Structural Engineering Specification

Defence Infrastructure Organisation

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Quality information

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D20
Excavating and filling

Generally/the site

145 Variations in ground water level

1. Give notice: If levels encountered are significantly different from levels in the site investigation report or previously measured.

150 Existing services, features and structures

1. Services: See Enabling Works Specification.
2. Site features to be retained: See Enabling Works Specification.
3. Structures: See Enabling Works Specification.

Clearance/excavating

250 Permissible deviations from formation levels

1. Beneath mass concrete foundations: ±25 mm.

255 Accuracy – linear dimensions

1. Permissible deviations from linear dimensions generally: ± 25mm.

260 Inspecting formations

1. Give notice: Make advance arrangements for inspection of formations for foundations and filling formations.
    1.1. Notice (minimum): 3 days.
2. Preparation: Just before inspection remove the last 150 mm of excavation. Trim to required profiles and levels. Prior to filling, undertake photographic records of the excavation and email to AECOM for review.
    2.1. Loose material: Remove.
3. Seal: Within 4 hours of inspection, seal formations with blinding concrete.

267 Inspection of formations in shrinkable soils

1. Inspect formation: For signs of conducting and fine moisture absorbing roots.
2. Give notice: If significant quantities of roots are visible in the formation or in the bottom 75 mm of the walls of the excavation.

270 Foundations generally

1. Give notice if
    1.1. A natural bearing formation of undisturbed subsoil is not obtained at the depth shown on the drawings.
    1.2. The formation contains soft or hard spots or highly variable material.

310 Unstable ground

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

330 Unrecorded features

1. 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

1. Excavation taken wider than required.
    1.1. Backfill: As instructed
2. Excavation taken deeper than required.
    2.1. Backfill: Under foundations: Concrete grade C30/37.

Disposal of materials

410 Excavated topsoil storage

1. Storage: Stockpile in temporary storage heaps on site.

441 Surplus subsoil

1. Excavated material: Stockpile in temporary storage heaps.
2. Retained material: Spread and level surplus subsoil on site.
    2.1. Locations: As agreed with the Kenyan Defence Force.
    2.2. Protected areas: Do not raise soil level within root spread of trees that are to be retained.

450 Water

1. Generally: Keep all excavations free from water until:
    1.1. Formations are covered.
    1.2. Below ground constructions are completed.
2. Removal of water: Provide temporary drains, sumps and pumping as necessary. Do not pollute watercourses with silt laden water.

454 Ground water level, springs or running water

1. Give notice: If it is considered that the excavations are below the water table.
2. Springs/ Running water: Give notice immediately if encountered.

457 Pumping

1. General: Do not disturb excavated faces or stability of adjacent ground or structures.
2. Pumped water: Discharge without flooding the site or adjoining property.
3. Sumps: Construct clear of excavations. Fill on completion.

Filling

730 Blinding

1. Surfaces to receive sheet overlays or concrete:
2. Blind with
    2.1. Concrete where shown on drawings; or
3. 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.
4. Sand for blinding: To BS EN 12620, grade 0/4 or 0/2 (MP).
5. Permissible deviations on surface level: ± 25mm.

Ω End of Section

E05
In situ concrete construction generally

To be read with preliminaries/ general conditions.

235 Openings, inserts and fixings

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

290 Accuracy of construction

1. Setting out: To BS 5964-1.
2. Geometrical tolerances: BS EN 13670, Tolerance Class 1.
   2.1. Conflicts: Notwithstanding tolerances specified elsewhere, do not exceed requirements for compliance with the designated code of practice.
   2.2. Substitution of alternative requirements: Kenyan equivalent standard subject to AECOM review prior to work commencing on site.

300 Levels of structural concrete floors

1. Tolerances (maximum)
   1.1. Level of floor: ± 5mm

310 Surface regularity of concrete floors to BS 8204 - general

1. Standard: To BS 8204-1.
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

1. Description: SR2
2. Location: All ground floor areas directly above beam and block floors.

410 In situ concrete construction - supervision/ checking

1. Standard: To BS EN 13670, Execution Class 2

430 Surface cracking

1. Description: RC columns and beams.
2. Method of measurement: Graduated magnifying devices or feeler gauges.
3. Maximum crack width: 0.3 mm
4. Action: Should cracks occur that are wider than the maximum crack width:
   4.1. Survey: Frequency and extent of such cracks and investigate cause.
   4.2. Report: Findings together with recommendations for rectification.

610 Specially constructed sample

1. Location: Ambulance Parking.
2. Description: As shown on drawings.
3. Placing, compaction and curing of the concrete is identical to that proposed for the element or part of the building.
4. Inspection of samples: Give notice.

5. Commencement of related parts of the Works: Do not proceed until instructed.

Ω End of Section

E10
Mixing/casting/curing in-situ concrete

Concrete

101 Specification

1. Concrete generally: To BS 8500-2 and KS EAS 131-1:2008.
2. Exchange of information: Provide concrete producer with information required by BS 8500-1, clauses 4 and 5.

105 Designated concrete

1. Description: Foundations, topping to beam and block floor, RC beams and RC columns.
2. Designation: RC30/37
3. Fibres: Not required
4. Aggregates
    4.1. Size (maximum): 20 mm
    4.2. Coarse recycled aggregates: Not permitted.
5. Special requirements for cement/ combinations: In accordance with EAS 131-1:2008.
6. Consistence class: Contractor's choice
7. Chloride class: Normal
8. Admixtures: None
9. Additional mix requirements: Samples of proposed sand and aggregate are to be submitted for approval at least 30 days prior to construction.

Materials, batching and mixing

218 Site mixed concrete

1. Batching by mass
    1.1. Restrictions: None
    1.2. Accuracy of measuring devices: To KS EAS 131-1:2008.
        1.2.1. Tolerances for quantity of constituent material: To KS EAS 131-1:2008.
2. Batching by volume
    2.1. Restrictions: None
3. Mixing: To KS EAS 131-1:2008.

221 Information about proposed concretes

1. Submit when requested
    1.1. Details listed in BS 8500-1, clause 5.2.
    1.2. Additional information: Data concerning the anticipated rate of strength gain.

225 Changes to specification

1. Changes to specification of fresh concrete (outside concrete producer's responsibility): Submit proposals

230 Interruption of supply during concreting

1. 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.
2. Elsewhere

2.1. Preparation: Manage pour to have a full face, and have materials available to form an emergency construction joint while concrete can still be worked.

2.2. Before pour is completed: Submit location and details of joint, make proposals for joint preparation.

315 Aggregates for exposed visual concrete

1. 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.
2. Colour: Consistent.
3. Supply: From a single source and maintained throughout the contract.
4. Samples: Submit on request.

325 Materials for exposed visual concrete

1. Alterations to sources, types and proportions: Submit proposals.

415 Admixtures

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

490 Properties of fresh concrete

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

Project testing/certification

505 Project testing of concrete - general

1. Testing: KS EAS 132-1:2008.
   1.1. Nonconformity: Obtain instructions immediately.
2. Recording: Maintain complete correlated records including:
   2.1. Concrete designation.
   2.2. Sampling, site tests, and identification numbers of specimens tested in the laboratory.
   2.3. Location of the parts of the structure represented by each sample.
   2.4. Location in the structure of the batch from which each sample is taken.

507 Initial project testing of concrete

1. Description: RC 30/37.
2. Tests: Compressive strength Early age compressive strength testing at 3, 7 and 28 days.
3. Timing: Prior to construction of sample building.
4. Sampling
   4.1. Point: At site.
   4.2. Number of batches: As specified in KS EAS 131-1:2008.
   4.3. Number of samples from each batch: As specified in KS EAS 131-1:2008.

508 Regular project testing of concrete

1. Tests: Compressive strength
2. Sampling
   2.1. Point: At point of discharge from on-site production plant.
   2.2. Rate: As specified in KS EAS 131-1:2008
3. Other requirements: Cubes for early age strength testing to be stored under same conditions as concrete in members.

520 Testing laboratory

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

530 Tests results

1. Submission of reports: Within one day of completion of each test.
2. Reports on site: A complete set, available for inspection.

550 Broken cubes from failed strength tests

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

Placing/ compacting/ curing and protecting

640 Construction joints

1. Location of joints: As shown on AECOM drawings.
2. 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

1. Requirement: Submit proposals for protecting concrete when predicted ambient temperatures indicate risk of concrete freezing or overheating.

650 Surfaces to receive concrete

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

660 Inspection of surfaces

1. Notice: Give notice to allow inspections of reinforcement and surfaces before each pour of concrete.
    1.1. Period of notice: Obtain instructions.
2. Timing of inspections: When fixing of reinforcement is complete.

670 Transporting

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

680 Placing

1. Records: Maintain for time, date and location of all pours.
2. Timing: Place as soon as practicable after mixing and while sufficiently plastic for full compaction.
3. Temperature limitations for concrete: 30°C (maximum) and 5°C (minimum), unless otherwise specified. Do not place against frozen or frost covered surfaces.
4. Continuity of pours: Place in final position in one continuous operation up to construction joints. Avoid formation of cold joints.
5. Discharging concrete: Prevent uneven dispersal, segregation or loss of ingredients or any adverse effect on the formwork or formed finishes.
6. Thickness of layers: To suit methods of compaction and achieve efficient amalgamation during compaction.

7. 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

1. General: Fully compact concrete to full depth to remove entrapped air. Continue until air bubbles cease to appear on the top surface.
    1.1. Areas for particular attention: Around reinforcement, under void formers, cast-in accessories, into corners of formwork and at joints.
2. Consecutive batches of concrete: Amalgamate without damaging adjacent partly hardened concrete.
3. Methods of compaction: To suit consistence class and use of concrete.

720 Vibrators

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

810 Curing generally

1. Requirement: Keep surface layers of concrete moist throughout curing period, including perimeters and abutments, by either restricting evaporation or continuously wetting surfaces of concrete.
    1.1. Surfaces covered by formwork: Retain formwork in position and, where necessary to satisfy curing period, cover surfaces immediately after striking.
    1.2. Top surfaces: Cover immediately after placing and compacting. If covering is removed for finishing operations, replace it immediately afterwards.
2. Surface temperature: Maintain above 5°C throughout the specified curing period or four days, whichever is longer.
3. 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

1. Sheet coverings: Suitable impervious material.
2. Curing compounds: Selection criteria:
    2.1. Curing efficiency: Not less than 75% or for surfaces exposed to abrasion 90%.
    2.2. Colouring: Fugitive dye.
    2.3. Application to concrete exposed in the finished work: Readily removable without disfiguring the surface.
    2.4. Application to concrete to receive bonded construction/ finish: No impediment to subsequent bonding.
3. 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.

815 Additional curing requirement - water curing

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

2.1.2. Wet hessian covered with impermeable sheeting.

817 Curing class

1. Standard: To BS EN 13670 Curing class 2.

818 Curing periods generally

1. Minimum periods: When not otherwise indicated, to BS EN 13670, Annex F.8.5.

840 Protection

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

Ω End of Section

E20
Formwork for in-situ concrete

Generally/ preparation

110 Loadings

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

120 Formwork details

1. Provide the following: Submit formwork proposals for review.

132 Propping

1. General: Prevent deflection and damage to the structure. Carry down props to bearings strong enough to provide adequate support throughout concreting operations.
2. Method statement: Submit proposals for prop bearings.
   2.1. Timing of submission: Minimum of 30 days prior to construction.

Construction

310 Accuracy

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

315 Substructure formwork and underslab insulation

1. Cutting: Neat and accurate to edges, and around penetrations and downstands.
2. Laying: Tightly butted and fully supported on firm, even substrate.
3. Vertical faces: Stiffen as necessary to act as shutter.
4. Formwork/ insulation surfaces: Protect from indentation by spacers and other items.
5. Joints in formwork/ insulation and with edge structure and penetrations: Seal to prevent penetration of concrete.
6. Concrete placement: Restrain formwork/ insulation against movement.

320 Joints in forms

1. Requirements including joints in form linings and between forms and completed work.
   1.1. Prevent loss of grout, using seals where necessary.
   1.2. Prevent formation of steps. Secure formwork tight against adjacent concrete.

330 Inserts, holes and chases

1. Positions and details
   1.1. Dimensioned on drawings provided on behalf of the Employer: Do not change without consent.
   1.2. Undimensioned or from other sources: Submit proposals.
2. Positioning relative to reinforcement: Give notice of any conflicts well in advance of placing concrete.

3. Method of forming: Fix inserts or box out as required. Do not cut hardened concrete without approval.

350 Form ties

1. Metal associated with form ties/ devices: Prohibited within cover to reinforcement. Compatible with reinforcement metal.

470 Release agents

1. Use: All formwork
2. General: Achieve a clean release of forms without disfiguring the concrete surface.
3. 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.
4. Protection: Prevent contact with reinforcement, hardened concrete, other materials not part of the form face, and permanent forms.

Striking

510 Striking formwork

1. Timing: Prevent any disturbance, damage or overloading of the permanent structure.

521 Minimum period for retaining formwork/ temporary supports in position

1. Concrete strength at time of formwork removal (minimum): 50% of 28 day strength
2. Assumptions: Maturity of adjacent elements of structure is at least equal to element under consideration
   2.1. Before removing formwork: Submit proposals if assumptions will not be realised.
3. Method to be used in assessing early age strength of concrete: Submit proposals.

Formed finishes

613 Ordinary finish

1. Location: All RC beams and columns.
2. Finish: Faces fully compacted. Formed surfaces free from major blemishes and honeycombing. Steps at joints to be less than 5 mm.

Ω End of Section

E30
Reinforcement for in situ concrete

Reinforcement

110 Quality assurance of reinforcement

1. Standards
   1.1. Reinforcement: To BS 4449, BS 4482, BS 4483 or BS 6744.
   1.2. Cutting and bending: To BS 8666.
2. Source of reinforcement: Companies holding valid certificates of approval for product conformity issued by the UK Certification Authority for Reinforcing Steels (CARES) or Kenyan equivalent.

150 Ribbed bar reinforcement

1. Standard: To BS 4449.
   1.1. Strength grade: B500B or Kenyan equivalent.
   1.2. Supplier details: Submit proposals for approval of reinforcement supplier.

Workmanship

310 Cutting and bending reinforcement

1. General: To schedules and to BS 8666.
2. Bending on site, including minor adjustments: Submit proposals.

320 Protection of reinforcement

1. Dropping from height, mechanical damage and shock loading: Prevent.
2. Cleanliness of reinforcement at time of pouring concrete: Free from corrosive pitting, loose mill scale, loose rust and contaminants which may adversely affect the reinforcement, concrete, or bond between the two.

410 Laps or splices

1. Details not shown on drawings: Obtain instructions.

451 Fixing reinforcement

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

480 Nominal cover to reinforcement

1. Nominal cover: As specified on drawings.

510 Rust staining

1. Staining of surfaces of concrete which will be exposed to view in the finished work: Prevent.

520 Cover meter survey

1. Purpose of survey: To check positions of reinforcement and that the specified cover has been achieved.
2. Type of cover meter: A magnetic induction digital display type selected to suit arrangement and type of reinforcement.
   2.1. Use: In accordance with recommendations of BS 1881-204 and manufacturer as appropriate to yield accurate results.
   2.2. Surveyor: Experienced with cover meter surveys.
   2.3. Calibration: At the outset and thereafter regularly at 45 minute (maximum) intervals.
3. Locations for checking: Include columns, beams, cantilevers, slab soffits and all faces exposed to the weather in the finished structure.
4. Timing: As soon as practicable after casting.
   4.1. Notification: Give adequate notice.
5. Results: Submit. Notify immediately where specified cover has not been achieved.

Ω End of Section

E40
Designed joints in in situ concrete

To be read with preliminaries/ general conditions.

120 Construction/ movement joints generally

1. Accuracy: Position and form joints accurately, straight, well-aligned and truly vertical, horizontal or parallel with setting out lines of the building.
2. Modifications to joint design or location: Submit proposals.
3. Placing concrete to form movement joints.
    3.1. Maintain effectiveness of joints. Prevent concrete entering joints, penetrating or impregnating compressible joint fillers.
    3.2. Do not place concrete simultaneously on both sides of movement joints.

210 Formed joints

1. Forms/ stop ends generally: Rigid and grout-tight.
2. Forms/ stop ends for projecting continuity reinforcement: To accommodate bars or fabric without temporary bending or displacement.

230 Preparation of construction joints

1. Roughening of joint surfaces: Select from:
    1.1. Brushing and spraying: Remove surface laitance and expose aggregate finish while concrete is still green.
    1.2. Other methods: Submit proposals.
2. Condition of joint surfaces immediately before placing fresh concrete: Clean and damp.

Ω End of Section

F10
Brick/ block walling

Types of walling

355 Concrete common blockwork

1. Description: 100mm & 190mm thick blocks - KEBS Class A3
2. Blocks: To BS EN 771-3.
    2.1. Manufacturer: Kenya Builders and Concrete Company Ltd.
        2.1.1. Product reference: Solid Concrete Masonry Block
    2.2. Configuration: Group 1
    2.3. Compressive strength
        2.3.1. Mean value: 10.5 N/mm²
        2.3.2. Category: II
    2.4. Freeze/ thaw resistance: Frost-resistant.
    2.5. Recycled content: None permitted.
    2.6. Work sizes (length x width x height): 390x100x190 and 190x190x190.
        2.6.1. Tolerance category: D1
3. Mortar: As section Z21.
    3.1. Standard: To BS EN 998-2
    3.2. Mix: 1:3 masonry cement:sand
    3.3. Additional requirements: Submit samples of sand for approval.
4. Bond: As shown on AECOM drawings.

Testing

410 Compressive strength of mortar for each walling type

1. Testing authority: An approved laboratory
2. Test method: To BS EN 1015-11.
3. Preliminary tests procedure: As follows:
    3.1. Specimens
        3.1.1. Number of specimens: Six.
        3.1.2. Type: 40 x 40 x 160 mm prism.
        3.1.3. Preparation: At least six weeks before walling commences.
    3.2. Specimen testing: Half of specimens at seven days. Remainder at 28 days.
        3.2.1. Retarded mixes: Extend curing periods to include retardation period.
    3.3. Response to result: If mean compressive strength at 28 days is not within the range given below repeat tests with more suitable sand or next higher Mortar class.
4. Site tests procedure: As follows.
    4.1. Number of specimens: Six per 150m² of walling or per storey whichever the more frequent.
    4.2. Specimen types: As preliminary test, but prepared during construction.
    4.3. Specimen testing: Half of specimens at seven days. Remainder at 28 days.
        4.3.1. Retarded mixes: Extend curing periods to include retardation period.
5. Required test mean compressive strength at 28 days (N/mm²): To be within the following range:
    5.1. Walling type: Both 100mm thick and 190mm thick blocks.
        5.1.1. Preliminary tests minimum (N/mm²): 6.0
        5.1.2. Preliminary tests maximum (N/mm²): No value.

5.1.3. Site tests minimum (N/mm²): 6.0

5.1.4. Site tests maximum (N/mm²): No value.

6. Results: Submit.

Workmanship generally

440 Conditioning of concrete bricks/ blocks

1. Autoclaved concrete bricks/ blocks delivered warm from manufacturing process: Do not use.
2. Age of nonautoclaved concrete bricks/ blocks: Do not use until at least four weeks old.
3. Avoidance of suction in concrete bricks/ blocks: Do not wet.
   3.1. Use of water retaining mortar admixture: Submit details.

460 Mortar designations

1. Mix proportions: For a specified designation select a mix from the following:
   1.1. Designation (ii) (BS EN 998-2 class M6 equivalent)
      1.1.1. 1:½:4-5 (Portland cement:lime:sand with or without air entraining additive).
      1.1.2. 1:3 (masonry cement:sand containing Portland cement and lime in approximate ratio 1:1, and an air entraining additive).
      1.1.3. 1:2½-3½ (masonry cement:sand containing Portland cement and inorganic materials other than lime and air entraining additive).
      1.1.4. 1:3-4 (Portland cement:sand and air entraining additive).
2. Batching: Mix proportions by volume.
3. Mortar type: Continuous throughout any one type of masonry work.

500 Laying generally

1. Mortar joints: Fill vertical joints. Lay bricks, solid and cellular blocks on a full bed.
2. AAC block thin mortar adhesive and gypsum block adhesive joints: Fill vertical joints. Lay blocks on a full bed.
3. Bond where not specified: Half-lap stretcher.
4. Vertical joints in brick and concrete block facework: Even widths. Plumb at every fifth cross joint.

520 Accuracy

1. Courses: Level and true to line.
2. Faces, angles and features: Plumb.
3. Permissible deviations
   3.1. Position in plan of any point in relation to the specified building reference line and/ or point at the same level: ± 10 mm.
   3.2. Straightness in any 5 m length: ± 5 mm.
   3.3. Verticality up to 3 m height: ± 10 mm.
   3.4. Verticality up to 7 m height: ± 14 mm.
   3.5. Overall thickness of walls: ± 10 mm.
   3.6. Level of bed joints up to 5 m (brick masonry): ± 11 mm.
   3.7. Level of bed joints up to 5 m (block masonry): ± 13 mm.

535 Height of lifts in walling using cement-gauged or hydraulic lime mortar

1. Quoins and advance work: Rack back.
2. Lift height (maximum): 1.2 m above any other part of work at any time.
3. Daily lift height (maximum): 1.5 m for any one leaf.

560 Coursing blockwork

1. Gauge: Mortar joints to be a consistent 10mm thickness. Four block courses including bed joints to be 800mm.

635 Jointing

1. Profile: Consistent in appearance.

645 Accessible joints not exposed to view

1. Jointing: Struck flush as work proceeds.

690 Adverse weather

1. General: Do not use frozen materials or lay on frozen surfaces.
2. Air temperature requirements: Do not lay bricks/ blocks:
   - 2.1. In cement-gauged mortars when at or below 3°C and falling or unless it is at least 1°C and rising.
   - 2.2. In hydraulic lime:sand mortars when at or below 5°C and falling or below 3°C and rising, or as manufacturer's/ supplier's recommendations.
   - 2.3. In thin-layer mortars when outside the limits set by the mortar manufacturer.
3. Temperature of walling during curing: Above freezing until hardened.
4. Newly erected walling: Protect at all times from:
   - 4.1. Rain and snow.
   - 4.2. Drying out too rapidly in hot conditions and in drying winds.

Additional requirements for facework

760 Appearance

1. Brick/ block selection: Do not use units with damaged faces or arrises.
2. Cut masonry units: Where cut faces or edges are exposed cut with table masonry saw.
3. Quality control: Lay masonry units to match relevant reference panels.
   - 3.1. Setting out: To produce satisfactory junctions and joints with built-in features and components.
   - 3.2. Coursing: Evenly spaced using gauge rods.
4. Lifts: Complete in one operation.
5. Methods of protecting facework: Submit proposals.

Ω End of Section

G10
Structural steel framing

General requirements/ information

110 Contractor's design of joints

1. Description: Steel to steel joints.
2. Design concept: AECOM have provided the design intent for each connection. The contractor is permitted to provide alternative joint arrangements if these better suit their methods of fabrication.
3. Design responsibility: Design connections and detail steelwork and connections.
4. Structural requirements
    4.1. Design: Complete in accordance with the designated code of practice to satisfy specified performance criteria.
    4.2. Connections: Steel to steel joints.
5. Design and production information: Prepare structural calculations for review by AECOM. Allow 30 days prior to fabrication for AECOM to review and comment.

112 Contractor's design

1. Description: All steel members.
2. Design concept: AECOM have provided the design for each steel member.
3. Design responsibility: Design and detail members and joints to suit the conceptual layout detailed in the contract drawings.
    3.1. Other responsibilities: The Main Contractor, in conjunction with the steelwork fabricator, is to suggest section sizes that are readily available in Kenya.
4. Structural requirements
    4.1. Design: Complete in accordance with the designated code of practice to satisfy specified performance criteria.
5. Design and production information: Prepare structural calculations for review by AECOM. Allow 30 days prior to fabrication for AECOM to review and comment.

115 Design constraints – general

1. Members forming bracing systems or girders of lattice construction: Unless detailed or instructed otherwise, position so that their lines of action intersect at a point.
2. Bolts
    2.1. Diameter (minimum): 12 mm
    2.2. Number per connection (minimum): Two, unless otherwise indicated.
    2.3. Other requirements: Choose bolt dimensions to ensure that threads do not occur in shear plane of joint
3. Punching of bolt holes: Not permitted
4. Welds: At least 6 mm fillet
5. Other constraints: None

123 Drawings and calculations prepared by Contractor

1. Information required: Draft fabrication drawings.
2. General arrangement drawings: Submit before preparing calculations. Clearly identify:
    2.1. Individual steel members.
    2.2. Conflicts with other work.
    2.3. Proposed changes to contract drawings.
3. Member and joint calculations: Submit before preparing fabrication drawings.

125 Specification standard

1. Standard: Comply with latest edition of National Structural Steelwork Specification (NSSS) or equivalent Kenyan Standard.
   1.1. Document availability: For the duration of the work, at fabrication shop and on site.
2. References to Engineer in NSSS: For the purpose of this contract, interpret such references as being to the person named in section A10 as Consulting Structural Engineer.
   2.1. Exceptions: None

130 General steel sections and plates

1. Description: All open sections and plates.
2. Certification: Provide European Technical Assessment (ETA) with CE marking and a Declaration of Performance (DoP)
3. Standard: To BS EN 10025-2
4. Grade: S275J0
   4.1. Options: None
5. Source: Obtain steel from a source accredited to a national or internationally accepted quality standard.
6. Other requirements: None

135 Hollow steel sections

1. Description: All closed sections.
2. Certification: Provide European Technical Assessment (ETA) with CE marking and a Declaration of Performance (DoP)
3. Standard: To BS EN 10210-1
4. Grade: S275J0H
5. Source: Obtain steel from a source accredited to a national or internationally accepted quality standard.
6. Other requirements: None

Frame systems - Not Used

Cold-formed materials - Not Used

Fabrication

180 Notification of commencement

1. Notice: Give notice before fabrication is due to start.
   1.1. Period of notice (minimum): 30 days.

190 Marking

1. Identifying and recording materials and components: Submit details of proposed methods.
2. Location of marks
   2.1. Generally: Visible for checking after erection.
3. Steel to be blast cleaned, pickled, metal sprayed or galvanized: Marked so that subsequent treatment cannot obliterate the marking.

195 Hard stamping

1. Usage: Not permitted.

210 End connections

1. Angle web cleats: Project 10 mm beyond ends of simply supported members.

215 Hollow sections

1. Insides of sections: Debris and moisture removed before sealing ends and openings.

220 Access/ Ventilation holes in base plates

1. Base plates larger than 1 m²: Make 25 mm diameter holes as necessary for pressure grouting, escape of entrapped air or direct compaction of filling/ bedding material.

235 Shop inspection

1. Give notice: Before fabricating first batch of steelwork.
    1.1. Period of notice (minimum): 30 days.

240 Trial shop assembly

1. Component: First roof truss.
2. Give notice: Before commencing trial assembly.
    2.1. Period of notice (minimum): 30 days.

Welding

250 Welding procedures

1. Quality management systems: To BS EN ISO 3834-3.
2. Certification of welders: Provide in advance of any welding.
    2.1. Third party certification: To BS EN ISO 9606-1.
    2.2. Verification of welding procedures: Submit.
    2.3. Welding procedure qualification records: To BS EN ISO 15614-1.

255 Site welding

1. Usage: Permitted only where indicated on drawings, or as agreed in advance with AECOM.
2. Working conditions: Suitable and safe. Do not weld when surfaces are wet or when ambient temperature is below 0°C.

270 Additional welds

1. Welds (including tack welds) not indicated on drawings: Not permitted without approval.

Bolt assemblies

302 Non-preloaded bolt assemblies

1. Certification: Provide European Technical Assessment (ETA) with CE marking and a Declaration of Performance (DoP)
2. Designation: Hexagon head bolts to BS EN ISO 4014, grade B
    2.1. Threading: Full length
3. Nuts and washers: To suit property class of bolt, as NSSS, clause 2.4.4.
4. Coating applied by manufacturer: Submit proposals.
5. Other requirements: None

305 Proprietary anchors

1. Description: Steel to concrete connections.
2. Manufacturer: Hilti
    2.1. Product reference: As shown on drawings.
3. Certification: Provide European Technical Assessment (ETA) with CE marking and a Declaration of Performance (DoP)

4. Anchor type: Thin-walled sleeve expansion anchor.
5. Material: Stainless steel

370 Galvanized coating to bolt assemblies

1. Standard: To BS 7371-6.
2. Galvanizing: Applied by fastener manufacturer. Passivated and lubricated if no additional coatings are specified. Nuts tapped after galvanizing.
3. Use/location: As shown on drawings.

390 Sealed hollow sections

1. Holes: Sealed to prevent access of moisture.
   1.1. Method of sealing: Submit proposals.

Erection

405 Outline method of erection

1. Documentation: Provide Erection method statement for review by AECOM at least 30 days before commencement of steel erection on site.

410 Pre-erection checks

1. Scope: At least 7 days before proposed erection start date, check the following:
   1.1. Foundations and other structures to which steelwork will be attached: Accuracy of setting out.
   1.2. Holding down bolts: Position, protruding length, slackness and condition.
2. Inaccuracies and defects: Report without delay.
3. Permission to commence erection: Obtain.

420 Setting out

1. Permissible deviations: In addition to the requirements of the NSSS, add permissible deviations for different types of dimension and locations, as necessary.

425 Modifications

1. Steelwork: Do not modify without approval.
2. Temporary fabrication/ erection attachments: Do not remove.

432 Temporary support

1. Permanent bracing system
   1.1. Vertical: Masonry walls
   1.2. Horizontal: Steel roof bracing as detailed
2. Temporary bracing/ restraints: Provide as necessary until permanent bracing system is complete and sufficiently mature to carry loads and all connections have been made to the permanent system.
3. Elements to be supported: Roof trusses.
4. Bracing/ Restraints: Provide as necessary until permanent connection can be made to roof structure.
5. Forces and moments in temporary supports: Make an independent assessment.

440 Column bases

1. Levels: Adjust using steel shims or folding wedges no larger than necessary.
2. Location of shims/ wedges: Position symmetrically around perimeter of base plate. Do not use a single central pack.

3. Give notice: If space beneath any column base is outside specified limits for bedding thickness.
4. Accuracy of erection: Check, and correct errors before filling and bedding beneath bases and carrying out other adjacent work.

441 Mortar filling/ bedding of column bases

1. Mortar
   1.1. Cement: Portland cement BS EN 197-1 - CEM I 42.5 or 52.5.
      1.1.1. Certification: Provide European Technical Assessment (ETA) with CE marking and a Declaration of Performance (DoP)
   1.2. Fine aggregate: To BS EN 12620, grade 0/4 or 0/2 (MP).
2. Bedding thickness range: 25-50mm
3. Bolt pockets: Completely filled with neat cement slurry.
4. Spaces beneath base plates: Completely filled as follows:
   4.1. Spaces 0-25 mm deep: Neat Portland cement, CEM 1.
   4.2. Spaces 25-50 mm deep: 1:1 cement:fine aggregate mortar, just fluid enough to pour. Tamped well as filling proceeds.
   4.3. Spaces 50 mm and above: 1:2 cement:fine aggregate mortar, just damp, tamped well against properly fixed supports as filling proceeds.

Testing - Not Used

Protective coatings

510 Surfaces not to be coated

1. Location: None.
2. Other requirements: None

521 Alternative manufacturers

1. Short list of manufacturers: Obtain coating materials from one only of the following: Steelwork Fabricator to submit proposals for review by AECOM.
2. Selected manufacturer: Submit details before ordering materials.

535 Inspection of coating work

1. Work in progress: Permit coating manufacturer to inspect and take samples of products.
2. Notice: Give notice of dates for:
   2.1. Start of surface preparation and coating.
   2.2. Coated members or components leaving the works.
   2.3. Period of notice (minimum): 5 working days.

Protective coating systems

638 Shop priming

1. Description: Priming of steelwork
2. Use/ location: Internal steelwork.
3. Shop preparation
   3.1. Generally: Blast cleaning to BS EN ISO 8501-1, preparation grade Sa 2½.
   3.2. Welds/ edges/ areas with surface imperfections: To BS EN ISO 8501-3, preparation grade P1.
4. Primer: Two pack epoxy
   4.1. Manufacturer: Submit proposals
      4.1.1. Product reference: Submit proposals.

4.2. Dry film thickness: Submit proposals.

5. Special requirements: Stripe intermediate coat to external angles

643 Protective painting

1. Description: TO EXTERNAL STEELWORK
2. Use/ location: External steelwork.
3. Paint manufacturer: Submit proposals.
4. Shop preparation
   4.1. Generally: Blast cleaning to BS EN ISO 8501-1, preparation grade Sa 2½.
   4.2. Welds/ edges/ areas with surface imperfections: BS EN ISO 8501-3, preparation grade P1.
5. Corrosion protection
   5.1. Standard: To BS EN ISO 12944-1.
   5.2. Corrosivity category: C2
   5.3. Durability range: H
6. System Number: Submit proposals.
7. Other requirements: Apply all coats in shop

Preparation for painting

710 Offsite preparation and painting

1. Working area: Covered and properly lit, heated and ventilated.
2. Sequence of working: Select from the following and submit proposals:
   2.1. Fabricate, blast clean, prime.
   2.2. Blast clean, fabricate, remove flash rust with a light overall sweep blast, prime.
   2.3. Blast clean, apply weldable prefabrication primer, fabricate, prime.
3. Prefabrication primer (option 3): Type recommended by manufacturer of post fabrication primer.
   3.1. Thickness of post fabrication primer coat: May be reduced if and as recommended by manufacturer.
4. Surfaces inaccessible after assembly: Apply full treatment and coating system including, if necessary, local application of site coatings.

730 Preparation for site welding of shop painted steelwork

1. Method: Select from the following:
   1.1. Mask weld areas immediately after blast cleaning and before coating steelwork. If paint system comprises more than one coat, step each coat 30 mm back from edge of preceding coat and away from masked areas. Remove masking immediately before welding.
   1.2. Prepare and paint steelwork including weld areas. Grind off to bare steel around each weld area immediately before welding.

735 Treatment of site welded joints in painted steelwork

1. Preparation: After welding, and without delay, remove scale and weld spatter from weld areas. Remove traces of rust. Wash with clean water and allow to dry. Prime without delay.
2. Protective/ Decorative coatings: Apply to weld areas to match surrounding painted areas.

740 Bolted joints (other than preloaded joints)

1. Steelwork to be shop painted: Apply full shop specification to joint faces.
2. Steelwork to be erected with mill finish then site painted: Before erection, prepare and prime joint faces and allow to dry.
3. Bolted joints in externally exposed steelwork

3.1. Immediately before assembling, apply a further coat of primer and bring surfaces together while still wet.

3.2. After assembling and before applying site coatings, seal crevices to bolts and joint perimeters with a compatible sealant.

755 Uncoated fasteners

1. Treatment: After steelwork erection and before applying site coatings, thoroughly degrease and clean. Without delay, coat to match adjacent shop painted areas.

765 Site preparation of shop painted steelwork

1. Preparation: Touch in shop coats, as necessary, and allow to dry. Before applying site coats (when specified), abrade surfaces or wash down or both, as recommended by paint manufacturer.

Painting

810 Environmental conditions

1. General requirements prior to starting coating work.
   1.1. Surfaces: Unaffected by moisture or frost.
   1.2. Steel temperature: At least 3°C above dew point, with conditions stable or improving, and not high enough to cause blistering or wrinkling of the coating.
   1.3. Relative humidity: Below 85%.

815 Coatings

1. Surfaces to be coated: Clean, dust free and suitably dry. Previous coats to be adequately cured.
2. Multiple coats of same material: Use different tints to assist checking of complete coverage.
3. Penultimate coat: Colour recommended by paint manufacturer to suit top coat colour.
4. Finish required: Smooth and even, of uniform thickness and colour, free from defects.

820 Film thickness

1. Wet film thickness: During application, check thickness of each coat with a wheel or comb gauge used in accordance with BS EN ISO 2808.
2. Accumulated dry film thickness: After each coat has dried, check total accumulated film thickness.
   2.1. Method: Magnetic or electromagnetic meter.
   2.2. Number and position of measurements: As directed.
   2.3. Validation: Measurements to be independently witnessed.
   2.4. Meter calibration: Check against standard shims and recalibrate regularly against a smooth steel reference plate.
3. Average dry film thickness
   3.1. At least specified thickness over any square metre.
   3.2. No reading to be less than 75% of specified thickness.
4. Top coat dry film thickness: Sufficient to give an even, solid, opaque appearance.

825 Stripe coat

1. External angles, nuts, bolt heads, rough weld seams, and areas difficult to coat: Apply an additional stripe coat of primer.

Ω End of Section