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Structural Engineer's Specification

Issue 1

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CONTENTS

D20 EXCAVATING AND FILLING

To be read with Preliminaries/ General conditions and in conjunction with the Planning Stage Design Statement by MBP.

GENERALLY/ THE SITE

110 SITE INVESTIGATION
- Report: SAS Ltd, June 2016.

145 VARIATIONS IN GROUND WATER LEVEL
- Give notice: If levels encountered are significantly different from levels in the site investigation report or previously measured.

CLEARANCE/ EXCAVATING

168 SITE CLEARANCE
- Timing: Before topsoil stripping, if any.
- General: Clear site of rubbish, debris and vegetation. Do not compact topsoil.

240 ADJACENT EXCAVATIONS
- Requirement: Where an excavation encroaches below a line drawn at an angle from the nearest formation level of another higher excavation, the lower excavation, all work within it and backfilling thereto, must be completed before the higher excavation is made.
- Angle of line below horizontal: 45° for stable soil and 30° for wet clay.
  Backfill material: Hardcore filling as clause 710.

250 PERMISSIBLE DEVIATIONS FROM FORMATION LEVELS
- Beneath mass concrete foundations: ±25 mm.
- Beneath ground bearing slabs and r.c. foundations: ±15 mm.
- Embankments and cuttings: ±50 mm.
- Ground abutting external walls: ±50 mm, but such as to ensure that finished level is not less than 150 mm below dpc.

270 FOUNDATIONS GENERALLY
- Give notice if:
  - A natural bearing formation of undisturbed subsoil is not obtained at the depth shown on the drawings.
  - The formation contains soft or hard spots or highly variable material.

310 UNSTABLE GROUND
- Generally: Ensure that the excavation remains stable at all times.
- Give notice: Without delay if any newly excavated faces are too unstable to allow earthwork support to be inserted.
- Take action: If instability is likely to affect adjacent structures or roadways, take appropriate emergency action.

320 RECORDED FEATURES
- Recorded foundations, beds, drains, manholes, etc: Break out and seal drained ends.
- Contaminated earth: Remove and disinfect as required by local authority.

330 UNRECORDED FEATURES
- Give notice: If unrecorded foundations, beds, voids, basements, filling, tanks, pipes, cables, drains, manholes, watercourses, ditches, etc. not shown on the drawings are encountered.

360 EXCESS EXCAVATION
- Excavation taken wider than required:
  - Backfill: As clause 700.
- Excavation taken deeper than required:
  - Backfill:
    - Under foundations: concrete C 32/40.
    - Underground bearing slabs: Hardcore as clause 710.

DISPOSAL OF MATERIALS

410 EXCAVATED TOPSOIL STORAGE
- General: Remove from site.

454 GROUND WATER LEVEL, SPRINGS OR RUNNING WATER
- Give notice: If it is considered that the excavations are below the water table.
- Springs/ Running water: Give notice immediately if encountered.

457 PUMPING
- General: Do not disturb excavated faces or stability of adjacent ground or structures.
- Pumped water: Discharge without flooding the site or adjoining property.
- Sumps: Construct clear of excavations. Fill on completion.
  - Locations: Contractor's choice.

FILLING

510 HAZARDOUS, AGGRESSIVE OR UNSTABLE MATERIALS
- General: Do not use fill materials which would, either in themselves or in combination with other materials or ground water, give rise to a health hazard, damage to building structures or instability in the filling, including material that is:
  - Frozen or containing ice.
  - Organic.
  - Contaminated or noxious.
  - Susceptible to spontaneous combustion.
  - Likely to erode or decay and cause voids.
  - With excessive moisture content, slurry, mud or from marshes or bogs.
  - Clay of liquid limit exceeding 80 and/or plasticity index exceeding 55.
  - Unacceptable, class U2 as defined in the Highways Agency 'Specification for highway works', clause 601.

520 FROST SUSCEPTIBILITY
- General: Except as allowed below, fill must be non frost-susceptible as defined in Highways Agency 'Specification for highway works', clause 801.8.
- Test reports: If the following fill materials are proposed, submit a laboratory report confirming they are non frost-susceptible:
  - Fine grained soil with a plasticity index less than 20%.
  - Coarse grained soil or crushed granite with more than 10% retained on a 0.063 mm sieve.
  - Crushed chalk.
  - Crushed limestone fill with average saturation moisture content in excess of 3%.
  - Burnt colliery shale.
- Frost-susceptible fill: May only be used:
  - At depths below the finished ground surface greater than 450mm.
  - Within the external walls of buildings below spaces that will be heated. Protect from frost during construction.
  - Where frost heave will not affect structural elements.

525 TESTING OF SUITABILITY OF FILL MATERIALS BEFORE START OF FILLING
- Laboratory: UKAS/ NAMAS accredited laboratory.
- Submit report to: Structural engineer.
  - Timing: 21 days before starting filling.

- Samples: Deliver to laboratory as required.
- Additional requirements: None.
- Tests: As directed.
- Frequency: Submit with tender proposed rate and frequency of testing to demonstrate continuing compliance of imported or reprocessed filled with specified properties.

530 PLACING FILL
- Surfaces of excavations and areas to be filled: Free from loose soil, topsoil, organic material, rubbish and standing water.
- Freezing conditions: Do not place fill on frozen surfaces. Remove material affected by frost. Replace and recompact if not damaged after thawing.
- Adjacent structures, membranes and buried services:
  - Do not overload, destabilise or damage.
  - Submit proposals for temporary support necessary to ensure stability during filling.
  - Allow 14 days (minimum) before backfilling against in situ concrete structures.
- Layers: Place so that only one type of material occurs in each layer.
- Earthmoving equipment: Vary route to avoid rutting.

535 COMPACTION GENERALLY
- General: Compact fill not specified to be left loose as soon as possible after placing.
- After compaction: Surface of each layer must be well closed, showing no movement under compaction plant, and without cracks, holes, ridges, loose material and the like.
- Defective areas: Remove and recompact to full thickness of layer using new material.

540 BENCHING IN FILL
- Adjacent areas: If, during filling the difference in level between adjacent areas of filling exceeds 600 mm, cut into edge of higher filling to form benches 600 mm minimum width and height equivalent to depth of a layer of compacted filling.
- New filling: Spread and compact to ensure maximum continuity with previous filling.

700 BACKFILLING AROUND FOUNDATIONS
- Under oversite concrete and pavings: Hardcore.
- Under grassed or soil areas: Material excavated from the trench, laid and compacted in 300 mm maximum layers.

710 HARDCORE FILLING, UNDER NEW SLABS IF REQUIRED
- Fill: Granular material, free from excessive dust, well graded, all pieces less than 75 mm in any direction, minimum 10% fines value of 50 kN when tested in a soaked condition to BS 812-111, and in any one layer only one of the following:
  - Crushed rock (other than argillaceous rock) or quarry waste with not more binding material than is required to help hold the stone together.
  - Crushed concrete, crushed brick or tile, free from plaster, timber and metal.
  - Crushed non-expansive slag.
  - Gravel or hoggin with not more clay content than is required to bind the material together, and with no large lumps of clay.
  - Well-burned non-plastic colliery shale.
  - Natural gravel.
  - Natural sand.
- Filling: Spread and level in 150 mm maximum layers. Thoroughly compact each layer.

730 BLINDING
- Surfaces to receive sheet overlays or concrete:
- Blind with:
  - Concrete where shown on drawings; or
  - Sand, fine gravel, or other approved fine material applied to fill interstices. Moisten as necessary before final rolling to provide a flat, closed, smooth surface.
- Sand for blinding: To BS EN 12620, grade 0/4 or 0/2 (MP).
- Permissible deviations on surface level: +0 -25 mm.

D50 UNDERPINNING

To be read with Preliminaries/ General conditions and in conjunction with the Planning Stage Design Statement by MBP.

GENERAL

155 GROUND INVESTIGATION
- Refer to section D20/110.

170 DISCONNECTION OF SERVICES IN WORKING AREAS
- Disconnections required: Contractor's choice.
  - Timing: Before commencing underpinning works within the building.
- Reconnection: Ensure that services cannot be reinstated by site operatives without consent.

TYPES OF UNDERPINNING

210 CONTINUOUS RC UNDERPINNING, ALL BASEMENT
- Underpinning blocks:
  - Depth: Nominal 1 metre.
  - Length (maximum): 1 metre.
  - Width on either side of wall centre line (minimum): 175mm.
  - Depth of hard pack: 50-100mm.
- Materials:
  - Concrete: See specification E10/106.
  - Hard packing: 1:3 cement:sharp sand mortar.
    Water content: Sufficient only to ensure that packing binds together.
- Sequence: Submit proposals but no more than 25% of wall length to be unsupported at any time. Proposals to be submitted 28 days before commencement on site to enable agreement with Party Wall surveyor.
- Curing periods (minimum):
  - Between casting underpinning block and pinning up: 24 hours.
  - Between completion of pinning up and commencement of excavation for the next sequence of underpinning: 24 hours.
    Extend curing periods to allow for inclement weather.
- Shear connection between underpinning blocks: joggle joints between adjacent stools.
- Features: underpin not to project further into site than existing footing.

ACCESSORIES FOR UNDERPINNING

435 IN SITU CONCRETE FOR UNDERPINNING
- Standard: To BS 8110-1.
- Concrete: designated as specification E10.
  - Embedded metal: None.
  - Fibres: None.
  - Immature concrete: Protect from drying, frost and loading for a minimum period of 7 days.
  - Extend period to allow for inclement weather.
- Cover to reinforcement (minimum):
  - Top face: not applicable.
  - Faces cast against not applicable.

440 MAKING CONCRETE GENERALLY
- Standard: To BS 8500-2.
- Exchange of information: Provide concrete producer with information required by BS 8500-1, clauses 4 and 5.
- Other requirements: None.

442 ADDITIONAL REQUIREMENT FOR CONCRETE QUALITY
- Variation from BS 8500-1: Comply with the requirements of BRE Special Digest 1 where these vary from those of BS 8500-1.

475 STEEL REINFORCEMENT GENERALLY
- Type/ Grade: 460.
- Cutting and bending: To BS 8666.
- Lap lengths (minimum): 40 x bar diameter.
- Supplier: Firm 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).
- Cleanliness: At time of placing concrete, reinforcement to be clean, free of corrosive pitting and loose millscale or rust.

EXECUTION

610 REPAIR OF MASONRY
- Specification: Test underside of existing masonry/footing for soundness by tapping with a hammer. Break-out and remove any loose or unsound material to a uniform level soffit.
- Timing: At least 7 days before commencement of underpinning operations.

615 CONSTRUCTION OF CONTNUOUS RC UNDERPINNING
- Block and working space: Excavate together.
- Formation:
  - Preparation: Remove or compact loose material.
  - Protection: Cover with 50 mm thickness of concrete if there will be a delay of more than four hours between completion of excavation and casting of concrete underpinning.
- Split sleeves: Provide around drain/ service passing through underpinning. Closely fit a rigid sheet to each side of opening to prevent ingress of fill or vermin.
- Clearance around drain/ service (minimum): 50mm.
- Dowels/ Shear key/ Front shutter: Provide where required.
- Casting underpinning: In one lift, leaving a gap for packing up beneath existing foundation.
- Packing: On completion of concrete curing period, hard pack gap between underpinning block and existing foundation. Allow packing to cure before commencing excavation for the next sequence of underpinning.

COMPLETION

910 HEALTH AND SAFETY FILE - RC UNDERPINNING
- Requirement: Collate and submit a full set of records for inclusion in the health and safety file.
  - Number of copies: 3.
- Content: For each underpinning block record:
  - Date of casting.
  - Depth of base below datum.
  - Length.
  - Width either side of wall.
  - Details of drains and services built into block and diameter of sleeving.
- Latest date for submission: Refer to Preliminaries clause A37.

E05 IN SITU CONCRETE CONSTRUCTION GENERALLY

To be read with Preliminaries/ General conditions and in conjunction with the Planning Stage Design Statement by MBP and design and Performance Specification for Detailing and Scheduling of Reinforced Concrete Elements.

215 CONTRACTOR DETAILING OF REINFORCEMENT

- Extent: All in situ reinforced concrete structure shown on MBP drawings.
- Requirement: Complete the detailing and scheduling of the reinforcement.
- Standards:
  - Design: To BS 8110-1 & liaison with Pudlo/Cementaid required.
  - Drawings: BS EN ISO 3766 & Refer to MBP performance specification.
  - Reinforcement schedules: To BS 8666.
- Design information:
  - Designed reinforcement: Format for design information to be agreed with contractor also refer to MBP performance specification.
  - Additional reinforcement:
    Control of cracking: Provide additional reinforcement and adjust spacing of reinforcement as design standard requirements for the control of cracking.
    Other: None.
- Reinforcement:
  - Order of priority when clashes occur: Raise query with MBP.
  - Other detailing requirements: None.
- Finished product: To comply with the requirements of design standard.

223 STRUCTURAL DRAWINGS AND SCHEDULES

- Standards:
  - Drawings: "*Standard method of detailing structural concrete*" published by the Institution of Structural Engineers.
  - Reinforcement schedules: To BS 8666.

225 TEMPERATURE RECORDS

- Requirement: Throughout period of concrete construction record:
  - Daily: temperature intervals at four hours.
  - Under adverse temperature conditions: Temperature at commencement and end of placing.
- Equipment: Contractor's choice.
  - Location: In the shade, close to the structure.

235 OPENINGS, INSERTS AND FIXINGS

- Requirement: Collate all information.
- Submit: Details where openings, inserts and fixings can only be accommodated by adjustments to reinforcement.
- Locate reinforcement: To ensure specified minimum cover at openings and inserts and to be clear of fixing positions.

290 ACCURACY OF CONSTRUCTION

- Setting out: To BS 5964-1.
- Geometrical tolerances: To BS EN 13670, Tolerance Class 1. -
  Conflicts: Notwithstanding tolerances specified elsewhere, do not exceed requirements for compliance with the designated code of practice.
  - Substitution of alternative requirements: None.

300 LEVELS OF STRUCTURAL CONCRETE FLOORS

- Tolerances (maximum):
  - Level of floor: +/- 10mm.
  - Steps in floor level: +/-5mm.

310 SURFACE REGULARITY OF CONCRETE FLOORS TO BS 8204 - GENERAL
- Standard: To BS 8204-1 or -2.
- Measurement: From underside of a 2 m straightedge (between points of contact) placed anywhere on surface and using a slip gauge.

315 SURFACE REGULARITY OF CONCRETE FLOORS TO BS 8204 - TOLERANCE CLASS SR3.
- Location: Lower ground floor slab.
- Abrupt changes: 10 mm maximum.

316 SURFACE REGULARITY OF CONCRETE FLOORS TO BS 8204 - TOLERANCE CLASS SR2
- Location: All slabs above lower ground floor level.
- Abrupt changes: 5 mm.

430 SURFACE CRACKING
- Method of measurement: To be proposed by contractor.
- Critical crack width: 0.3 mm.
- Action: Should cracks occur that are wider than the critical crack width:
  - Survey: Frequency and extent of such cracks and investigate cause.
  - Report: Findings together with recommendations for rectification.

E10 MIXING/ CASTING/ CURING IN SITU CONCRETE

To be read with Preliminaries/ General conditions and in conjunction with the Planning Stage Design Statement by MBP.

CONCRETE

101 SPECIFICATION
- Concrete generally: To BS EN 206-1 and BS 8500-2.
- Other requirements: For concrete in the ground, requirements for concrete quality in special digest 1:2005 take precedence over those in BS 8500-1.
- Exchange of information: Provide concrete producer with information required by BS 8500-1, clauses 4 and 5.

106 DESIGNATED CONCRETE FOR ALL RC STRUCTURES
- Designated concrete: RC 32/40.
- Reinforcement/ embedded metal: YES.
- Aggregates:
- Size (maximum): 20 mm.
- Other requirements for admixtures: An accelerator or retarder may be used.

110 BASIC DESIGNATED CONCRETE FOR MASS CONCRETE BLINDING/FILLING
- Designation: GEN1.
- Coarse recycled aggregates: No special requirements.
- Consistence class: S3.
- Additional requirements: Submit proposals.

125 SUBSTITUTION OF STANDARDIZED PRESCRIBED CONCRETE FOR DESIGNATED CONCRETE
- General: Conform to BS 8500-2, clause 8.
- Substitution: In accordance with BS 8500-1, table A.7.
- Proposals: Submit for each substitution, stating reasons.
- Site mixing: If standardized prescribed concretes are made on site conform to BS 8000-2.1, subsections 2, 3 and 4.

132 DESIGNED CONCRETE FOR LINER WALLS AND BASEMENT SLAB WITH WATERPROOF ADDITIVE
- Reinforcement/ embedded metal: Yes.
- Compressive strength class (cylinder/ cube): C 32/40.
- Target density (oven-dry): Normal.
- Aggregates:
  - Size (maximum): 20 mm.
  - Type/ Density: Normal weight.
  - Recycled coarse aggregates: RCA Permitted subject to acceptance by the waterproof additive manufacturer (see below).
  - Other requirements: None.
- Design chemical class: AC-1.
- Limiting values for composition:
  - W/c ratio (maximum): 0.45.
  - Cement/ Combination content (minimum): In accordance with the waterproof additive manufacturer's requirements.
  - Cement/ Combination content (maximum): In accordance with the waterproof additive manufacturer's requirements.
  - Air content (minimum): No requirement.
- Consistence class: Contractor's choice/ In accordance with the waterproof additive manufacturer's requirements.
- Cement/ Combinations: II subject to waterproof additive manufacturer's requirements.
- Chloride class: 0.4.
- Admixtures: Waterproof additive by Pudlo/Cementaid or similar approved; other admixtures permitted subject to selected waterproof additive manufacturer's approval.
- Colour: Not required.
- Other requirements: None.

MATERIALS, BATCHING AND MIXING

215 READY-MIXED CONCRETE
- Production plant: Currently certified by a body accredited by UKAS to BS EN ISO/IEC 17065 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.

218 SITE MIXED CONCRETE
- Batching by mass:
  - Restrictions: Limit to mass concrete underpin, mass fill & blinding.
  - Accuracy of measuring devices: To BS EN 206-1, clause 9.6.2.2.

  Tolerances for quantity of constituent material: To BS EN 206-1, table 21.
- Batching by volume:
  - Restrictions: None.
- Mixing: To BS 8000-2.1, subsections 2, 3 and 4.

221 INFORMATION ABOUT PROPOSED CONCRETES
- Submit when requested:
  - Details listed in BS 8500-1, clause 5.2.
  - Additional information: None.

225 CHANGES TO SPECIFICATION
- Changes to specification of fresh concrete (outside concrete producer's responsibility): Prohibited.

230 INTERRUPTION OF SUPPLY DURING CONCRETING
- Elements without joints: Where elements are detailed to be cast in a single pour without joints, make prior arrangements for a back-up supply of concrete.
- Elsewhere:
  - Preparation: Manage pour to have a full face, and have materials available to form an emergency construction joint while concrete can still be worked.
  - Before pour is completed: Submit location and details of joint, make proposals for joint preparation.

310 RECYCLED AGGREGATE
- Standard: To BS 8500-2, clause 4.3.
- Type: Submit proposals.
- Source: Submit proposals.

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

418 PROPRIETARY ADMIXTURE
- Type: Superplastet SR and Everdure Caltite.
  - Manufacturer: Cementaid.
  - Special requirements: to be used strictly in accordance with manufacturer's instructions.

490 PROPERTIES OF FRESH CONCRETE
- Adjustments to suit construction process: Determine with concrete producer. Maintain conformity to the specification.

PROJECT TESTING/ CERTIFICATION

505 PROJECT TESTING OF CONCRETE - GENERAL
- Testing: To BS EN 206-1, Annex B and BS 8500-1, Annex B.
  - Non conformity: Obtain instructions immediately.
- Recording: Maintain complete correlated records including:
  - Concrete designation.
  - 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.
- Tests:
  - Sampling: One sample per 20 m^3.

508 REGULAR PROJECT TESTING
- Tests: Compressive strength.
- Sampling:
  - Point: At point of placing.
  - Rate: one sample per 20 m^3.
- Other requirements: None.

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

550 BROKEN CUBES FROM FAILED STRENGTH 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.

PLACING/ COMPACTING/ CURING AND PROTECTING

610 CONSTRUCTION/ SEQUENCE/ TIMING REQUIREMENTS
- Maximum pour sizes to be in accordance with Cementaid requirements.
- Contractor to submit sequence proposals as part of their method statement.

620 TEMPERATURE OF CONCRETE
- Application: Basement raft slab.
- Objective: Limit maximum temperature of concrete to minimize cracking during placing, compaction and curing. Take account of:
  - High temperatures and steep temperature gradients: Prevent build-up during first 24 hours after casting. Prevent coincidence of maximum heat gain from cement hydration with high air temperature and/ or solar gain.
  - Rapid changes in temperature: Prevent during the first seven days after casting.
- Proposals for meeting objective: Submit.

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
- Location of joints: To be part of contractor's method statement.
- Preparation of joint surfaces: Remove surface laitance and expose aggregate by lightly brushing and spraying. Joint surface to be clean and damp immediately before placing fresh concrete.

648 ADVERSE TEMPERATURE CONDITIONS
- Requirement: Submit proposals for protecting concrete when predicted ambient temperatures indicate risk of concrete freezing or overheating.

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.
- Timing of inspections: When fixing of reinforcement is complete.

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), unless otherwise specified. 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.

810 CURING GENERALLY

- Requirement: Keep surface layers of concrete moist throughout curing period, including perimeters and abutments, by either restricting evaporation or continuously wetting surfaces of concrete.
  - 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.

815 ADDITIONAL CURING REQUIREMENT – WATER CURING

- Commencement of water curing: As soon as practicable after placing and compacting concrete.
  - Surfaces covered by formwork: Expose to water curing as soon as practicable.
  - Top surfaces: Cover immediately with impermeable sheeting to prevent evaporation before commencement of water curing.
- Water curing: Wet surfaces continuously throughout curing period.
  - Select methods from:

  Mist spray.

  Wet hessian covered with impermeable sheeting.

820 CURING PERIODS

- General: Curing periods are in days (minimum).
  - Definition of 't': The average surface temperature of concrete in degrees Celsius during the curing period.
- Curing periods for concrete made using CEM1 strength class 42.5 or 52.5, or SRPC class 42.5:
  - Drying winds or dry, sunny weather (relative humidity < 50%): 80/ (t + 10).
  - Intermediate conditions (relative humidity between 50 and 80%): 60/ (t + 10).
  - Damp weather, protected from sun and wind (relative humidity > 80%): NR.
- Curing periods for concrete made using cements listed in BS 8500-1, table A.6 except for those listed above and for supersulfated cement:
  - Drying winds or dry, sunny weather (relative humidity < 50%): 140/ (t + 10).
  - Intermediate conditions (relative humidity between 50 and 80%): 80/ (t + 10).
  - Damp weather, protected from sun and wind (relative humidity > 80%): NR.
- Curing periods for concretes using admixtures or other types of cements/ combinations: Submit proposals.
- Other requirements: None.

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 and in conjunction with the Planning Stage Design Statement by MBP.

GENERALLY/ PREPARATION

110 LOADINGS
- Requirement: Design and construct formwork to withstand the worst combination of the following:
  - Total weight of formwork, reinforcement and concrete.
  - Construction loads including dynamic effects of placing, compacting and construction traffic.
  - Wind and snow loads.

132 PROPPING
- General: Prevent deflection and damage to the structure. Carry down props to bearings strong enough to provide adequate support throughout concreting operations.
- Method statement: Submit proposals for prop bearings and sequence of propping/ re-propping and back-propping.
  - Timing of submission: To be agreed between the permanent works designer and the temporary works coordinator.

145 PERMANENT FORMWORK
- Location and materials: See Section G30.

170 WORK BELOW GROUND
- Casting vertical faces of footings, bases and slabs against faces of excavation: Obtain consent.
- Casting walls against faces of excavation: Use formwork on both sides.

CONSTRUCTION

310 ACCURACY
- General requirement for formwork: Accurately and robustly constructed to produce finished concrete in the required positions and to the required dimensions.
- Formed surfaces: Free from twist and bow (other than any required cambers).
- Intersections, lines and angles: Square, plumb and true.

320 JOINTS IN FORMS
- Requirements including joints in form linings and between forms and completed work:
  - Prevent loss of grout, using seals where necessary.
  - Prevent formation of steps. Secure formwork tight against adjacent concrete.

330 INSERTS, HOLES AND CHASES
- Positions and details:
  - Dimensioned on drawings provided on behalf of the Employer: Do not change without consent.
  - Undimensioned or from other sources: Submit proposals.
- Positioning relative to reinforcement: Give notice of any conflicts well in advance of placing concrete.
- Method of forming: Fix inserts or box out as required. Do not cut hardened concrete without approval.

340 KICKERS
- Method statement: Submit proposals including means of achieving quality of concrete consistent with that specified for the column or wall.
  - Kicker height : 100 mm.

350 FORM TIES
- Metal associated with form ties/ devices: Prohibited within cover to reinforcement. Compatible with reinforcement metal.

361 FORM TIES FOR WATER RESISTANT CONCRETE
- General: Maintain water resistance of construction –.
- Tie type and sealing system: refer to Cementaid standard details.

470 RELEASE AGENTS
- General: Achieve a clean release of forms without disfiguring the concrete surface.
- Product types: Compatible with formwork materials, specified formed finishes and subsequent applied finishes. Use the same product throughout the entire area of any one finish.
- Protection: Prevent contact with reinforcement, hardened concrete, other materials not part of the form face, and permanent forms.

480 SURFACE RETARDERS
- Use: Obtain approval.
- Reinforcement: Prevent contact with retarder.

STRIKING

510 STRIKING FORMWORK
- Timing: Prevent any disturbance, damage or overloading of the permanent structure.

521 MINIMUM PERIOD FOR RETAINING FORMWORK/ TEMPORARY SUPPORTS IN POSITION
- Concrete strength at time of formwork removal (minimum): 20 N/mm^2
- Assumptions: None.
  - Before removing formwork: Submit proposals if assumptions will not be realised.
- Method to be used in assessing early age strength of concrete: Cube testing.

FORMED FINISHES

620 PLAIN SMOOTH FINISH – ALL CAST SURFACES
- Finish: Even with panels arranged in a regular pattern as a feature of surfaces to be left exposed in the permanent condition.
- Permissible deviation of surfaces:
  - Sudden irregularities (maximum): 5 mm.
  - Gradual irregularities when measured from the underside of a 1 m straightedge, placed anywhere on surface (maximum): 5 mm.
- Variations in colour:
  - Permitted: Those caused by impermeable form linings.
  - Not permitted: Discoloration caused by contamination or grout leakage.
- Surface blemishes:
  - Permitted: Blowholes less than 10 mm in diameter and at an agreed frequency.
  - Not permitted: Voids, honeycombing, segregation and other large defects.
- Formwork tie holes: In a regular pattern and filled with matching mortar.

E30 REINFORCEMENT FOR IN SITU CONCRETE

To be read with Preliminaries/ General conditions and in conjunction with the Planning Stage Design Statement by MBP.

REINFORCEMENT

110 QUALITY ASSURANCE OF REINFORCEMENT
- Standards:
  - Reinforcement: To BS 4449, BS 4482, BS 4483 or BS 6744.
  - Cutting and bending: To BS 8666.
- Source of reinforcement: Companies holding valid certificates of approval for product conformity issued by the UK Certification Authority for Reinforcing Steels (CARES).

150 RIBBED BAR REINFORCEMENT
- Standard: To BS 4449.
  - Strength grade: B500B.

WORKMANSHIP

310 CUTTING AND BENDING REINFORCEMENT
- General: To schedules and to BS 8666.
- Bending on site, including minor adjustments: Not permitted.

320 PROTECTION OF REINFORCEMENT
- Dropping from height, mechanical damage and shock loading: Prevent.
- Cleanliness of reinforcement at time of pouring concrete: Free from corrosive pitting, loose millscale, loose rust and contaminants which may adversely affect the reinforcement, concrete, or bond between the two.

410 LAPS OR SPLICES
- Details not shown on drawings: Obtain instructions.

425 LAPS NOT DETAILED ON DRAWINGS
- Laps in bar reinforcement (minimum): 40 x bar diameter.
- Laps in mesh reinforcement (minimum): 40 x bar diameter.
  - Laps at corners: Avoid four layer build-up.

451 FIXING REINFORCEMENT
- Standard: To BS 7973-1 and -2.
- Installation: In addition to any spacers and chairs shown on drawings or schedules, provide adequate support, tie securely and maintain the specified cover.
- Tying:
  - Wire type: 16 gauge black annealed. Use stainless steel wire for stainless steel reinforcement.
  - Ends of tying wire: Prevent intrusion into the concrete cover. Remove loose ends.
- Compatibility of metals: Prevent contact between ordinary carbon steel and stainless or galvanized reinforcement.

470 TOLERANCES ON COVER
- Definition of nominal cover to BS 8500-1: Minimum cover plus tolerance for fixing.
  - Tolerance (maximum): walls and slabs 10mm.
- Checking specified cover dimensions: Before concreting check that cover dimensions will be achieved.

480 NOMINAL COVER TO REINFORCEMENT
- Top face: 30 mm, but varies for underground structures.
- Formed faces: 30 mm, but varies for underground structures.

E41 WORKED FINISHES TO IN SITU CONCRETE

To be read with Preliminaries/ General conditions and in conjunction with the Planning Stage Design Statement by MBP.

150 FINISHING

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

P31 HOLES, CHASES, COVERS AND SUPPORTS FOR SERVICES

To be read with Preliminaries/ General conditions and in conjunction with the Planning Stage Design Statement by MBP.

EXECUTION

620 HOLES AND CHASES IN IN SITU CONCRETE
- Cast in: Holes larger than 10 mm diameter and chases.
- Cutting and drilling:
  - Permitted for holes not larger than 10 mm diameter.
  - Not permitted for holes larger than 10 mm diameter except as indicated on drawings.

630 HOLES AND CHASES IN PRECAST CONCRETE
- Cutting and drilling: Not permitted except as indicated on drawings.

650 HOLES, RECESSES AND CHASES IN MASONRY
- Locations: To maintain integrity of strength, stability and sound resistance of construction.
- Sizes: Minimum needed to accommodate services.
  - Holes (maximum): 300 x 300 mm.
- Walls of hollow or cellular blocks: Do not chase.
- Walls of other materials:
  - Vertical chases: No deeper than one third of single leaf thickness, excluding finishes.
  - Horizontal or raking chases: No longer than 1 m. No deeper than one sixth of the single leaf thickness, excluding finishes.
- Chases and recesses: Do not set back to back. Offset by a clear distance at least equal to the wall thickness.
- Cutting: Do not cut until mortar is fully set. Cut carefully and neatly. Avoid spalling, cracking and other damage to surrounding structure.

690 INSTALLING PIPE SLEEVES
- Sleeves: Fit to pipes passing through building fabric.
- Material: Match pipeline.
- Size: One or two sizes larger than pipe to allow clearance.
- Finish: Install sleeves flush with building finish. In areas where floors are washed down, install protruding 100 mm above floor finish.
- Masking plates: Fit at visible penetrations, including through false ceilings of occupied rooms.

APPENDIX A

MBP PERFORMANCE SPECIFICATIONS FOR RC DETAILING

PERFORMANCE SPECIFICATION FOR DETAILING AND SCHEDULING OF REINFORCED CONCRETE ELEMENTS

To be read with Preliminaries/ General conditions and in conjunction with the specifications and Planning Design Statement by MBP.

Definitions: For the Structural Engineer read CA as necessary in the context.

1.0 GENERALLY

The contractor is required to carry out the detailing of reinforcement bars and the production of bar bending schedules for the works.

2.0 DESIGN

The Structural Engineer has carried out and is responsible for the design of all reinforced concrete elements, except for proprietary items, contractor-designed elements, or as otherwise provided for in the project specification.

3.0 INFORMATION PROVIDED BY THE ENGINEER

The Structural Engineer, or the relevant specialist sub-contractor for contractor-designed elements, will provide the following information:

- The design reinforcement requirements in the form of summary calculations and/or marked-up drawings.
- At the Structural Engineer's discretion, detailed sketches and/or drawings of specific areas where the reinforcement is deemed to be particularly critical.
- Where the Structural Engineer has special curtailment requirements they will be stated and/or shown on marked up drawings.

4.0 DRAWINGS

All drawings are to be A1size and generally to the following scales:

- Slabs & walls 1:50
- Beams 1:20
- Details to suit & ensure clarity.

Drawings are to be produced using CAD.

Contractor detailed reinforcement drawings are required for the following areas (refer also to drawings):

- In situ reinforced concrete capping beams, beams, columns, walls and all slabs.
- Reinforced structural toppings to profiled metal decks.
- Sundry in situ reinforced concrete items;

5.0 DETAILING

Detailing shall be carried out in accordance with all relevant British Standards and the recommendations given in "Standard method of detailing structural concrete", published by the Institution of Structural Engineers, unless instructed to the contrary by the Structural Engineer. The simplified curtailment rules given in BS8110 shall apply unless otherwise stated.
Starter bars are to be shown on the drawings referring to elements that are cast first, e.g. retaining wall starters are to be shown on the retaining wall base reinforcement drawing.

The contractor shall be free to detail the reinforcement to suit his proposed method of construction, however he should note the requirements in other parts of the Project Specification for seeking approval of his proposals in this respect.

6.0 PROGRAMME:

Prepare a programme for drawing production.
Submit programme to CA for agreement.

7.0 CHECKING AND APPROVALS:

A detailed check – by the contractor – for each drawing/schedule will be required by a person other than the originator. The checked drawing/schedule ("greened/redded" off) must be available for inspection by the Structural Engineer.
Submit reinforcement drawings to the Structural Engineer for a design check. Allow not less than 2 weeks for acceptance.

Specification Prepared by:

Name
Ezio Lauro
For Michael Barclay Partnership LLP

Specification Checked by:

Name (Principal)
Tony Hayes
Date: 20.06.16