APPENDIX 3C: GENERAL SPECIFICATION

E10 MIXING/ CASTING/ CURING IN SITU CONCRETE

CONCRETE

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

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.
- Mixing: If standardized prescribed concretes are made on site conform to BS 8000-2.1, subsections 2, 3 and 4.
- The contractor must forward design and reinforcement calculations for all structural concrete elements, prior to commencement.

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.

315 AGGREGATES FOR EXPOSED VISUAL CONCRETE
- Limitations on contaminants: Free from absorbent particles which may cause ‘popouts’, and other particles such as coal and iron sulfide which may be unsightly or cause unacceptable staining.
- Colour: Consistent.
- Supply: From a single source and maintained throughout the contract.
- Samples: Submit on request.

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

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.

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.

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.

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	140 t+10	180 t+10
Intermediate conditions t+10	100 t+10	140
Damp weather, protected from sun and wind t+10	100 t+10	100

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

Drying winds or dry, sunny weather	80 t+10	140 t+10
Intermediate conditions t+10	60 t+10	80
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

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.

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.

180 COLLAPSIBLE BOARD SUBSTRUCTURE FORMWORK:
- Where used for foundations, ground beams, etc. carefully wrap each board in 500 gauge polyethylene sheet to protect from ground water.
- Where used for ground slabs, lay boards on a level bed of dry sand, not less than 25 mm thick, then overlay with 500 gauge polyethylene sheet with lapped joints sealed with waterproof tape.
- Protect board from indentation by chairs and spacers by use of plates obtained from the board manufacturer.

181 COMPRESSIBLE BOARD SUBSTRUCTURE FORMWORK:
- Low density expanded polystyrene compressible fill.
- Where used for foundations, ground beams, etc. lay boards on a flat and even bed. If necessary, blind the bottom of the trench with fine granular fill or concrete.
- Vertical faces of trenches: Ensure that the boards are fully supported for the total depth and restrain the top edge of boards to prevent uplift during concreting. Securely fix all boards and pieces of board.
- Piled construction: Cut boards neatly round concrete piles.
- Protect boards from indentation by chairs and spacers using methods recommended by the board manufacturer.

200 UNDERSLAB SHEET INSULATION:
- 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.

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.

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.

E30 REINFORCEMENT FOR IN SITU CONCRETE

140 PLAIN BAR REINFORCEMENT: To BS 4449, Grade 250.

150 DEFORMED BAR REINFORCEMENT: To BS 4449, Grade 460.

210 FABRIC REINFORCEMENT: To BS 4483.

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 DBS
8666.

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.

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.

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.

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.

P30 TRENCHES/ PIPEWAYS/ PITS FOR BURIED ENGINEERING

SERVICES GENERALLY

110 ROUTES OF SERVICES BELOW GROUND
- Locations of new service runs and pipeducts: Submit proposals.
- Temporary marking: Indicate new service runs and pipeducts with 75 x 75 mm softwood posts painted white and projecting not less than 600 mm above ground level, or with clearly visible waterproof markings on hard surfaces.

130 TRENCHES
- Width: As small as practicable.
- Trench sides: Vertical.
- Trench bottoms: Remove mud, rock projections, boulders and hard spots. Trim level.
- Give notice: To inspect trench for each section of the work.

PIPEDUCTS

220 LAYING PIPEDUCTS
- General: Lay straight to line, true to gradient or level on an even continuous bed.
- Clearance between pipeducts where they cross (minimum): 50 mm.
- Drawlines: During laying, thread through pipeducts.
- Material, strength and length: As specified by service undertaker.
- Protection: Protect from ingress of debris. During construction, temporarily seal all exposed ends.

- Inspection: Before backfilling, allow service undertakers to inspect installation.
- Surround material: Lay and compact to 150 mm (minimum) above pipeduct crown.

230 BEDDING/ SURROUND FOR PIPEDUCTS - SELECTED AS-DUG MATERIAL
- As dug bed: Trim by hand to accurate gradients, replacing overdig with compacted spoil.
- Surround: Selected material, free from vegetable matter, rubbish, frozen soil and excluding lumps and stones retained on a 40 mm sieve. Thoroughly compact by hand in 150 mm maximum layers.

260 BACKFILLING GENERALLY
- Backfill from top of pipeduct surround: Material excavated from the trench.
- Backfilling: Lay and compact in 300 mm maximum layers. Do not use heavy compactors before backfill is 600 mm deep.

265 BACKFILLING UNDER ROADS AND PAVINGS
- Backfill from top of pipeduct surround: Granular sub-base material to Highways Agency Specification for highway works, clause 803 (Type 1).
- Backfilling: Lay and compact in 150 mm maximum layers.

280 WARNING MARKER TAPES
- Type: Continuous colour coded, heavy gauge polyethylene identification tapes.
- Installation: During backfilling.
- Location, depth, colour and markings: To requirements of service undertaker.

GAS COLLECTION SYSTEMS

530 VENT PIPES FOR DIESEL AND PETROL TANKS
- Material: galvanised steel
- Diameter: as per the recommendations in the blue book

P31 HOLES/ CHASES/ COVERS/ SUPPORTS FOR SERVICES

To be read with Preliminaries/ General conditions.

150 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.

185 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.

400 METER CABINETS
- Keys: Hand over to Employer at completion.

Q21 IN SITU CONCRETE ROADS/ PAVINGS/ BASES

To be read with Preliminaries/ General conditions.

TYPES OF PAVING

110 UNREINFORCED CONCRETE PAVING
- Granular sub-base: As section Q20 clause _____.
  - Thickness: _____ mm.
  - Separation membrane: Polyethylene sheet 125 micrometres thick. Lap edges 300 mm.
- Concrete:
  - Designated mix: _____ to BS 5328.
  - Nominal maximum size of aggregate: _____ mm.
  - Exposure condition: _____.
  - Workability: _____ mm slump.
- Minimum thickness of slab: _____ mm.
- Finish: _____.

115 REINFORCED CONCRETE PAVING
- Granular sub-base: As section Q20 clause _____.
  - Thickness: _____ mm.
  - Separation membrane: Polyethylene sheet 125 micrometres thick. Lap edges 300 mm.
  - Mesh reinforcement: To BS 4483 type _____ free from oil, dirt, loose rust and scale.
  - Concrete cover: _____ mm.
- Concrete:
  - Designated mix: _____ to BS 5328.
  - Nominal maximum size of aggregate: _____ mm.
  - Exposure condition: _____.
  - Workability: _____ mm slump.
  - Minimum thickness of slab: _____ mm.
- Finish: _____.

GENERAL/ PREPARATION

230 REINFORCEMENT QUALITY ASSURANCE
- Steel reinforcement to BS 4449 or BS 4483: Obtain from firms holding a certificate of approval issued under a product certification scheme obtained from a third party certification body with appropriate category 2 accreditation from the United Kingdom Accreditation Service (UKAS).

240 SUB-BASE PREPARATION
- Surface: Sound, free of debris, mud and soft spots, and suitably close textured.
- Levels and falls: Within specified tolerances:
  - Vehicular areas: ±20 mm.
  - Pedestrian areas: ±12 mm.
  - Drainage outlets: +0 to -10 mm of required finished level.
  - Kerbs and edgings: Complete, adequately bedded and haunched, and to required levels.

250 LAYING MESH REINFORCEMENT
- Flatness: Lay in flat sheets, straight and out of winding.
- Main reinforcement: Parallel to long axis of slab.
- Temporary support: Securely fix and support mesh during construction of slab.
- Lapping at joints:
  - Transversely: 450 mm (minimum).
  - Longitudinally: 300 mm (minimum).
- Extent of mesh: Fully within slab and:
  - 300 ±50 mm from slab edges.
  - 300 ±50 mm from centre line of transverse joints.
  - 125 ±25 mm from centre line of longitudinal joints.

- Alternative placing method: Mesh may be placed on top of first compacted layer of concrete, followed by top layer of concrete, placed within two hours of the first layer.

260 STEEL FORMWORK

- Side forms: Steel, drilled for dowel bars, free from warping and kinks.
- Fixing:
  - To required line, ±10 mm.
  - To required level, ±3 mm.
  - Locking plates: Use where necessary to ensure rigidity and prevent movement during laying and compaction of concrete.
  - Removal of forms: Six hours (minimum) after completing compaction. Treat exposed edges with waterproof compound.

265 TIMBER PERMANENT FORMWORK

- Side forms: Softwood board, drilled as required for dowel bars.
  - Size: 150 x 38 mm.
    - Fixing: Galvanized nails to 50 x 50 x 450 mm long softwood pegs driven into the ground at 1200 mm centres.
- Preservative treatment : As section Z12 and British Wood Preserving and Damp-Proofing Association Commodity Specification C4.
  - Type/ Desired service life: CCA or creosote, 20 years.

LAYING CONCRETE

310 TRANSPORTING CONCRETE

- General: Avoid contamination, segregation, loss of ingredients, excessive evaporation and loss of workability. Cover concrete during heavy rain.
- Truck mixers: Add water only under supervision, on site or at the central batching plant. Do not add water in transit.
  - Equipment: Clean immediately after use and whenever cement or aggregate is changed.
  - Placing: Use suitable walkways and barrow runs for traffic over reinforcement and freshly placed concrete.

320 LAYING CONCRETE GENERALLY

- Timing: Place as soon as practicable after mixing and while sufficiently plastic for full compaction. After discharge from the mixer do not add water or retemper.
- Temperature of concrete at point of delivery:
  - In hot weather (maximum): 30°C.
  - In cold weather (minimum): 5°C.
- Cold weather:
  - Do not use frozen materials.
  - Do not place concrete against frozen or frost covered surfaces.
    - Do not place concrete when air temperature is below 3°C on a falling thermometer. Do not resume placing until rising air temperature has reached 3°C.
- Surfaces on which concrete is to be placed: Free from debris and standing water.
- Placing in final position: Place in one continuous operation up to construction joints.
  - Do not place concrete simultaneously on both sides of movement joints.
  - Spreading: Spread and strike off with surcharge sufficient to obtain required compacted thickness.
  - Adjacent work: Form neat junctions and prevent damage. Keep clean all channels, kerbs, inspection covers, etc.

330 COMPACTING

- General: Fully compact concrete to full depth (until air bubbles cease to appear on the surface) especially around reinforcement, cast-in accessories, into corners and at joints.
  - Poker vibrators: Do not use to make concrete flow into position. Do not allow to come into contact with fabric reinforcement.
- Wet formed joint grooves: Rectify any irregularities by means of a vibrating float.

- Finish: A dense, even textured surface free from laitance or excessive water.
- Excess concrete: Remove from top of groove formers.

340 MANHOLE COVER/ GULLY GRATING FRAMES

- General: Set frames in independent concrete slabs placed over, but slightly larger than, exterior of manhole shaft or gully pot and any concrete surround.
- Positioning of joints in main slab: Set out so that manhole/ gully slabs are adjacent to a main transverse joint, wherever possible.
- Joints: Separate the independent slabs from main slabs with 25 mm thick joint filler board. Set board 20 mm below top of slab to form a sealing groove.

350 LEVELS

- Lines and levels of finished surface: Smooth and even, with regular falls to prevent ponding.
- Finished surfaces: Within ±6 mm of required levels (+6 -0 mm adjacent to gullies and manholes).

360 SURFACE REGULARITY

- General: Where appropriate in relation to the geometry of the surface, the variation in gap under a 3 m straightedge (with feet) placed anywhere on the surface to be not more than 5 mm.
- Sudden irregularities: Not permitted.

JOINTS

410 JOINTS GENERALLY

- Layout: All joints to be accurately located, straight and well aligned.
- Construction joints made at end of working day: Form as contraction joints.
- Modifications to joint design or location: Submit proposals.
- Temporary support: Prior to concreting, set formwork, dowel bars, tie bars, joint filler boards, sealing groove fillets and the like rigidly in position and support to prevent displacement. Maintain support until concrete has set.
- Keep clean:
  - Do not allow concrete to enter any gaps or voids in the formwork or to render the movement joints ineffective.
  - Do not allow concrete to impregnate or penetrate any materials used as compressible joint fillers.

420 TIE BARS

- Materials: Plain round mild steel to BS 4449 grade 250, 12 mm diameter x 1000 mm long, and free from oil, dirt, loose rust and scale.
- Finish: Middle 400 mm to be thoroughly cleaned and coated with a corrosion resistant flexible polymeric coating.
- Location: Place tie bars in longitudinal joints at 600 mm centres, centred on and perpendicular to line of joint. Position within middle third of the slab depth and not less than _____ mm below top crack inducer joint grooves.

430 DOWEL BARS

- Materials: Plain, round, mild steel to BS 4449, grade 250 and free from oil, dirt, loose rust and scale.
- Bar dimensions: _____.
- Location: Place dowel bars in movement joints at mid depth of the slab ±20 mm, centred on joint and at 300 mm centres. Bars to be parallel to longitudinal axis and top surface of the slab within a misalignment tolerance of ±3 mm per 300 mm length of dowel bar.
- Debonding of bars: Flexible plastics sleeve covering, not less than 0.6 mm thick.
- Bars in expansion joints: Provide 100 mm long plastics caps for free bar movement. Before placing concrete, ensure there is a space between the end of the cap and the end of the dowel bar 10 mm greater than the thickness of the joint filler board.

440 LONGITUDINAL CONSTRUCTION JOINTS

- Definition: Longitudunal joints are those parallel to the main axis of the paving.
- Standard: To Concrete Society Technical report 28.

- Form groove:
  - Size (minimum width x depth): 15 x 13 mm.
  - Preparation: Repair damaged edges of initially cast slab prior to forming groove.
    - Method: Fix preformed fillet against top edge of the initially cast slab before placing the adjacent slab. Remove when concrete is fully cured.
- Completion: Round upper edges of slabs at joints to 5 mm radius. Do not overwork concrete.

450 CONTRACTION JOINTS WITH SAWN GROOVE
- Standard: To Concrete Society Technical report 28.
- Temperature: Do not start sawing if temperature is falling.
- Sawn groove:
  - Timing: Cut as early as possible after the slab has been placed but without causing edges of groove to spall.
  - Width (minimum): 3 mm.
  - Depth: 3 mm per 10 mm depth of slab.
  - Depth (minimum): 50 mm.
- Upper portion of joint: Enlarge by sawing a groove:
  - Width (minimum): 13 mm.
  - Depth: _____.

470 EXPANSION JOINTS
- Joint filler board: _____.
  - Thickness: 25 mm.
    - Joint filler board must extend from underside of sealing groove fillet to full depth of slab to provide complete separation of adjacent slabs.
  - Accurately bore or punch holes in filler board to form a sliding fit for dowel bars.
  - Completion: Round upper edges of slabs at joints to 5 mm radius. Do not overwork concrete.

SURFACE FINISH

520 TAMPED FINISH
- Method: Use edge of a board or beam to give an even texture of parallel ribs.

530 BRUSHED FINISH
- Method: Brush in one direction at right angles to longitudinal direction of the slab, with a stiff bristle or wire brush not less than 450 mm wide.
- Texture depth: 1 mm with finished surface having an overall even texture.

CURING/ PROTECTION/ FINISHING

610 CURING
- General: Immediately after completion of surface treatment prevent evaporation from surface and exposed edges of slabs for a minimum period of seven days.
- Early curing:
  - Cover with waterproof sheeting held clear of surface. Seal against draughts at edges and junctions.
  - Do not apply sprayed compounds or sheets in direct contact until surface is in a suitable state and will not be marked.
- Coverings for curing: Contractor's choice of:
  - Impervious sheet material.
    - Resin based aluminized curing compound containing a fugitive dye and with an efficiency index of 90% when tested to BS 7542.
  - Sprayed plastics film.

640 HOT JOINT SEALING
- Sealant: To BS 2499-1, type _____.
  - Provide manufacturer's certificate of compliance in accordance with annex B.
- Application: Prepare joints and apply sealant to BS 2499-2.

650 COLD JOINT SEALING

- Sealant: To BS 5212-1, type _____.
  - Provide manufacturer's certificate of compliance in accordance with annex B.
- Application: Prepare joints and apply sealant in accordance with BS 5212-2.

660 PROTECTION
- Prevent damage to concrete:
  - From rain, indentation, physical damage, dirt, staining, rust marks and other disfiguration.
  - From thermal shock.
  - In cold weather, from freezing expansion of water trapped in pockets, etc.
  - By use as a building platform or for storing, mixing or preparing materials.

670 OPENING TO TRAFFIC
- Light vehicles: Seven days after placing concrete.
- Heavy vehicles: 28 days after placing concrete.

V90 ELECTRICAL INSTALLATION

210 GENERAL DESIGN
- Standards: To BS 7671 and the requirements of the electricity distributor.
- Design: Complete the design and detailing of the electrical installation.
  - Design information: Submit calculations, manufacturer's literature and drawings showing equipment positions and routes.
- Installation: Provide a safe, well insulated, earth protected system capable of serving the building.

220 INCOMING ELECTRICAL SUPPLY DESIGN
- Capacity: Determine the anticipated maximum demand of the installation.
  - Establishing the supply: Manage and liase with the electricity distributor to establish an incoming electricity supply.
- Incoming earthing arrangement: Establish with the electricity distributor.
  - Location: Coordinate the location of the incoming supply and establish the spatial requirements for the electricity distributor's equipment and metering.

230 LV DISTRIBUTION DESIGN
- Design: To cater for the complete arrangement.
- Spare capacity: 30%
- Equipment: Provide electrical supplies to equipment requiring power.

235 ARRANGEMENT OF PARTICULAR CIRCUITS
- Separation: Divide installation into separately controlled circuits if required

270 SMALL POWER DESIGN
- Small power outlets: Install to serve the equipment.
- Fixed equipment: Install supplies.

280 EARTHING AND BONDING DESIGN
- Earthing, main bonding, supplementary bonding and protective conductors: In accordance with BS 7430.

PRODUCTS

310 PRODUCTS GENERALLY
- Standard: To BS 7671.
- CE Marking: Required.
- Proposals: Submit drawings, technical information and manufacturer's literature.

320 DISTRIBUTION BOARDS AND CONSUMER UNITS
- Standards: To BS 5486-12, -13 and BS EN 60439-3. ASTA certified.
- Enclosure:
  - Material: steel
  - Ingress protection to BS EN 60529

- Lockable

340 CONDUIT, TRUNKING AND DUCTING
- Standard: To BS 50086-1.
- Type: Suitable for location and use.

342 STEEL CONDUIT AND FITTINGS _____
- Standards: To BS 4568-1 and BS EN 50086.

350 STEEL SURFACE TRUNKING SYSTEMS _____
- Standard: To BS 4678-1.
- Accessories and fittings: Factory made of the same material type, finish and thickness as cable trunking.

360 PROPRIETARY TRUNKING/ CABLE MANAGEMENT SYSTEMS
- Accessories and fittings: Factory made of the same material type, finish and thickness as cable trunking.

410 CABLES
- Standard: BASEC certified.

420 PROTECTIVE CONDUCTORS
- Type: Cable conductors with yellow/ green sheath.

430 ELECTRICAL ACCESSORIES
- Standard: To BS EN 60669-1.

580 EARTHING AND BONDING
- Earth electrodes: In accordance with BS 7430.
- Earth clamps: To BS 951.

585 EARTH BARS
- Separate earth bar: Required.
- Size: Determine.
- Material: Copper.

EXECUTION

610 EXECUTION GENERALLY
- Standard: To BS 7671.

630 CONNECTION TO INCOMING SUPPLY
- Main switchboard/ distribution board: Connect to main incoming metering equipment.

650 SWITCHGEAR INSTALLATION
- Clearance in front of switchgear (minimum): 1 m.
- Labelling: Permanently label each way, identifying circuit function, rating and cable size.

700 CABLES LAID DIRECTLY IN THE GROUND
- Cable bedding: 75 mm of sand.
- Backfilling: 75 mm of sand over cables, then as-dug material.
- Multiple cables in same trench: Set 150 mm apart.
- Cables below roads and hardstandings: Duct, derate if longer than 10 m.

710 CABLES ENTERING BUILDINGS FROM BELOW GROUND
- Pipeducts: Seal at both ends.
- Proposals: Submit drawings.

720 CABLE TRAY INSTALLATION
- Support: Submit proposals.

- Access: Provide space encompassing cable trays to permit access for installing and maintaining cables.
- Supports and fasteners: Avoid contact between dissimilar metals. Use corrosion resistant components in locations where moisture may occur.
- Cutting: Along an unperforated line. Minimize. Make good edges. Treat surface as the tray.

730 CABLE BASKET INSTALLATION

- Support: Submit proposals.
  - Access: Provide space encompassing cable basket to permit access for installing and maintaining cables.
- Fittings: Side action bolt croppers.
  - Supports and fasteners: Avoid contact between dissimilar metals. Use corrosion resistant components in locations where moisture may occur.

740 CONDUIT AND FITTINGS

- Fixing: Fix securely. Fix boxes independently of conduit.
  - Location: Position vertically and horizontally in line with equipment served and parallel with building lines. Locate where accessible.
- Jointing:
  - Number of joints: Minimize.
  - Lengths of conduit: Maximize.
  - Cut ends: Remove burrs and plug during building works.
  - Movement joints in structure: Manufactured expansion coupling.
    - Threaded steel conduits: Tightly screw to ensure electrical continuity, with no thread showing.
    - Conduit connections to boxes and items of equipment, other than those with threaded entries: Earthing coupling/ male brass bush and protective conductor.
  - Changes of direction: Site machine-formed bends, junction boxes and proprietary components. Do not use elbows or tees. Alternatively, use conduit boxes.
- Connections to boxes, trunking, equipment and accessories: Screwed couplings, adaptors, connectors and glands, with rubber bushes at open ends.
- Mounting and support: _____ .

745 CONDUIT IN CONCRETE

- Fixing: Fix conduit securely to reinforcement. Fix boxes to formwork to prevent displacement.

748 DRAINAGE OF CONDUIT

- Drainage outlets: Locate at lowest points in conduit installed externally, and where condensation may occur.

750 INSTALLING TRUNKING/ DUCTING/ CABLE MANAGEMENT SYSTEMS

- Positioning: Accurate with respect to equipment served and parallel with other services, and where relevant, floor level and other building lines.
- Access: Provide space encompassing cable trunking to permit access for installing and maintaining cables.
- Jointing:
  - Number of joints: Minimize.
  - Lengths of conduit: Maximize.
    - Steel systems: Mechanical couplings. Do not weld. Fit a copper link at each joint to ensure electrical continuity.
- Movement: Fix securely. Restrain floor mounted systems during screeding.
- Junctions and changes of direction: Proprietary jointing units.
- Cable entries: Fit grommets, bushes or liners.
  - Protection: Fit temporary blanking plates. Prevent ingress of screed and other extraneous materials.
- Service outlet units: Fit when cables are installed.

800 CABLE ROUTES

- Cables generally: Conceal wherever possible.

- Concealed cable runs to wall switches and outlets: Align vertically with the accessory.
- Exposed cable runs: Submit proposals.
- Orientation: Straight, vertical and/ or horizontal and parallel to walls.
- Distance from other services running parallel: 150 mm minimum.

810 INSTALLING CABLES

- General: Install cables neatly and securely. Protect against accidental damage, adverse environmental conditions, mechanical stress and deleterious substances.
- Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.
- Jointing: At equipment and terminal fittings only.
- Cables passing through walls: Sleeve with conduit bushed at both ends.
- Cables surrounded or covered by insulation: Derate.

811 CABLES IN PLASTER

- Protection: Cover with galvanized steel channel nailed to substrate.

812 CABLES IN VERTICAL TRUNKING/ DUCTS

- Support: Pin racks or cleats at each floor level or at 5 m vertical centres, whichever is less.
- Heat barrier centres (maximum): 5 m.
- Heat barriers: Required except where fire resisting barriers are not provided.

813 CABLES IN ACCESSIBLE ROOF SPACES

- Cables running across ceiling joists: Fix to timber battens which are nailed to joists.

820 ARMOURED CABLE

- Temperature: Do not start installation if cable or ambient temperature is below 0°C, or has been below 0°C during the previous 24 h.
- Galvanized steel guards: Fit where cables are vulnerable to mechanical damage.
- Earthing: Bond armour to equipment and main earthing system.
- Connections to apparatus: Moisture proof, sealed glands and PVC shrouds.

825 PVC SHEATHED CABLE

- Temperature: Do not install cables if ambient temperature is below 5°C.

840 ELECTRICAL ACCESSORIES AND EQUIPMENT

- Location: Coordinate with other wall or ceiling mounted equipment.
- Positioning: Accurately and square to vertical and horizontal axes.
- Alignment: Align adjacent accessories on the same vertical or horizontal axis.
- Mounting heights (finished floor level to underside of equipment/ accessory): _____ .

845 FINAL CONNECTIONS
- Size: Determine.
- Cable: Heat resisting white flex.
- Length: Allow for equipment removal and maintenance.

850 MULTIGANG SWITCHES
- General: Connect switches so that there is a logical relationship with luminaire positions. Fit blanks to unused switch spaces.
- Segregation: Internally segregate each phase with phase barriers and warning plates.

860 INSTALLING LUMINAIRES
- Supports: Adequate for weight of luminaire.
- Locations: Submit proposals.

865 INSTALLING EMERGENCY LUMINAIRES
- Permanent electrical supplies: Derive from adjacent local lighting circuit.
- Charge indicator: Position in a conspicuous location.

880 INSTALLING EARTH BARS
- Location: At incoming electrical service position.
- Mounting: Wall mounted on insulated supports.

890 LABELLING
- Identification and notices:
  - Standards: To BS 5499-5 and BS 5378-2.
  - Equipment: Label when a voltage exceeding 230 V is present.
  - Distribution boards and consumer units: Card circuit chart within a reusable clear plastic cover. Fit to the inside of each unit. Include typed information identifying the outgoing circuit references, their device rating, cable type, size, circuit location and details. Label each outgoing way corresponding to the circuit chart.
- Sub-main cables: Label at both ends with proprietary cable marker sleeves.

895 ENGRAVING
- Metal and plastic accessories: Engrave, indicating their purpose.
- Emergency lighting test key switches: Describe their function.
- Multigang light switches: Describe the luminaire arrangement.

COMPLETION

910 FINAL FIX
- Accessory faceplates, luminaires and other equipment: Fit after completion of building painting.

915 CLEANING
- Electrical equipment: Clean immediately before handover.
- Equipment not supplied but installed and electrically connected: Clean immediately before handover.

920 INSPECTION AND TESTING
- Standard: To BS 7671.
- Notice before commencing tests (minimum): 24 hours.
- Labels and signs: Fix securely before system is tested.

- Inspection and completion certificates: Submit.
  - Number of copies: 3

990 DOCUMENTATION

- Timing: Submit at practical completion.
- Contents:
  - Full technical description of each system installed.
    - Manufacturer’s operating and maintenance instructions for fittings and apparatus.
  - Manufacturer’s guarantees and warranties.
    - As-installed drawings showing circuits and their ratings and locations of fittings and apparatus.
  - List of normal consumable items.