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Consulting Structural & Civil Engineers

RENFREW HOTEL

GLASGOW

CONCRETE SPECIFICATION

Revision P01
21/02/2019

E05 IN SITU CONCRETE CONSTRUCTION GENERALLY

To be read with Preliminaries/ General Conditions.

- 110 ARRANGEMENT OF INFORMATION: The different parts of in situ concrete construction are specified in separate sections as follows:
E10 In situ concrete mixes, casting and curing
E20 Formwork
E30 Reinforcement
E40 Designed joints
E41 Worked finishes/Cutting
E60 Precast/Composite concrete floors/roof decks
Clauses dealing with particular aspects of certain types of construction may thus be dispersed over several sections.
- 300 LEVELS OF STRUCTURAL CONCRETE FLOORS
- Tolerances: See Preliminaries section A33/370
- 310 SURFACE REGULARITY OF CONCRETE FLOORS - GENERAL
- Surface deviation: Sudden irregularities not permitted.
- Measurement: From underside of a straightedge (between points of contact) placed anywhere on surface and using a slip gauge to BS 8204-1 or -2 (or equivalent).
- 312 SURFACE REGULARITY OF FLOORS - WEARING SURFACES
- Maximum permissible deviation when measured as clause 310:
- 5 mm under a 3 m straightedge.
- 2 mm under a 1 m straightedge.
- 313 SURFACE REGULARITY OF FLOORS - SURFACES TO RECEIVE SHEET/ TILE FINISHES DIRECTLY BEDDED IN ADHESIVE
- Maximum permissible deviation when measured as clause 310:
- 5 mm under a 3 m straightedge.
- 2 mm under a 1 m straightedge.
- 314 SURFACE REGULARITY OF FLOORS - SURFACES TO RECEIVE SCREEDS/ BEDS
- Maximum permissible deviation when measured as clause 310:
- Screeds/ beds up to 50 mm thick: 10 mm under a 3 m straightedge.
- 316 SURFACE REGULARITY OF FLOORS - SURFACES TO RECEIVE MASTIC ASPHALT
- Maximum permissible deviation when measured as clause 310:
- Mastic asphalt with levelling coats: 10 mm under a 3 m straightedge.
- Mastic asphalt-laid direct: To the same surface regularities as defined in the relevant type of flooring clause in section M11.

E10 MIXING/ CASTING/ CURING IN SITU CONCRETE

To be read with Preliminaries/ General conditions.

All concrete mixes in contact with soil to comply with BRE Special Digest 1, "Concrete in Aggressive Ground", **class DS-2, AC-2**.

CONCRETE**101 SPECIFICATION**

- Concrete generally: To BS EN 206-1 and BS 8500-2.

130 DESIGNED CONCRETE – SUB-STRUCTURES – Pilecaps, ground beams and retaining walls beneath Ground floor slab.

- Reinforcement/ embedded metal: DT2 TO BS8666 .
- Compressive strength class (cylinder/ cube): **C32/40**
- Aggregates:
 - Size (maximum): 20mm
 - Type/ Density: To BS 882/NORMAL
 - Recycled coarse aggregates: NONE
- Design chemical class: DC-2
- Limiting values for composition:
 - W/c ratio (maximum): 0.55
 - Cement/ Combination content (minimum): 320 kg/m³
 - Cement/ Combination content (maximum): 410 kg/m³
- Consistence class: S3.
- Cement/ Combinations: IIB + SR
- Chloride class: 0,40
- Admixtures: None.

131 DESIGNED CONCRETE – Waterproof Concrete (lift pits, manholes, attenuation tank) - Admixture Supplier TBC

- Reinforcement/ embedded metal: DT2 TO BS8666 .
- Compressive strength class (cylinder/ cube): **C28/35 CAL**
- Aggregates:
 - Size (maximum): 20mm
 - Type/ Density: To BS 882/NORMAL
 - Recycled coarse aggregates: NONE
 - Other requirements:
- DESIGN CHEMICAL CLASS: DC2
- Limiting values for composition:
 - W/c ratio (maximum): 0.40
 - Cement/ Combination content (minimum): 380 kg/m³
 - Cement/ Combination content (maximum): 400 kg/m³
- Consistence class: S3.
- CEMENT/ COMBINATIONS: CIIIA + 50% GGBS
- Chloride class: 0,40
- Admixtures: Cementaid Caltite

Note: Deep sections (such as lift pit bases) that require a layer of Mix 131 on top, to be poured with Mix 132 below (to have the same shrinkage characteristics)

132 DESIGNED CONCRETE – **Composite lift base pours - only as required – which use both waterproof mix 131 and mix 132**

- Reinforcement/ embedded metal: DT2 TO BS8666 .
- Compressive strength class (cylinder/ cube): **C28/35**
- Aggregates:
 - Size (maximum): 20mm
 - Type/ Density: To BS 882/NORMAL
 - Recycled coarse aggregates: NONE
 - Other requirements:
- DESIGN CHEMICAL CLASS: DC2
- Limiting values for composition:
 - W/c ratio (maximum): 0.40
 - Cement/ Combination content (minimum): 380 kg/m3
 - Cement/ Combination content (maximum): 400 kg/m3
- Consistence class: S3.
- CEMENT/ COMBINATIONS: CIIIA + 50% GGBS
- Chloride class: 0,40
- Admixtures: submit proposals (Must contain at least a super-plasticiser)

133 DESIGNED CONCRETE –**Superstructure – columns & walls noted as C50**

- Reinforcement/ embedded metal: DT2 TO BS8666 .
- Compressive strength class (cylinder/ cube): **C40/50**
- Aggregates:
 - Size (maximum): 20mm
 - Type/ Density: To BS 882/NORMAL
 - Recycled coarse aggregates: NONE
- Design chemical class: DC-1.
- Limiting values for composition:
 - W/c ratio (maximum): 0.55.
 - Cement/ Combination content (minimum): 340 kg/m3
 - Cement/ Combination content (maximum): 410 kg/m3
- Consistence class: S3.
- Cement/ Combinations: CEM I
- Chloride class: 0,40
- Admixtures: NONE.

134 DESIGNED CONCRETE – **Superstructure – columns & walls from Ground Level up to and including Level 7 (unless noted as C50)**

- Reinforcement/ embedded metal: DT2 TO BS8666 .
- Compressive strength class (cylinder/ cube): **C32/40**
- Aggregates:
 - Size (maximum): 20mm
 - Type/ Density: To BS 882/NORMAL
 - Recycled coarse aggregates: NONE
- Design chemical class: DC-1
- Limiting values for composition:
 - W/c ratio (maximum): 0.6
 - Cement/ Combination content (minimum): 330 kg/m3
 - Cement/ Combination content (maximum): 400 kg/m3
- Consistence class: S3.

- Cement/ Combinations: CEM 1
- Chloride class: 0,40
- Admixtures: NONE.

135 DESIGNED CONCRETE – **Superstructure – columns & walls Level 8 to Roof**

- Reinforcement/ embedded metal: DT2 TO BS8666 .
- Compressive strength class (cylinder/ cube): **C28/35**
- Aggregates:
 - Size (maximum): 20mm
 - Type/ Density: To BS 882/LIGHTWEIGHT
 - Recycled coarse aggregates: NONE
- Design chemical class: DC-1
- Limiting values for composition:
 - W/c ratio (maximum): 0.6
 - Cement/ Combination content (minimum): 320 kg/m³
 - Cement/ Combination content (maximum): 400 kg/m³
- Consistence class: S3.
- Cement/ Combinations: CEM 1
- Chloride class: 0,40
- Admixtures: NONE.

136 DESIGNED CONCRETE –**Superstructure – Typical Floor & Roof slabs**

- Reinforcement/ embedded metal: DT2 TO BS8666 .
- Compressive strength class (cylinder/ cube): **C32/40**
- Aggregates:
 - Size (maximum): 20mm
 - Type/ Density: To BS 882/NORMAL
 - Recycled coarse aggregates: NONE
- Design chemical class: DC-1.
- Limiting values for composition:
 - W/c ratio (maximum): 0.55
 - Cement/ Combination content (minimum): 330 kg/m³
 - Cement/ Combination content (maximum): 390 kg/m³
- Consistence class: S3.
- Cement/ Combinations: CEM 1
- Chloride class: 0,40
- Admixtures: NONE.

137 DESIGNED CONCRETE –**External Slabs (as/if required –excludes Crane Base)**

- Reinforcement/ embedded metal: DT2 TO BS8666 .
- Compressive strength class (cylinder/ cube): **C32/40**
- Aggregates:
 - Size (maximum): 20mm
 - Type/ Density: To BS 882/NORMAL
 - Recycled coarse aggregates: NONE
- Design chemical class: DC2, XD-3, XF2
- Limiting values for composition:
 - W/c ratio (maximum): 0.45
 - Cement/ Combination content (minimum): 360 kg/m³
 - Cement/ Combination content (maximum): 400 kg/m³
- Consistence class: S3.
- Cement/ Combinations: IIB-V

- Chloride class: 0,40
 - Admixtures: Air entraining
- 138 **DESIGNED CONCRETE – External Crane Base**
- Reinforcement/ embedded metal: DT2 TO BS8666 .
 - Compressive strength class (cylinder/ cube): **C40/50**
 - Aggregates:
 - Size (maximum): 20mm
 - Type/ Density: To BS 882/NORMAL
 - Recycled coarse aggregates: NONE
 - Design chemical class: DC-2, XC-2
 - Limiting values for composition:
 - W/c ratio (maximum): 0.45
 - Cement/ Combination content (minimum): 340kg/m³
 - Cement/ Combination content (maximum): 400 kg/m³
 - Consistence class: S3.
 - Cement/ Combinations: IVB-V
 - Chloride class: 0,40
 - Admixtures: NONE.
- 140 **NORMAL DESIGN MIX FOR BLINDING CONCRETE**
- To the relevant clauses of BS 5328-2, BS 5328-3 and BS 5328-4.
 - Grade ST3-S2
 - Cement: As BS 5328
 - Nominal maximum size of aggregate: 20mm
 - Aggregate(s): As BS 882

MATERIALS, BATCHING AND MIXING

- 215 **READY-MIXED CONCRETE**
- Production plant: Currently certified by a body accredited by UKAS to BS EN 45011 for product conformity certification of ready-mixed concrete.
 - Source of ready-mixed concrete: Obtain from one source if possible. Otherwise, submit proposals.
 - Name and address of depot: Submit before any concrete is delivered.
 - Delivery notes: Retain for inspection.
 - Declarations of nonconformity from concrete producer: Notify immediately.
- 220 **CHEMICAL DRUM WASH SYSTEMS** for ready-mixed concrete may be used when covered by an appropriate Agrément certificate. Keep records of the deliveries and where they have been incorporated.
- 221 **INFORMATION ABOUT PROPOSED CONCRETES**
- Details listed in BS 8500-1 clause 5.2: Submit when requested.
- 255 **CEMENTS:**
- The following abbreviations apply:
 - PC42.5 Portland cement, Class 42.5 (in lieu of OPC)
 - PC52.5 Portland cement, Class 52.5 (in lieu of RHPC)
 - SRPC Sulfate resisting Portland cement
 - PBFC Portland blastfurnace cement
 - HSBC High slag blastfurnace cement (in lieu of LHPBC)

PPFAC Portland pulverised-fuel ash cement
 ggbs Ground granulated blastfurnace slag
 pfa Pulverized fuel ash

- Cements, ggbs and pfa must comply with the relevant British Standards. Portland cements must have cement certification meeting the requirements of the NACCB, Category 2 for product conformity.

305 DRYING SHRINKAGE

- Drying shrinkage of concrete (maximum): 0.075%.
- Test method: To BS EN 1367-4.

355 RISK OF ALKALI-SILICA REACTION IN DESIGNED/ PRESCRIBED MIXES: Take one of the precautions specified for Designated mixes in BS 5328-2, clause 1.4. Inform CA if this necessitates a change in specification. Submit evidence of compliance to CA before making concrete for use in the Works.

415 ADMIXTURES

- Calcium chloride and admixtures containing calcium chloride: Do not use.

490 PROPERTIES OF FRESH CONCRETE

- Adjustments to suit construction process: Determine with concrete producer. Maintain conformity to the specification.

IDENTITY TESTING/ CERTIFICATION

505 IDENTITY TESTING OF FRESH CONCRETE

- Testing: To BS EN 206-1, annex B and BS 8500-1, annexe B.
 - Nonconformity: Obtain instructions immediately.
- Recording: Maintain complete correlated records including:
 - Sampling, site tests, and identification numbers of specimens tested in the laboratory.
 - **Location of the parts of the structure represented by each sample.**
 - Location in the structure of the batch from which each sample is taken.

508 REGULAR IDENTITY TESTING

- Tests:
CUBE TESTING, SLUMP TESTING .
- Sampling:
ONE SET OF FOUR PER 30 cu.m, not less than two per day, SLUMP TESTS TWO PER DAY.

TESTING/CERTIFICATION

510 COMPLETE CORRELATED RECORDS must be maintained for each Designed and Prescribed mix including:

- Information in accordance with BS 5328-3, clauses 3.1 and 3.2.

- All sampling, site tests and identification numbers of all specimens tested in the laboratory.
- The location of the part(s) of the structure represented by each sample.
- The location in the structure of the batch from which each sample is taken.

520 IDENTITY TESTING LABORATORY

- Laboratory: Accredited by UKAS or other national equivalent.
 - Name and UKAS reference number: Submit well in advance of making trial mixes or concrete for use in the works.

530 IDENTITY TESTS RESULTS

- Submission of reports: Within one day of completion of each test.
 - Number of copies: 4.
- Reports on site: A complete set, available for inspection.

550 BROKEN CUBES FROM FAILED IDENTITY TESTS

- Nonconformity: Keep separately the pieces of each cube which fail to meet the conformity requirements for individual results.
- Period for keeping cubes: Obtain instructions.

570 EARLY AGE STRENGTH TESTING: A regime of accelerated or normal curing and early testing which is capable of predicting the 28 day strength of Designed mixes may be used for determining compliance, subject to prior approval. If such a regime is adopted, two additional cubes must be made from each sample and cured normally so that, in the event of noncompliance, they can be tested at 28 days to provide information which will help in deciding the action to be taken.**580 FAILURES:**

- If a concrete sample fails to achieve specified criteria or to pass specified tests, inform the CA without delay and submit:
 - Confirmation of the validity of the test results, and/or
 - Proposals for further tests to assess the strength of the concrete in the structure, as set out in BS 6089, and/or
 - Proposals for rectification.
- Obtain approval of all such evidence and proposals before proceeding. The CA may issue instructions for the work to be stopped or delayed until reasons for the failure have been established, possible consequences assessed, and appropriate preventative and remedial measures taken.

581 FAILURES: Wherever the specified sampling, testing and compliance procedures show that a concrete mix is not in accordance with the specification (even if the work is eventually accepted), and measures are taken to help in establishing whether or not the work is acceptable, such measures:

- will be at the expense of the Contractor, and
- will not be considered as grounds for extension of time.

PLACING/ COMPACTING/ CURING AND PROTECTION**630 PREMATURE WATER LOSS**

- Requirement: Prevent water loss from concrete laid on absorbent substrates.
 - Underlay: Select from:

Polyethylene sheet: 250 micrometres thick.

Building paper: To BS 1521, grade B1F.

- Installation: Lap edges 150 mm.

640 CONSTRUCTION JOINTS

- Locations of construction joints: Submit proposals where not shown on drawings.
- Preparation of joint surfaces: Select from:
 - Brushing and spraying: Remove surface laitance and expose aggregate finish while concrete is still green.
 - Other methods: Submit proposals.
- Condition of joint surfaces immediately before placing fresh concrete: Clean and damp.

650 SURFACES TO RECEIVE CONCRETE

- Cleanliness of surfaces immediately before placing concrete: Clean with no debris, tying wire clippings, fastenings or free water.

660 INSPECTION OF SURFACES

- Notice: Give notice to allow inspections of reinforcement and surfaces before each pour of concrete.
 - Period of notice: Obtain instructions.

670 TRANSPORTING

- General: Avoid contamination, segregation, loss of ingredients, excessive evaporation and loss of workability. Protect from heavy rain.
- Entrained air: Anticipate effects of transport and placing methods in order to achieve specified air content.

680 PLACING

- Records: Maintain for time, date and location of all pours.
- Timing: Place as soon as practicable after mixing and while sufficiently plastic for full compaction.
- Temperature limitations for concrete: 30°C (maximum) and 5°C (minimum). Do not place against frozen or frost covered surfaces.
- Continuity of pours: Place in final position in one continuous operation up to construction joints. Avoid formation of cold joints.
- Discharging concrete: Prevent uneven dispersal, segregation or loss of ingredients or any adverse effect on the formwork or formed finishes.
- Thickness of layers: To suit methods of compaction and achieve efficient amalgamation during compaction.
- Poker vibrators: Do not use to make concrete flow horizontally into position, except where necessary to achieve full compaction under void formers and cast-in accessories and at vertical joints.

690 COMPACTING

- General: Fully compact concrete to full depth to remove entrapped air. Continue until air bubbles cease to appear on the top surface.
 - Areas for particular attention: Around reinforcement, under void formers, cast-in accessories, into corners of formwork and at joints.

- Consecutive batches of concrete: Amalgamate without damaging adjacent partly hardened concrete.
- Methods of compaction: To suit consistence class and use of concrete.

720 VIBRATORS

- General: Maintain sufficient numbers and types of vibrator to suit pouring rate, consistency and location of concrete.
- External vibrators: Obtain approval for use.

730 PLASTIC SETTLEMENT

- Settlement cracking: Inspect fresh concrete closely and continuously wherever cracking is likely to occur, including the top of deep sections and at significant changes in the depth of concrete sections.
 - Timing: During the first few hours after placing and whilst concrete is still capable of being fluidized by the vibrator.
- Removal of cracks: Revibrate concrete.

CURING AND PROTECTION

810 CURING GENERALLY

- Evaporation from surfaces of concrete: Prevent, including from perimeters and abutments, throughout curing period.
 - Surfaces covered by formwork: Retain formwork in position and, where necessary to satisfy curing period, cover surfaces immediately after striking.
 - Top surfaces: Cover immediately after placing and compacting. If covering is removed for finishing operations, replace it immediately afterwards.
- Surface temperature: Maintain above 5°C throughout the specified curing period or four days, whichever is longer.
- Records: Maintain details of location and timing of casting of individual batches, removal of formwork and removal of coverings. Keep records on site, available for inspection.

811 COVERINGS FOR CURING

- Sheet coverings: Suitable impervious material.
- Curing compounds: Selection criteria:
 - Curing efficiency: Not less than 75% or for surfaces exposed to abrasion 90%.
 - Colouring: Fugitive dye.
 - Application to concrete exposed in the finished work: Readily removable without disfiguring the surface.
 - Application to concrete to receive bonded construction/ finish: No impediment to subsequent bonding.
- Interim covering to top surfaces of concrete: Until surfaces are in a suitable state to receive coverings in direct contact, cover with impervious sheeting held clear of the surface and sealed against draughts at perimeters and junctions.

812 PREVENTING EARLY AGE THERMAL CRACKING

- Deep lifts or large volume pours: Submit proposals for curing to prevent early age thermal cracking, taking account of:
 - Temperature differentials across sections.
 - Coefficient of thermal expansion of the concrete.
 - Strain capacity of the concrete mix (aggregate dependent).

- Restraint.

820 CURING PERIODS

- General: Curing periods are in days (minimum).
 - Definition of 't': The average number of degrees Celsius air temperature during the curing period.
- Curing periods for concrete surfaces which, in the finished building, will be exposed to the elements; concrete wearing surface floors and pavements; water resistant concrete:

	Concrete made using CEM1; SRPC (BS 4027); IIA	Concrete made using IIB; IIIA; IIIB; IVB
Drying winds or dry, sunny weather	$\frac{140}{t+10}$	$\frac{180}{t+10}$
Intermediate conditions	$\frac{100}{t+10}$	$\frac{140}{t+10}$
Damp weather, protected from sun and wind	$\frac{100}{t+10}$	$\frac{100}{t+10}$

- Curing periods for other structural concrete surfaces (cements/ combinations as above):

Drying winds or dry, sunny weather	$\frac{80}{t+10}$	$\frac{140}{t+10}$
Intermediate conditions	$\frac{60}{t+10}$	$\frac{80}{t+10}$

Damp weather,

protected from
sun and wind

No special
requirements

No special
requirements

_____ . _____ . _____ . _____ . _____ . _____ . _____

- Curing periods for concretes using admixtures or other types of cements/ combinations: Submit proposals.

840 PROTECTION

- Prevent damage to concrete, including:
 - Surfaces generally: From rain, indentation and other physical damage.
 - Surfaces to exposed visual concrete: From dirt, staining, rust marks and other disfiguration.
 - Immature concrete: From thermal shock, physical shock, overloading, movement and vibration.
 - In cold weather: From entrapment and freezing expansion of water in pockets, etc.

E20 FORMWORK FOR IN SITU CONCRETE

To be read with Preliminaries/General conditions.

GENERALLY/PREPARATION

- 110 LOADINGS: Design and construct formwork to withstand the worst combination of:
- Total weight of formwork, reinforcement and concrete.
 - Construction loads including dynamic effects of placing, compacting and construction traffic.
 - Wind and snow loads.
- 130 PROPPING: Provide adequate propping to prevent deflection and damage to the structure. Carry down such props to bearings strong enough to provide adequate support.
- 140 PROPPING OF PROFILED STEEL SHEETS: Provide continuous support along the centre of each span until the concrete has reached an adequate strength as agreed with the CA.
- 150 BEARINGS:
- Prop through other decks if construction load on a particular deck exceeds:
 - the design loading, or
 - where less than 28 days have elapsed from casting, a reduced loading agreed with CA.
 - Submit details of proposed prop bearings and through propping to CA. Accept responsibility for cost of checking effects on structure.
- 160 CAMBERS:
- Specified cambers relate to the concrete immediately before formwork is struck. Make adequate allowance for deflection of formwork under weight of fresh concrete. Top surfaces of concrete must also be cambered to maintain the required structural depths and profiles.
 - After striking of formwork and removal of props check levels to determine extent of any residual camber and inform CA.
- 161 CAMBERS: Unless otherwise shown on drawings construct forms to achieve the following upward cambers:
- Slabs: % of span measured at centre:
0.2
 - Beams: % of span measured at centre:
0.2
 - Cantilever beams: % of cantilever measured at free end:
0.35
- 170 WORK BELOW GROUND:
- Vertical faces of strip footings, bases and slabs may be cast against faces of excavation, provided:
 - Prior approval is obtained.
 - The faces are sufficiently accurate and stable.
 - Supports to faces are withdrawn progressively as concrete is placed.
 - Adequate measures are taken to prevent contamination of concrete.
 - Faces of walls must be cast against formwork.

- 200 **UNDERSLAB SHEET INSULATION:** **“ARCHITECT TO COMPLETE”**
- Manufacturer and reference: _____
 - Thickness: _____
 - Lay sheets on _____
 - Seal all joints with tape recommended by manufacturer or by completely overlaying with 500 gauge polyethylene with lapped joints.
 - Ensure that insulation is covered with concrete blinding (see section E10) before fixing slab reinforcement.
- 210 **STEELWORK:** Remove all loose millscale and loose rust before encasing in concrete.

CONSTRUCTION

- 310 **ACCURACY:** Construct formwork accurately and robustly with adequate supports to produce finished concrete to the required dimensions. Formed surfaces must be free from twist and bow (other than any required cambers), all intersections, lines and angles being square, plumb and true.
- 320 **JOINTS IN FORMS:** Construct formwork, including joints in form linings and between forms and completed work, to prevent loss of grout, using seals when necessary. Secure formwork tight against adjacent concrete to prevent formation of steps.
- 330 **INSERTS, HOLES AND CHASES:**
- Confirm positions and details to ensure that alterations to and decisions about their size and location are not made without the knowledge and approval of the CA.
 - Fix inserts or box out as required in correct positions before placing concrete. Form all holes and chases; do not cut hardened concrete without approval.
- 340 **KICKERLESS CONSTRUCTION:** Unless shown otherwise form horizontal construction joints at base of walls and columns without kickers, using one of the methods described in BCA Publication 47.023 'Kickerless construction'. The Contractor must satisfy himself as to the suitability of the chosen method.
- 350 **FORM TIES:** No metal part of any device for securing forms is to remain within the specified concrete cover.
- 351 **FORM TIES:** Do not use in formwork for Capping beam, basement walls and lift pits.
- 470 **RELEASE AGENTS:** Type(s) which are suitable for use with the type(s) of formwork, formed finishes and specified applied finishes. Use the same type and make throughout the entire area of any one finish. Apply evenly to form faces, from top downwards, and to horizontal surfaces last. Use the minimum amount necessary to obtain a clean release and prevent excessive local collection. Prevent release agent touching the reinforcement, hardened concrete, other materials not part of the form face, and permanent forms.
- 480 **SURFACE RETARDERS:** Do not use without approval. Prevent retarder from touching the reinforcement.

STRIKING

- 510 **RESPONSIBILITY:** Strike formwork without disturbing, damaging or overloading structure, and without disturbing props. Notwithstanding other clauses in this specification and any checking or approvals by the CA, the responsibility for safe removal of any part of the formwork and any supports without damaging the structure rests with the Contractor.
- 520 **MINIMUM PERIODS:** The following periods (in days) for retaining formwork in position before striking apply to class 42.5 or sulfate-resisting Portland cement concrete with no cement replacement materials or admixtures:

Type of and formwork	Average mean of daily minimum and maximum air temperatures during the period		
	16°C	7°C	3°C
Vertical formwork to columns, walls and beams	½	¾	1
Soffit forms to slabs	4	6	8
Props to slabs and soffit forms to beams	10	15	20
Props to beams	14	21	28

Submit details of proposed periods for mixes using admixtures or other types of cement.

- 521 **MINIMUM PERIODS:** Alternative methods of determining minimum periods for retaining formwork in position may be submitted for approval. Accept responsibility for cost of checking of proposals by CA and for any testing.

FORMED FINISHES

- 610 **BASIC FINISH:** no particular requirements, except those for tolerances and full compaction. – Pilecaps and ground beams.
- 615 **FINISH TO RECEIVE ASPHALT TANKING:**
- Produce an even finish with a sheet material (e.g. plywood), suitable to receive asphalt, and acceptable to asphalt contractor.
 - Avoid excessive use of release agents.
 - Abrupt irregularities to be not greater than 3 mm.
Gradual irregularities, expressed as a maximum permissible deviation from a 1 m straight edge, to be not greater than 3 mm.
 - Blowholes less than 10 mm in diameter will be permitted but otherwise surface to be free from voids, honeycombing, segregation and other large defects.
 - Making good: Projecting fins are to be removed and rubbed down with a carborundum stone but otherwise the finish is to be left as struck. Making good of small defects will normally be permitted after inspection by CA.
 - Formwork tie holes are not permitted.

620 PLAIN SMOOTH FINISH: TO ALL SHUTTERED CONCRETE ELEMENTS OTHER THAN FLOOR SLABS.

- Produce an even finish with a sheet material (e.g. plywood), with panels arranged in a regular pattern as a feature of the surface.
- Abrupt irregularities to be not greater than 5 mm. Gradual irregularities, expressed as maximum permissible deviation from a 1 m straight edge, to be not greater than 5 mm.
- Variation in colour resulting from the use of an impermeable form lining will be permitted but the surface to be free from discolouration due to contamination or grout leakage.
- Blowholes less than 10 mm in diameter and at an agreed frequency will be permitted but otherwise surface to be free from voids, honeycombing, segregation and other large defects.
- Making good: Projecting fins are to be removed and rubbed down with a carborundum stone but otherwise the finish is to be left as struck. Making good of small defects will normally be permitted after inspection by CA.
- Arrises to be sharp on slabs, 20mm chamfer on columns.
- Formwork tie holes to be in an approved regular pattern, filled with matching mortar to an approved sample.

630 FINE SMOOTH FINISH: POWER FLOATED FINISH.

- Produce a smooth even finish with an impervious sheet material (e.g. resin film faced plywood), with panels as large as is practicable and arranged in an approved regular pattern as a feature of the surface. Do not replace parts of formwork panels where this may cause a change of colour in the concrete.
- Abrupt irregularities to be not greater than 3 mm. Gradual irregularities, expressed as maximum permissible deviation from a 1 m straight edge, to be not greater than 3 mm.
- Variation in colour resulting from the use of an impermeable form lining will be permitted but the surface is to be free from discolouration due to contamination or grout leakage.
- Cover spacers: Do not use without approval.
- Blowholes less than 5 mm in diameter and at an agreed frequency will be permitted but otherwise surface to be free from voids, honeycombing, segregation and other defects.
- Making good: Projecting fins are to be removed and rubbed down with a carborundum stone but otherwise the finish is to be left as struck. Making good will not normally be permitted.
- Arrises to be Chamfered, 20mm
- Formwork tie holes to be in an approved regular pattern, filled with matching mortar to an approved sample.

E30 REINFORCEMENT FOR IN SITU CONCRETE

To be read with Preliminaries/General conditions.

REINFORCEMENT

- 110 QUALITY ASSURANCE: All steel reinforcement specified to comply with BS 4449 or BS 4483 and cut and bent to BS 8666 is to be obtained from firm(s) holding a valid certificate of approval issued under a product certification scheme operated by a third party certification body with appropriate Category 2 accreditation from the United Kingdom Accreditation Service (UKAS).
- 140 PLAIN BAR REINFORCEMENT:
To BS 4449, Grade 250.
- 150 DEFORMED BAR REINFORCEMENT:
To BS 4449, Grade 460.
- 210 FABRIC REINFORCEMENT: To BS 4483.

WORKMANSHIP

- 310 CUT AND BEND reinforcement to schedules and to BS 8666. Do not bend when below 5°C without approval. Steel may be warmed to not more than 100°C. Do not rebend bars without approval. Tag bundles of reinforcement with labels to BS 8666.
- 311 CUT AND BEND stainless steel bars to BS 8666 as for high yield bars.
- 317 MECHANICAL DAMAGE: Reinforcement must not be roughly handled, dropped from a height, or subjected to shock loading or mechanical damage.
- 325 CLEANLINESS: At time of placing concrete, reinforcement to be clean and free of corrosive pitting, loose millscale, loose rust, ice, oil and other substances which may adversely affect the reinforcement, concrete, or bond between the two.
- 330 ADJUSTMENTS: Provide on site facilities for hand bending to deal with approved minor adjustments.
- 360 PROJECTING REINFORCEMENT: Grade 250 bars may be bent to radii not less than BS 8666, Table 3. Grade 460 bars must not be bent or straightened without approval.
- 410 LAPS OR SPLICES: Obtain instructions if details are not shown on drawings.
- 420 LAPS in nominal bar reinforcement to be not less than 300 mm.
- 421 LAPS in fabric reinforcement, where not detailed, to be not less than 250 mm. Where necessary seek instructions to avoid a four layer build-up at corners.
- 434 STRUCTURAL WELDED JOINTS will not be permitted.

445 MECHANICAL JOINTS may be substituted for lapped joints subject to approval. Submit full details, including joint type(s) and location(s). Accept responsibility for cost of checking by the CA and for any supervision and testing.

451 FIXING GENERALLY:

- Unless otherwise permitted fix reinforcement in position before placing concrete. In addition to any spacers and chairs shown on drawings or schedules, provide adequate support, tie securely and maintain the specified cover. Comply generally with Concrete Society Report CS 101 'Spacers for reinforced concrete'.
- Unless otherwise specified tie using 16 swg annealed tying wire. Ensure that tying wire does not intrude into the concrete cover. Do not tack weld unless authorised by the CA and recommended by the reinforcement manufacturer.
- Do not fix or place reinforcement in contact with nonferrous metals.

470 TOLERANCES ON COVER:

- Not less than the nominal cover minus 5 mm.
- Where reinforcement is located in a particular direction in relation to only one face of a member, not more than the nominal cover plus:
5 mm on bars up to and including 12 mm size.
10 mm on bars over 12 mm up to and including 25 mm size.
15 mm on bars over 25 mm size.
- Before concreting check thoroughly that the specified cover dimensions have been obtained.

481 GROUND BEARING SLABS: Where these are reinforced with a single layer of fabric in the upper part of the slab, either:

- lay fabric on top of the first compacted layer of concrete, followed by the top layer of concrete, placed within two hours of the first layer, or
- fully support the fabric on suitable proprietary supports/chairs.

491 SPACERS TO FORMED CONCRETE FINISHES, if permitted (see section E20) to be approved type(s).

500 DAMAGE: Prevent damage to and disfigurement of forms, form linings and adjacent work.

510 RUST STAINING: Prevent rust staining of surfaces of concrete which will be exposed to view in the finished work, caused by e.g. rust stained formwork or unprotected projecting reinforcement.

520 CHECKING COVER: Check the position of the reinforcement in the hardened concrete as soon as practicable after casting using a magnetic induction digital display type cover meter in accordance with manufacturer's recommendations and BS 1881-204. Pay particular attention to columns, beams, cantilevers, soffits of slabs and all faces which will be exposed to the weather in the finished building. Inform CA when such checking is to be carried out, confirm that it has been carried out and that the results were satisfactory.

E40 DESIGNED JOINTS IN SITU CONCRETE

To be read with Preliminaries/General conditions.

120 CONSTRUCTION/MOVEMENT JOINTS GENERALLY

- Accuracy: Position and form joints accurately, straight, well-aligned and truly vertical or horizontal or parallel with setting out lines of the building.
- Modifications: If necessary to any joint design or location, agree before proceeding.
- Placing concrete:
 - Prevent concrete entering joints or penetrating compressible joint fillers and making movement joints ineffective.
 - Do not place concrete simultaneously on both sides of movement joints.

210 FORMED JOINTS

- Construction: Rigid, grout-tight side forms or stop ends designed to accommodate projecting bars or fabric without temporary bending or displacement.

211 FORMED JOINTS IN CONCRETE WEARING SURFACES

- Temporary forms: Square edged with a steel top surface and in good condition.
- Placing concrete: Compact thoroughly at edges to give level, closely abutted joints with no lipping.

230 CONSTRUCTION JOINT FACES

- Roughening: While concrete is still green, remove laitance without loosening the aggregate to leave a thoroughly roughened, exposed aggregate finish.

260 CRACK INDUCING GROOVES (IN GROUNDBEARING SLABS)

- Groove dimensions:
 - Depth: 20 mm.
 - Width: 5mm
- Forming grooves: One of the following:
- Temporary strips inserted into the fully compacted concrete. Recompact and relevel slab. Remove strips.
- If the type of aggregate so permits, grooves sawn sufficiently early to prevent random cracking (within 24 hours of casting slab).

410 TIE BARS

- Standard: To BS 4449, Grade 250, clean and free from loose millscale, loose rust, ice, oil and other deleterious substances.
- Position: Fix centred on the joints.

430 DOWEL BARS

- Standard: To BS 4449, Grade 250, perfectly straight, with sawn (not sheared) ends.
- Debonding: Coat half of each bar with a suitable proprietary debonding compound or fit with a suitable plastics sleeve.
- Position: Fix bars at right angles to and centred on the joint.
- Expansion joints: Fit an approved type of cap incorporating not less than 20 mm of compressible material to debonded ends of all bars.

520 SHEET JOINT FILLER for expansion joints

- Manufacturer: Flexcell

- Where sealant is specified: Leave sufficient space for sealant by using temporary formers.

530 SEALANT FOR JOINTS IN STRUCTURAL CONCRETE

- Type: COMPRIBAND ILLMOD 600
- Preparation and application: As section Z22.

E41 WORKED FINISHES TO IN SITU CONCRETE

To be read with Preliminaries/General conditions.

150 FINISHING GENERALLY

- Timing: Carry out finishing operations at optimum times in relation to the setting and hardening of the concrete.
- Prohibited treatments to concrete surfaces: Wetting to assist working and sprinkling cement.

210 TAMPED FINISH: To Kitchen Areas, Tamp surface with edge of a board or beam to give an even texture of parallel ribs.**320 TROWELLED FINISH** to receive close fitted carpet, tiling etc.

- Float concrete to an even surface with no ridges or steps, then immediately commence curing as specified in section E10.
- When the concrete is suitably stiff, hand or power trowel to give a uniform smooth but not polished surface, free from trowel marks and other blemishes, and suitable to receive the specified flooring material.
- Resume specified curing without delay.
- Protect the surface from construction traffic until flooring material is laid.
- If, because of inadequate finishing or protection, the surface of the concrete is not suitable to receive the specified flooring material, it must be made good by application of a smoothing compound by and to the satisfaction of the flooring subcontractor. Allow for the cost of any such making good.