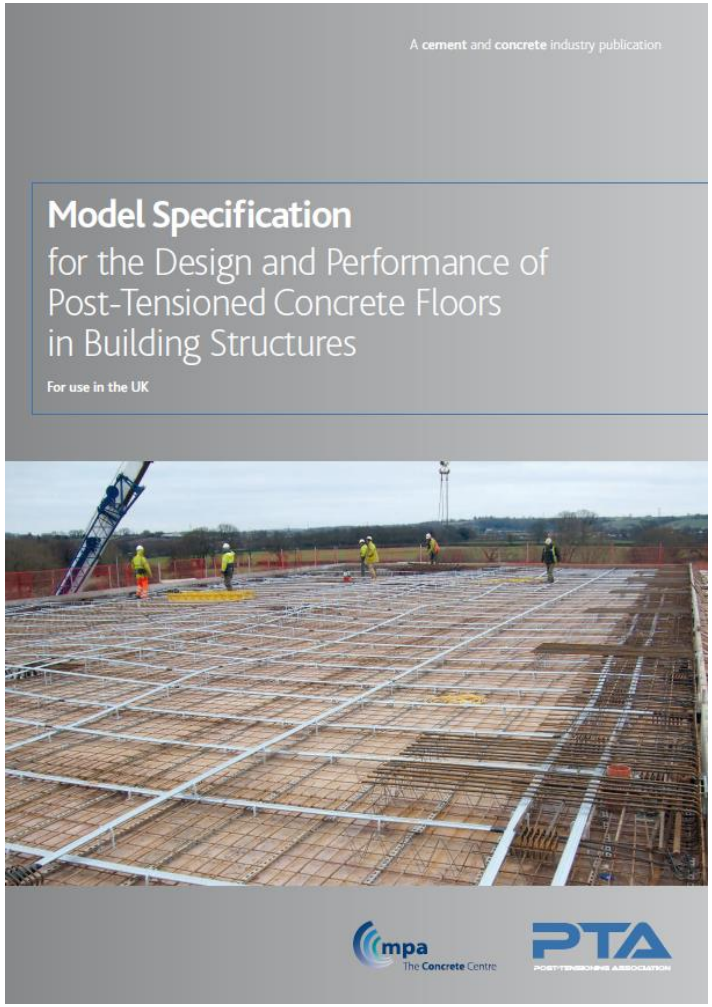
Information	When required Number of working days before construction with updates as requested unless noted		Format/Notes P – Paper E – Electronic B – Both	
	Default	Project	Default	Project
Contractor's Quality Assurance Certification	At tender		Paper	
SpeCC registration	As requested		Paper	
Detailed construction programme	20		Paper	
Falsework and formwork: design	20		Calculations & drawings	
Falsework and formwork: pre-concreting cleanliness	As requested		Paper	
Reinforcement: source and supplier	20		Paper	
Reinforcement: Certification	20		Paper	
Reinforcement: pre-concreting location	As requested		Paper	
Spacers	As requested		Paper	
Couplers: source and supplier	20		Paper	

Information	When required Number of working days before construction with updates as requested unless noted		Format/Notes P = Paper E = Electronic B = Both
	Default	Project	Default
Contractor's Quality Assurance Certification	At tender		Paper
SpeCC registration, or equivalent	As requested		Paper
Detailed construction programme	20		Paper
Falsework and formwork: design	20		Calculations & drawings
Falsework and formwork: pre-concreting cleanliness	As requested		Paper

Prestressed Concrete

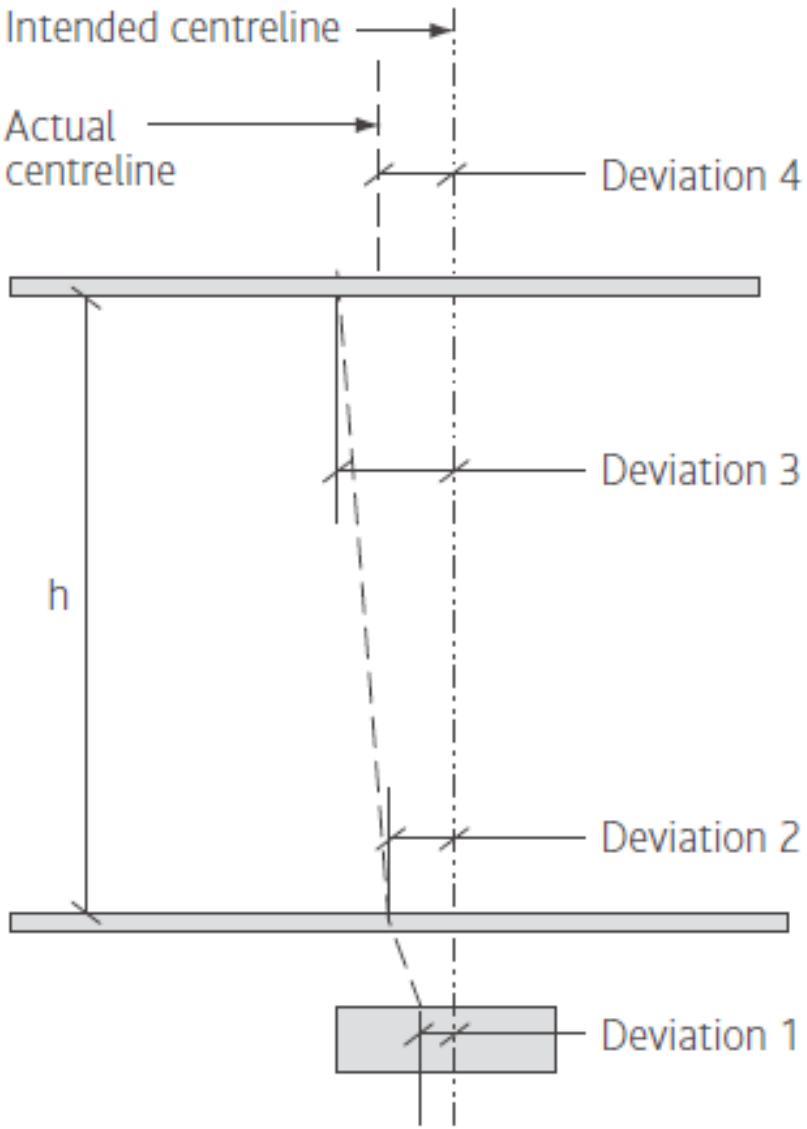
- The NSCS now incorporates the CARES model prestressing specification
- The document is coordinated with the ENs for grout and the ETAG requirements for stressing

Post-tensioned concrete



Tolerances

- Tolerances MUST be thought about carefully as there is no fixed system that can be applied to give the “right” answer every time.
- This section can be read as “stand alone” in the NSCS as it brings together normative and informative EN tolerances
- Tolerances are “right” for a typical building and need more care in other cases.



Typical storey

Deviations 2, 3 & 4 are governed by the 'box' principle and are less than 50 mm as BS EN 13670: 2009, Cl. 10.1.(5)

Deviation 3 less deviation 2 must be less than 15 mm or h/400 (Cl.10.5.2 of NSCS Standard Specification)

Deviation 4 less deviation 3 must be less than 10 mm or t/30 (Cl. 10.5.3. of NSCS Standard Specification) This is a 'corrective tolerance' to ensure that:

Deviation 4 less deviation 2 is less than 10 mm (Cl.10.5.1 of NSCS Standard Specification)

Bottom storey – special case

Deviation 2 must be less than 10 mm from the intended Design position (Cl. 10.5.1 of NSCS Standard Specification)

Deviation 1 for the base (substructure), not the superstructure, must be less than 25 mm from the intended design position (Cl. 10.3.1 of NSCS Standard Specification)

In a multi-storey structure the columns can therefore only deviate over 10 mm/storey in complying with Cl.10.5.1 of NSCS Standard Specification, although there is greater verticality tolerance. Any 'drift' in one direction will be limited by the need to satisfy the requirements of Cl.10.2.1 of NSCS Standard Specification.

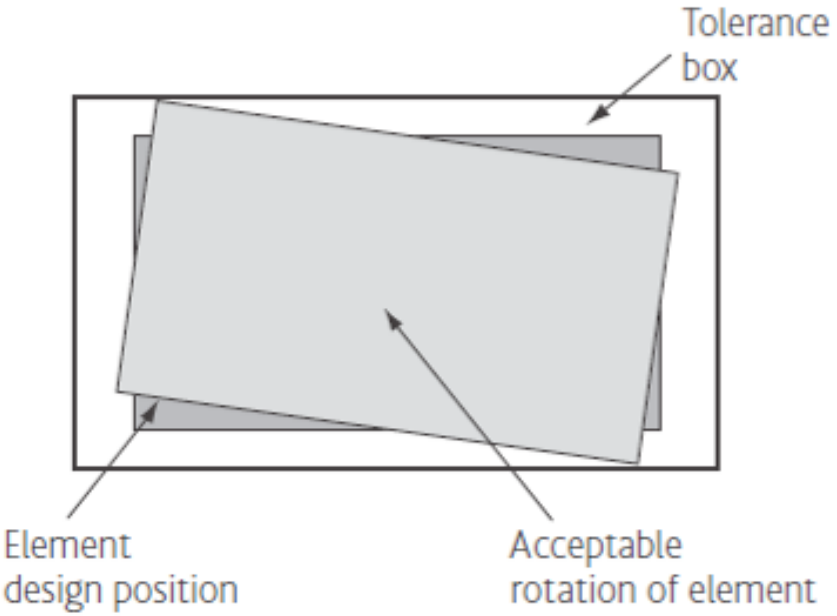
Note

There are two situations where mutually compliant tolerances may cause a problem and they must be defined in NSCS Project Specification.

1 Where a combination of column height and thickness allows the tolerance for verticality from Cl. 10.5.2 of NSCS Standard Specification and offset from Cl. 10.5.3 prevents the tolerance for position in Cl. 10.5.1 being achieved.

2 Where a combination of column height and thickness and verticality of adjacent columns have divergent tolerances from Cl. 10.5.2 of NSCS Standard Specification would prevent the distance between columns at the top in Cl. 10.5.6 being achieved.

Rotational tolerance



Concrete Finishes

- The BS8110 types of surface finish A, B & C with finish classes 1, 2 & special have been replaced.
- BS EN 13670 has basic, ordinary, plain and special concrete finishes for formed **and** unformed surfaces
- For formed surfaces the definitions are developments of the BS 8110 descriptions for Types A and B and NBS descriptions of plain smooth and fine smooth finishes.
- The “plain” is intended to be suitable as an exposed finish almost “as struck”, but not a super quality architectural finish which must be a special.

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Concrete Specification

- Teamwork is the key – only with all of the team engaged will the client get the right result

- A great specification can be spoilt by poor application

- A poor specification can produce a great result – sometimes even when this is not required

Thank You

Any Questions