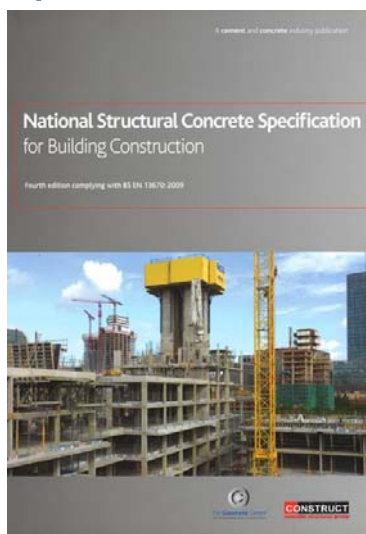


Specifying Cast In Situ Frames

Jenny Burridge
Head of Structural Engineering

National Structural Concrete Specification

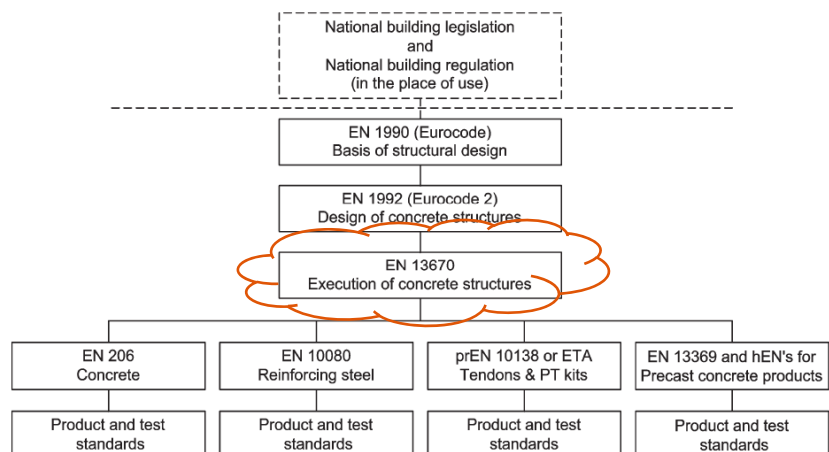


- Definitive, simple and straightforward
- Agreed with designers and builders
- Follows the current codes and standards
- All the information collected together in one place
- Can be used with NBS

BRITISH STANDARD

BS EN 13670:2009

Execution of concrete structures



Execution Specification for Concrete

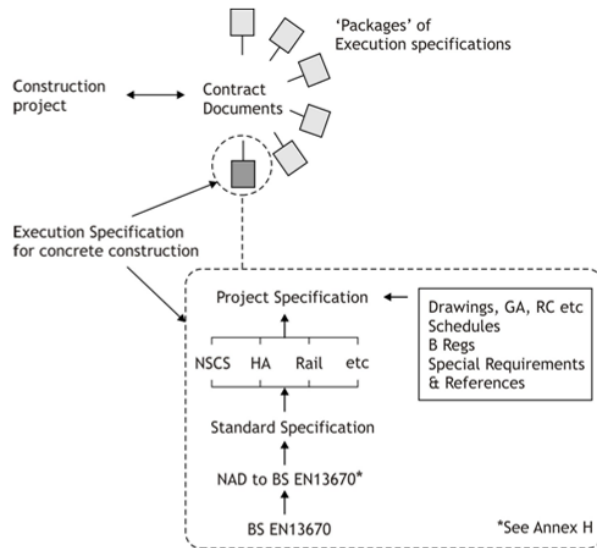


From the Design Team's point of view:

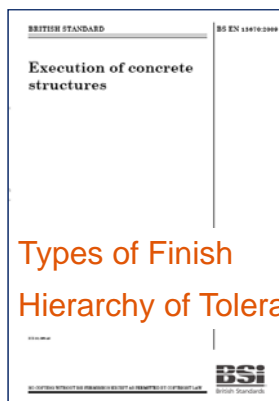
- What is wanted - functional or a beautiful, long lasting building
- How do you get there? What do you ask for?
- Construction - fresh concrete properties
- Construction - formwork, location and tolerances
- Strength - concrete and reinforcement properties
- Durability - concrete properties
- Appearance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



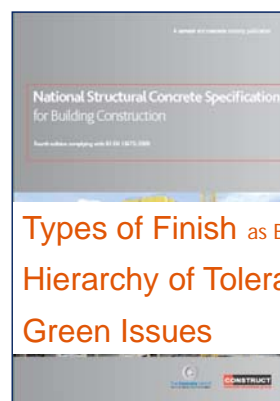
Execution specifications:



BS EN 13670 & NSCS



Types of Finish
Hierarchy of Tolerances



Types of Finish as BS EN 13670
Hierarchy of Tolerances
Green Issues





A cement and concrete industry publication

**National Structural Concrete Specification
for Building Construction**


Fourth edition complying with BS EN 13670:2009

mpa
The Concrete Centre

- Part 1 Standard Specification (10 sections)
- Part 2 Project Specification: (2 sections)
- Part 3 Guidance
- Colour co-ordinated!

CONSTRUCT
CONCRETE STRUCTURES GROUP

NSCS Part 1



**National Structural Concrete Specification
for Building Construction**

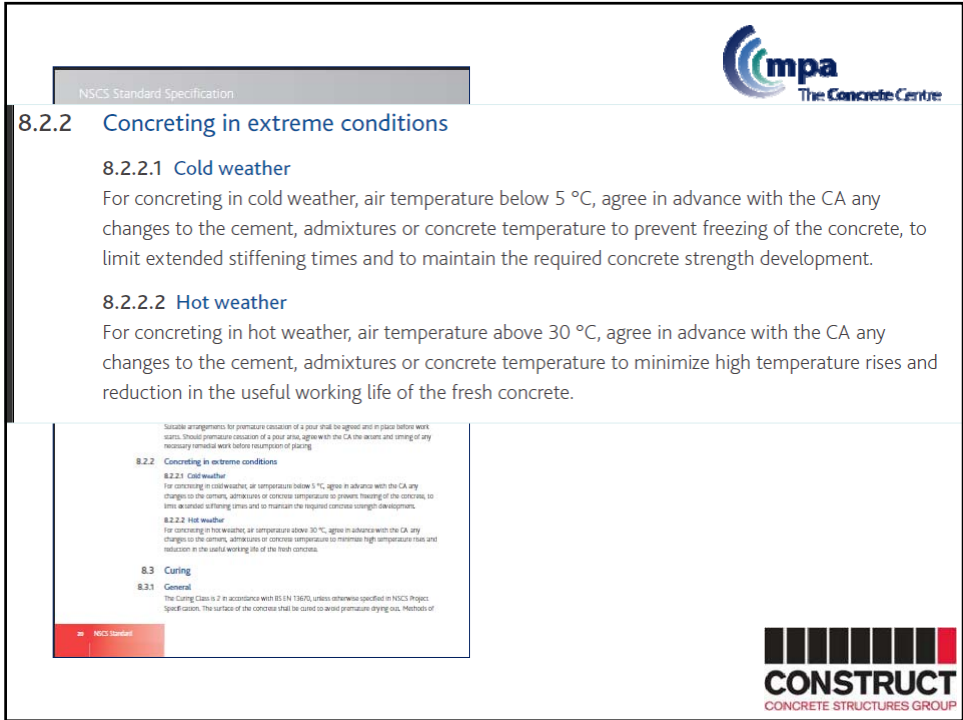
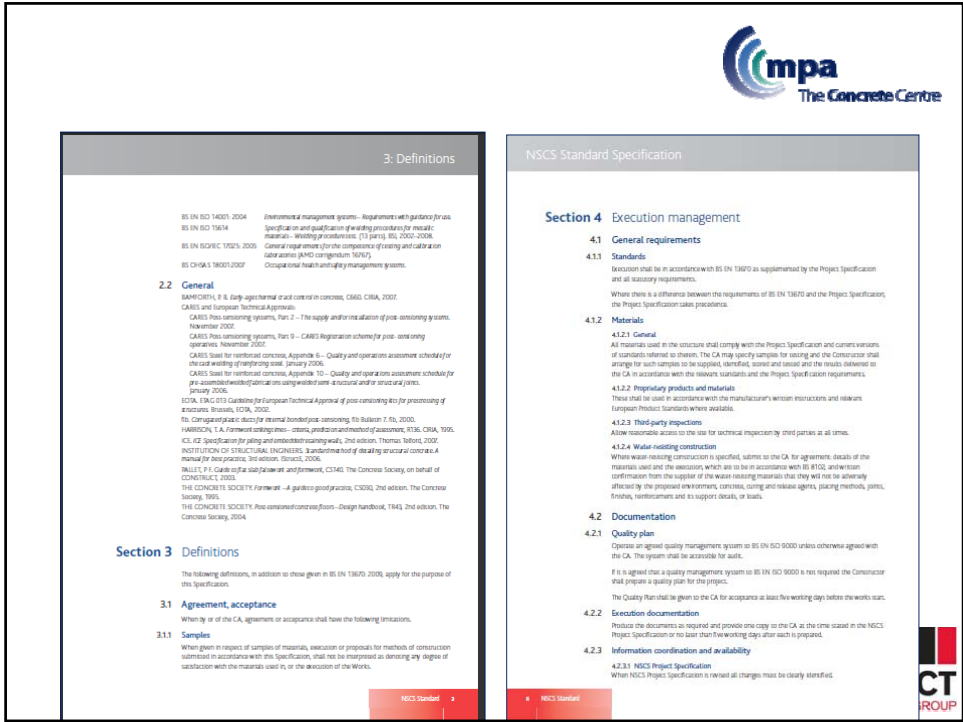
Fourth edition complying with BS EN 13670:2009

Standard Specification

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This part contains the standard specification clauses

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NSCS Standard Specification

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

10.5.3 Offset between floors
 Deviation between centres at floor level:

Permitted deviation Δ = the larger of 10 mm or $L/100$ mm, but not more than 20 mm

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

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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



National Structural Concrete Specification
for Building Construction
Fourth edition complying with BS EN 13670: 2009

NSCS Project Specification


This part should be filled in for each project.

The following can be specified:

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



NSCS		Section P1 Information to be supplied TO the Constructor	Project Specification
Section P1 Information to be supplied BY the Constructor P1.1 General information P1.1.1 Project contacts Project name Project ref. Address Employer Name Address Contact name Telephone Principal Contractor Name Address Contact name Telephone Engineer Name Address Contact name Telephone Contract administrator (CA) Name Address Contact name Telephone Other named parties to the Contract Name Name P1.1.2 Description of the project work Nature of building and intended use Foundations, basement, location of supporting walls and columns	P1.1	General information	
	P1.2	Design	
	P1.3	Drawings and calculations	
	P1.4	Execution management	
	P1.5	Materials	supplied BY the Constructor with updated information issued for construction.
	P1.6	Project requirements	
	P1.7	Water-resisting construction	
	P1.8	Concrete	Small
	P1.9	Surface finishes	
	P1.10	Precast concrete	
	P1.11	Prestressed concrete construction	Small Reinforced but in-situ
	P1.12	Deflection allowances	
	P1.13	Further information	Small
		Section P2 Information to be supplied BY the Constructor	
	P2.1	General information	Small
	P2.2	Design	Structure as defined in Table P1.3.
	P2.3	Drawings and calculations	
	P2.4	Execution management	Use in CL P1.4 and other specification changes
	P2.5	Materials	
	P2.6	Project requirements	Based on the construction programme and this Specification being approved.
	P2.7	Water-resisting construction	
	P2.8	Concrete and concreting	
	P2.9	Further information	



NSCS Part 3

National Structural Concrete Specification for Building Construction

Fourth edition complying with BS EN 13670: 2009

NSCS Guidance

NCS Guidance

B.1.2 Materials

General
The final specification given to the concrete Producer will include information from the Designer(s) of the structure and the Contractor, and it is important that all parties are aware of the specified information given to the Producer by others.

Selection of the correct concrete for use in any application must consider the exposure conditions, the effect of variations on the specified concrete cover, the manufacturing site, the required finish, the method of placing and the means of compacting the concrete. Specifications therefore should, where appropriate, include requirements other than strength, such as maximum water/cement ratio, cement and aggregate type.

The location at which there is a change to concrete specification could in some instances be critical (e.g. monolithic ceiling); see NCS Guidance to CL B.2.3.1.

Concrete can be subject to chemical attack and the restrictions on mix constituents to avoid problems with chlorides, sulfates and alkali-silica reaction (ASR) are given in BS 8000-3:2006, Annex A, alongside with durability. More comprehensive guidance on ASR is given in BRE Digest 330. ASR alkalisation in concrete and Concrete Society publication TR04: Alkali-silica reaction – minimising the risk of damage to concrete, 3rd edition, 1999. Guidance on resistance to chemical attack from materials in the ground is given in BRE Special Digest 7 (2005).

When freezing and thawing occurs under wet conditions, enhanced durability can be obtained by the use of suitable air-entrained concrete. The specification requirements are given in BS 8000-3:2006, Annex A. Where specified, the concrete must also be designed to include a minimum of 10% coarse aggregate (see BS 8000-1:2006, Annex A, CL A.2).

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. The specification can also make a significant contribution to the reduction of global warming potential of the concrete through the minimisation of Portland (CEM) cement content, and hence minimisation of the use of other cementitious materials.

The practical minimum cement content will vary with many factors including concrete strength class, reinforcement class, cement type, placement method (e.g. wet/dry) and aggregate type and grading. Concrete suppliers should be encouraged to employ **low carbon cement** to enable use of the **low carbon concrete** with the **low carbon aggregate** required by the concrete.

The inclusion of other cementitious materials, such as fly ash, ground granulated blastfurnace slag (GGBS), limestone fines and silica fume has been established over many years due to the positive benefits to the properties of the resulting concrete in certain circumstances.

A suitable specification for cement replacement might be either:

- fly ash to BS EN 450-1 in the following proportions:
 - 33% by mass of cement in structural elements (cement type MS-V)
 - 40% by mass of cement in foundations (cement type MS-V)
 - 10% in NCC applications (cement type N-V)

“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.”

NCS Guidance

B.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.

B.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 gap may be up to 3 mm. Cast marks are generally due to slight abundance 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 fresh concrete with the concrete delivered, the release agent used and reuse of the forming material. Project sample panels should not be specified for the 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 uncorrected by agreement between the CA and Contractor based on achieving an overall standard similar to the reference panels. If a system formwork is to be used e.g. Peri Tri/Ox, the finish off the formwork will generally be acceptable and the CA is expected to be aware of its quality.

B.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 gap may be up to 3 mm. The bolt holes should ideally be recessed, or alternately filled flush, although this may not be so architecturally 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 at one of the first areas of concrete poured on the project and used as the benchmark for the rest of the concrete.

B.6.1.4 Special finish

A special finish should be specified in NCS Project Specification for architectural formed finishes and where 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 suit the project detail and confirm that the execution can produce the finish on a regular 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.
- Beams of acceptable blowholes. These depend on formwork type, concrete, release agents and compaction – some blowholes are inevitable.
- How much making good may be accepted – some is inevitable.
- Arns type required.
- Use of cover spacers.
- Arrangements of formwork joints and tie holes (filled but ideally left recessed).
- Location of a ‘sample’ or similar finish.
- Special appearance – must be achievable.
- Light reflectance.

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

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

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

Drawings & calculations (P1.3)

Footnotes
¹ Types of construction:
 RC: Reinforced concrete
 PC: Precast concrete
 PCP: Precast concrete elements
 PCE: Precast concrete elements
 PSC: Precast concrete elements

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

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Prestressed Concrete



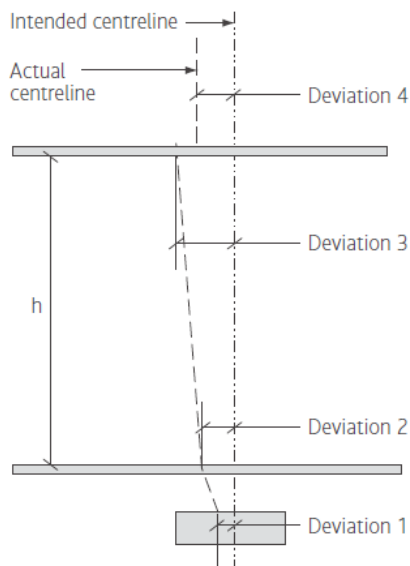
- The NSCS now incorporates the CARES model prestressing specification
- The document is coordinated with the ENs for grout and the ETAG requirements for stressing



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)

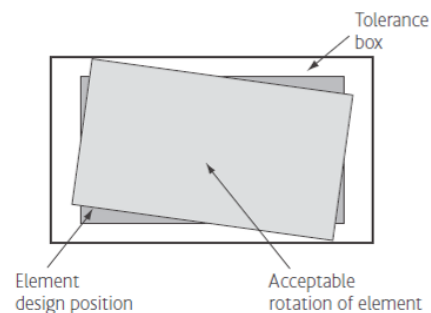
In a multi-storey structure the columns can therefore only deviate over 10 mm/storey in complying with CL.10.5.1 of NSCS Standard Specification, although there is greater verticality tolerance. Any 'drift' in one direction will be limited by the need to satisfy the requirements of CL.10.2.1 of NSCS Standard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





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

