



COOP LIVE

## **H42 - PRECAST CONCRETE PANEL CLADDING/FEATURES**

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|                                                      |           |
|------------------------------------------------------|-----------|
| <b>H42 PRECAST CONCRETE PANEL CLADDING/ FEATURES</b> | <b>1</b>  |
| <b>GENERAL</b>                                       | <b>1</b>  |
| 110 WORKS INCLUDED                                   | 1         |
| 111 APPLICABLE DESIGN RESPONSIBILITY                 | 1         |
| 112 TENDER SUBMITTALS                                | 1         |
| 113 SAMPLES                                          | 1         |
| 114 MOCK-UPS, PROTOTYPES AND QUALITY BENCHMARKS      | 2         |
| 115 TESTING                                          | 2         |
| <b>PRODUCTS</b>                                      | <b>3</b>  |
| 210 PERFORMANCE REQUIREMENTS                         | 3         |
| 211 SYSTEMS                                          | 6         |
| 212 MATERIALS                                        | 12        |
| 213 CLADDING SUPPORT SYSTEM                          | 15        |
| 214 FABRICATION                                      | 15        |
| 215 ANCILLARIES                                      | 16        |
| <b>EXECUTION</b>                                     | <b>16</b> |
| 310 WORKMANSHIP                                      | 16        |
| 311 TOLERANCES                                       | 18        |

## H42 PRECAST CONCRETE PANEL CLADDING/ FEATURES

### GENERAL

#### 110 WORKS INCLUDED

1. Scope of Works: This section of the Specification, when read in conjunction with the Design Drawings, provides particular requirements with respect to the following:
  - a. Precast concrete wall cladding.
2. Particular Interfaces
  - a. Complete the Detailed Design of all interfaces with adjoining trades prior to commencement of manufacture.
  - b. Ensure that all interfaces are fully co-ordinated prior to commencement.
3. Related Documents and Sections: Examine the Design Drawings and the Contract Documents for requirements that directly affect or are affected by Work of this Section. Other Documents and Sections that directly relate to work of this Section include, but are not limited to:
  - a. The Preliminaries, general provisions of the Contract, including General and Supplementary Conditions, and Architectural General Requirements Specification Sections.

#### 111 APPLICABLE DESIGN RESPONSIBILITY

1. Design & Build Procurement Routes
  - a. Appoint a specialist sub-contractor to complete the Detailed Design maintaining at all times the intent portrayed on the Design Drawings whereby the Architect's role post-novation or during subsequent design stages shall be limited to checking compliance with quality, design and visual intent only.

#### 112 TENDER SUBMITTALS

1. Tender Response
  - a. Provide tender submittals in accordance with the requirements of SUBMITTALS clauses of the A Section of the Specification.
  - b. Prior to appointing a subcontractor or supplier for these works, submit the following:
    - 1). List of Tests included.
    - 2). Samples where specified.
    - 3). QA/ QC programme.
    - 4). List of proposed Working Drawings.
    - 5). Summary of deviations from the Architectural Specification.
    - 6). Outline technical specifications reflecting proposed materials/ systems.
    - 7). A list of proposed suppliers and sub-contractors intended to be used.

#### 113 SAMPLES

1. Pre-contract Samples: Provide pre-contract samples in accordance with SUBMITTALS clauses of the A Section, including trade literature and technical specifications:
  - a. A minimum of 6 No. 300mm x 300mm samples of precast rainscreen panel of each principal textural variant from different batches illustrative of potential tonal variance.
2. Post Contract Samples: Provide post contract samples in accordance with SUBMITTALS clauses of the A Section:
  - a. 900mm x 900mm sample(s) of each type of rainscreen panel system including proposed range of finish, edge, corners, and joint conditions.
  - b. 600mm x 600mm sample(s) of EWS-468.

#### 114 MOCK-UPS, PROTOTYPES AND QUALITY BENCHMARKS

1. Mock-ups: Provide mock-ups in accordance with SUBMITTALS clauses of the A Section as follows:
  - a. Not required.
2. Prototype Requirements: Provide a prototype in accordance with SUBMITTALS clauses of the A Section as follows:
  - a. Not required.
3. Benchmark Requirements: The following quality benchmarks shall be provided in accordance with SUBMITTALS clauses of the A Section:
  - a. First fully installed and completed area of each type of the works comprising of not less than 20m<sup>2</sup> as accepted by the Architect.

#### 115 TESTING

1. General:
  - a. The Contractor may provide data from previous independently certified tests to demonstrate that the Contractor's proposed systems meet the performance requirements. The information shall be to the entire satisfaction of the Architect.
  - b. If suitable data to demonstrate compliance with the performance requirements is not available, provide prototypes of each type and have them independently tested in accordance with the specified testing criteria.
  - c. Independently certified test data, as applicable, shall include static and dynamic results, and Agrément certificates.
  - d. On-Site testing: The Contractor shall include for all on-Site testing specified herein which shall be independently assessed and certified.
2. Wind Resistance Testing: Provide certification to demonstrate that the works have been tested to meet the following:
  - a. To the CWCT Standard for cladding, windows and doors. Samples tested shall have been subjected to at least 5 cycles of positive pressure to satisfy maximum gust conditions and to meet the performance requirements as specified. The procedure shall then have been repeated with negative pressure. The results shall meet with the maximum deflection values.
3. Site Hose Testing: Site water hose tests shall be carried out in accordance with the recommendations of the CWCT standard carried out to 5% of interfaces only.
  - a. Extent of Testing: The Architect shall specify those areas to be tested.
4. Impact Test: Carry out impact tests to satisfy the CWCT Standard test methods.

5. Remedial Work and Re-testing:
  - a. Wherever leakage has occurred, make watertight to satisfy the requirements of the Specification.
  - b. After all necessary remedial work has been completed all repaired areas shall be re-tested, following the same procedure as before. Should leakage still be found, further remedial measures shall be taken and testing shall be repeated until the designated area is found to be satisfactory.
  - c. Each failure shall be rectified and retested until the area is found to be satisfactory and a further additional area of a similar extent is to be tested at the Contractor's own expense.

## PRODUCTS

### 210 PERFORMANCE REQUIREMENTS

1. General
  - a. Comply with the general performance of Section A and the following specific performance requirements.
  - b. The precast concrete wall cladding systems shall be in accordance with BS 8297, BS 8298, BS EN 13369, National Structural Concrete Specification (NSCS) and the CWCT Standard for Systemised Building Envelopes.
2. Structural
  - a. Specific Movements
    - 1). Refer to the Structural Engineer's Documentation for details on structural movements and tolerances.
    - 2). The works shall withstand all movements of the building structure under all specified design loads or combination of loads without damage or any reduction in performance.
    - 3). Provide expansion and movement joints to accommodate the maximum movements that can be derived from the specified and determined design loads and movements. Under maximum movements the joints shall meet all the performance criteria of the Architectural Specification.
    - 4). The works shall be capable of accommodating loads imposed upon the system by defined movements of its supporting structure and/ or other adjacent elements.
  - b. Specific Dead Loads
    - 1). The works shall accommodate their own dead loading without causing deflections or movements that adversely affect the system itself or the supporting structure.
    - 2). Provide dead loading calculations for the installed system, plus any other dead load and imposed loadings transmitted to surrounding construction. This shall be expressed as the weight in kN/ m<sup>2</sup> and shall not relieve the Contractor of contractual responsibilities.
  - c. Specific Live Loads: The works shall be capable of accommodating the following live loads without any reduction in performance:
    - 1). Horizontally applied loads acting on the surface of any component. The works shall sustain safely, without reduction in performance and without permanent deformation to any component, a static 500N load applied horizontally through a square of 100mm sides on any part of the system.

- 2). A horizontal line load applied to the works, due to the occupants, in accordance with BS 6180 and BS EN 1991: Part 1-1. Refer to the Structural Engineer's Documentation for locations and loadings.
  - 3). Wind loads.
  - 4). Specified impact loads, that occur during the service life, without deterioration in performance and without sustaining non-repairable damage.
  - 5). Loads imposed during replacement of panels/ units.
  - d. Imposed Gravity Loads: The works shall be capable of accommodating specified loads imposed by adjacent and/ or attached elements that bear onto, are suspended from or fixed to the system. Refer to the Design Drawings for information on such elements and/ or required load capacities. No elements from other trades shall be fixed to and/ or supported by the cladding, unless accurately specified, shown on the Design Drawings and/ or agreed by the Architect.
  - e. Inertial Loads: The works shall be capable of accommodating inertial loads arising due to the acceleration/ deceleration of moving sections including opening lights, doors and vents of the building or enclosure. Consult the Architect regarding the motion requirements for such elements.
  - f. Deflections
    - 1). The maximum allowable deflection of any element of the works, when carrying full specified design loads including those imposed during cleaning and maintenance, shall not exceed those necessary to ensure the appearance and performance of the works remain unaffected.
    - 2). The works shall not deflect under specified loading in any way that is detrimental to any element of the works or adjacent structural or building elements.
    - 3). All components, couplings and fixings shall be capable of accommodating all of the above deflection without permanent distortion, deformation or failure.
    - 4). The works shall accommodate differential structural movements arising from any specified loads imposed by adjacent structures.
    - 5). The magnitude of the allowable deflections shall be reduced if they are detrimental to any part of the works, their support structure or internal finishes.
    - 6). Provide evidence including calculations to demonstrate that the works would not deflect in a manner that is detrimental to its appearance and performance under limits of safety and serviceability.
  - g. Wind Loads: The works shall be designed to withstand, without permanent deformation, the effects of specified wind loads. Calculated pressure loads shall include the effect of internal air pressures within the building, taking into account the presence of significant openings that might arise occasionally within the building enclosure during or after construction.
3. Thermal Movement
- a. Allow for local thermal movements.
  - b. The works, including all necessary support structure, shall be designed so as to be capable of accommodating changes in dimension and shape of its components resulting from changes in specified service temperatures and from differential surface temperatures between the inside and outside of the building without any reduction in the specified performance.

- c. The design shall cater for all temporary and permanent conditions specified for the works.
  - d. The annual surface temperature ranges for the materials used in the works shall be confirmed during the Detailed Design period, both for external surface temperatures and internal temperatures when the building is in normal use and when empty or out of use. Due regard shall be made to the effects of orientation of the building towards the sun, in particular for overhead and sloped glazing situations and thermal stress calculations and risk assessments shall be submitted by the Contractor for review.
4. Moisture Movement
- a. The works shall withstand movement without permanent deformation or any reduction in the specified performance:
    - 1). Due to changes in the moisture content of its components, resulting from variations in the moisture content of the air. Refer also to BS 8297, BS 8298: Part 1, BS 8298: Part 4 and BS EN 1992.
    - 2). Due to the expansion of absorbed or retained moisture caused by freezing.
  - b. Allowance shall be made to control the flow of any water that may collect behind the element and for directing this water to the outside, such that no water remains internally.
5. Thermal Performance Requirements
- a. The average U-value through the works shall meet all Statutory requirements as well as Part L of the Building Regulations.
    - 1). Refer to the Facade Types Matrix for thermal conductivity requirements.
  - b. Submit thermal calculations for the various components and the average thermal performance of the proposed works.
  - c. Ensure that thermal movements shall not result in unacceptable levels of audible noise.
6. Capillarity
- a. Water migration caused by capillarity shall be prevented to areas that are designed to remain dry.
7. Weather and Water Penetration Resistance
- a. The works shall be adequately designed and installed, ensuring the prevention of water leakage onto the core and internal face of the works designed to remain dry.
  - b. The Detailed Design of the works shall not be based on a single line of defence. Cladding joints and openings and the cavities between the lines of defence shall be suitably designed to achieve pressure equalization or be drained and ventilated to the exterior.
  - c. The Detailed Design and construction of the works shall be such that all rigid or fixed joints shall remain rigid and accommodate all specified thermal, building structure or other movements and any applicable loads without compromising its watertightness. All movement joints shall also be finally designed and constructed to accommodate such specified loads or movements without compromising the works' watertightness.
8. Local Factors

- a. Visit the Site in order to become familiar with local requirements. Local microclimatic conditions shall be taken into account and grades of materials assessed as suitably durable for the location shall be selected.
  - b. An assessment of microclimatic conditions shall be made with due allowance for any factors likely to have an adverse effect upon materials intended for the works. More appropriate materials shall be substituted if adverse effects are predicted.
- 9. Acoustic
  - a. Comply with the Acoustic Report/ acoustic performance requirement drawings.
  - b. The works shall effectively insulate the internal areas of the building to the specified acoustic requirements.
  - c. Evidence that the specified acoustic performance requirements are met shall be provided.
  - d. Internal walls perpendicular to the Cladding Types has an Acoustic performance. Composite construction shall demonstrate resistance of flanking transmission between adjacent rooms.
- 10. Fire
  - a. Comply with the Fire Strategy Report/ fire performance requirements drawings and all applicable provisions in the Building Regulations, whilst giving full consideration to the principles set out in BS 9991/ BS 9999.
  - b. Fire and Smoke Stopping: Provide cavity barriers in the external wall and fire stopping at the junction of the external wall with other fire resisting elements of the structure.
  - c. Fire Hazards: The works shall comply with the provisions of the CWCT Standard.
- 11. Visual Requirements
  - a. Precast concrete formed and unformed finishes shall generally be as categorised in accordance with the National Structural Concrete Specification (NSCS) 4th edition.
- 12. Durability: The performance criteria shall be satisfied for the full design life of the works, as stated in the Specification, provided always that the maintenance has been carried out as specified.
- 13. Sustainability
  - a. Refer to Section A.600 series SUSTAINABILITY clause, determine and evaluate the applicability of the specified requirements including BREEAM Credit Requirements to the works specified in this Section of the Specification. Comply with all relevant requirements.

## 211 SYSTEMS

- 1. Overview
  - a. The precast panel cladding strategy shall be employed alongside GRC cladding units defined within Section H92 of the Specification whereupon a requirement exists to achieve high levels of both tonal and pattern consistency between the dissimilarly produced types.
  - b. Where possible, the precast concrete cladding panels described herein shall be manufactured by the same manufacturer as the counterpart GRC cladding units defined within Section H92 of the Specification.
- 2. Type EWS-451 Precast Concrete Cladding - Ribbed

- a. Description: External, thermal, fire and acoustically rated, precast concrete cladding system typical of South, East and West elevations from Level 01 podium to underside of Level 02.
- b. Primary support structure: Secondary steelwork to Structural Engineer's specification.
- c. Conformance: CWCT, BS EN 1169 and BS EN 15191.
- d. Specific Performances: Refer to the Facade Types Matrix.
- e. Panels:
  - 1). Material: Precast concrete panels with bonded steel sheet for blast mitigation.
  - 2). Modularity: As indicated on the Design Drawings.
  - 3). Thickness: Refer to the Design Drawings.
  - 4). Face Profile: Ribbed/striated to accepted samples achieved by a proprietary thermoplastic form liner, and indicative system for which shall be reference 1/47 Rib Type P by Reckli.
  - 5). Finish: Fine.
  - 6). Colour: Techrete C195 LAE.
  - 7). Edge: As indicated. Special splayed reveal detail to all entrance.
- f. Support System/Fixings: Fully adjustable concealed, hot dipped galvanised rail system supported back to secondary steelwork with a corrosion protected steel outer sheet of minimum thickness 1mm.
- g. The steel frame support system shall span from L01 podium slab level to underside of L02 overhanging soffit with interface conditions to the landscaping, cladding, doors, internal wall, floor and ceiling finishes and movement joints.
- h. The system shall be deemed to include the interfaces with landscape, doors, internal walls, floor and ceiling finishes and movement joints.
- i. Joints:
  - 1). Sealant/Mortar joints, as indicated on the Design Drawings.
  - 2). Joint width: Panel to panel joint shall be 10mm nominal.
- j. Insulation: Nominal 200mm zone of mineral/stone wool of thickness and density to achieve the performance requirements.
- k. Non-flammable VCL, an indicative system for which shall be Proctor FR200 VCL.
- l. Panel to panel joints to be provided with two layers of protection against air and water leakage.
- m. EPDM bandage forming air tight interfaces to adjoining works.
- n. Stainless steel vermin mesh shall be provided at landscape interfaces.
- o. The system shall be subject to subsequent design development with the Cladding Contractor and manufacturer as part of the Working Drawings stage whereupon in particular the following shall be included:
  - 1). Peripheral interface flashings/ external corner interface profiles.
  - 2). Other integrated/incorporated elements.

- 3). Panel sizes schedule.
  - p. Protection: The exposed surface area of the cladding shall be subject to the application of a clear microporous protection coating.
  - q. The system shall include reinforcements, cast-ins, fixings, packing shims, cavity barriers, fire stopping, vapour control, breather membrane/ air barrier, cavity trays, flashing, trims, damp-proofing and other suitable accessories as necessary to complete the installation.
  - r. Indicative manufacturer: Techrete UK.
3. Type EWS-452 Precast Concrete Cladding - Ribbed
    - a. Description: External, fire rated precast concrete rainscreen cladding system generally as principal system EWS-451 except referring to zones on the North elevation from Level 01 requiring no thermal insulation as part of the build-up.
  4. Type EWS-453 Precast Concrete Cladding - Plain
    - a. Description: External, thermal, fire and acoustically rated, precast concrete cladding system typical of North elevation.
    - b. Primary support structure: Secondary steelwork to Structural Engineer's specification.
    - c. Conformance: CWCT, BS EN 1169 and BS EN 15191.
    - d. Specific Performances: Refer to the Facade Types Matrix.
    - e. Panels:
      - 1). Material: Precast concrete panels with bonded steel sheet/stud backing.
      - 2). Modularity: As indicated on the Design Drawings.
      - 3). Thickness: Refer to the Design Drawings.
      - 4). Face Profile: Plain.
      - 5). Finish: Fine.
      - 6). Colour: Techrete C195 LAE, with the joint sealant to match the panel colour.
      - 7). Edge: As indicated. Special splayed reveal detail to all entrance.
    - f. Support System/Fixings: Fully adjustable, hot-dipped galvanised concealed rail system supported back to secondary steelwork with a corrosion protected steel outer sheet of minimum thickness 1mm.
    - g. The steel frame support system shall span from L00 podium slab level to underside of L02 overhanging soffit with lateral support provided by Level 01 slab edge.
    - h. The system interface conditions to the landscaping, cladding, doors, internal wall, floor and ceiling finishes and movement joints.
    - i. Joints:
      - 1). Sealant/Mortar joints, as indicated on the Design Drawings.
      - 2). Joint width: Panel to panel joint shall be 20mm nominal.
    - j. Insulation: Nominal 200mm zone of mineral/stone wool of thickness and density to achieve the performance requirements.

- k. Non-flammable VCL, an indicative system for which shall be Proctor FR200 VCL.
  - l. Panel to panel joints to be provided with two layers of protection against air and water leakage.
  - m. EPDM bandage forming air tight interfaces to adjoining works.
  - n. Stainless steel vermin mesh shall be provided at landscape interfaces.
  - o. Insulation: Mineral/stone wool of thickness and density to achieve the performance requirements.
  - p. The system shall include fire barriers between studs behind the cladding panels.
  - q. The system shall be subject to subsequent design development with the Cladding Contractor and manufacturer as part of the Working Drawings stage whereupon in particular the following shall be included:
    - 1). Peripheral interface flashings/ external corner interface profiles.
    - 2). Other integrated/incorporated elements.
    - 3). Panel sizes schedule.
  - r. Protection: The exposed surface area of the cladding shall be subject to the application of a clear microporous protection coating.
  - s. The system shall include reinforcements, cast-ins, fixings, packing shims, cavity barriers, fire stopping, vapour control, breather membrane/ air barrier, cavity trays, flashing, trims, damp-proofing and other suitable accessories as necessary to complete the installation.
  - t. Indicative manufacturer: Techrete UK / Reider Sales.
- 5. Type EWS-454 Precast Concrete Cladding - Plain - Uninsulated
    - a. Description: External, fire rated precast concrete cladding system typical of North elevation, generally as EWS-453 except referring to areas of the North elevation where no thermal performance is required.
    - b. Length of panel bottom edge varies to suit landscape level.
  - 6. Type EWS-455A Precast Concrete Corner Cladding Panel - Ribbed
    - a. Description: External, thermal, fire and acoustically rated, precast concrete 'L' form corner cladding system generally as principal system EWS-451 in terms of thermal performance, support and interface requirements.
    - b. The acceptable arris radius shall be not exceed 10mm.
  - 7. Type EWS-455B Precast Concrete Corner Cladding Panel - Ribbed
    - a. Description: External, fire rated, precast concrete 'L' form corner cladding system generally as principal system EWS-455A except in zones with no requirement for thermal or acoustic performance.
  - 8. Type EWS-455C Precast Concrete Corner Cladding Panel - Plain
    - a. Description: External, thermal, fire and acoustically rated, precast concrete 'L' form corner cladding system generally as system EWS-455A except referring to plain, un-ribbed panels.
  - 9. Type EWS-455D Precast Concrete Corner Cladding Panel - Plain

- a. Description: External, fire rated, precast concrete 'L' form corner cladding system generally as principal system EWS-455A except in zones with no requirement for either thermal or acoustic performance to plain, un-ribbed panels.
10. Type EWS-456 Precast Concrete Architrave Cladding Panel - Plain
- a. Deep reveal surrounds to doors incorporating openings and mounting positions for signage over doors, comprising a precast concrete cladding goal-post arrangement with verticals incorporating mitred 'L' at top and separate horizontal panel(s) mounted on fully adjustable support rail system.
  - b. System shall be mounted on fully adjustable hot dip galvanised steel brackets, supported back variously to superstructure and secondary steel framing.
  - c. Incorporates interfaces to landscape, cladding, doors, internal wall, floor and ceiling finishes, movement joints.
  - d. Colour: Techrete C195 LAE, with the joint sealant to match the panel colour.
  - e. Incorporate conduit with internally threaded socket for mounting and power/data to signage over doors.
  - f. The acceptable arris radius shall be not exceed 10mm.
  - g. Insulation: Nominal 200mm zone of mineral/stone wool of thickness and density to achieve the performance requirements.
  - h. Non-flammable VCL, an indicative system for which shall be Proctor FR200 VCL.
  - i. Panel to panel joints to be provided with two layers of protection against air and water leakage.
  - j. EPDM bandage forming air tight interfaces to adjoining works.
  - k. Stainless steel vermin mesh shall be provided at landscape interfaces.
  - l. Protection: The exposed surface area of the cladding shall be subject to the application of a clear microporous protection coating.
  - m. The system shall include reinforcements, cast-ins, fixings, packing shims, cavity barriers, fire stopping, vapour control, breather membrane/ air barrier, cavity trays, flashing, trims, damp-proofing and other suitable accessories as necessary to complete the installation.
  - n. Indicative manufacturer: Techrete UK.
11. Type EWS-457 Precast Concrete Architrave Cladding Panel - Plain
- a. Deep reveal surround to doors generally as Type EWS-456, typical of the architrave condition to service door Type DRS-271 except heights vary to suit landscape levels.
12. Type EWS-458 Precast Concrete Architrave Cladding Panel - Plain
- a. Reveal surround generally as EWS-456 and EWS-457 except referring to the loading bay condition and louvred door system DRS-271 where dimensional variance and landscape levels similarly apply.
- ~~13. Type EWS-459 Precast Concrete Parapet Cladding - Plain~~
- ~~a. Precast cladding panel mounted on fully adjustable support rail system forming parapet and façade to west elevation of podium, top hung from L01 slab edge and restrained against secondary framing behind.~~
14. Type EWS-468 Precast Concrete and Composite Panel Wall Combination

- a. Description: Combination system comprising external, precast concrete wall cladding system as a background for prefinished composite panel system Type EWS-301 described within Section H43 of the Specification intended for purposes of fire integrity and acoustic attenuation at the L05 External Plant Compound.
  - b. Primary support structure: Concrete plant enclosure deck and specialist subcontractor designed support framework integrated with plant requirements.
  - c. Conformance: BS 8297, BS EN 13369, BS EN 1992 and CWCT Standards.
  - d. Specific Performances: Refer to the Facade Types Matrix.
  - e. Panels:
    - 1). Material: Reinforced homogeneous precast concrete panels.
    - 2). Modularity: As indicated on the Design Drawings.
    - 3). Thickness: ~~200mm~~220mm nominal.
    - 4). Face Profile: Flat.
    - 5). Finish: 'Ordinary' class to NSCS 4.
    - 6). Colour: Natural/ standard grey to receive a matt black (RAL ~~9905~~9005) masonry paint finish - Refer to system Type PT-113 defined with Section M60.
    - 7). Edge: Square.
  - f. Support System/Fixings: Concealed mechanical type of size, frequency and location to manufacturer's specification and structural calculations.
  - g. Joints:
    - 1). Sealant/Mortar joints, as indicated on the Design Drawings.
    - 2). Joint width: Panel to panel joint shall be 10mm nominal.
  - h. Insulation: Mineral/stone wool of thickness and density to achieve the performance requirements.
  - i. The system shall be subject to subsequent design development with the manufacturer as part of the Working Drawings stage whereupon in particular the following shall be included:
    - 1). Peripheral interface flashings/ external corner interface profiles.
    - 2). Panel sizes schedule.
  - j. The system shall include reinforcements, cast-ins, fixings, packing shims, cavity barriers, fire stopping, vapour control, breather membrane/ air barrier, cavity trays, flashing, trims, damp-proofing and other suitable accessories as necessary to complete the installation.
15. Type EWS-471 Precast Concrete Parapet Coping
- a. Once weathered, precast concrete parapet coping element to the top of cladding Types EWS-454 and EWS-459 wall systems.
  - b. Dimensions/configuration: As indicated on the Design Drawings.
  - c. Finish: To match to upper zones of Types EWS-454 and EWS-456.
  - d. Maximum joint width: 10mm.

- e. Mechanical connection using concealed stainless steel cramps.

212

## MATERIALS

## 1. Concrete

## a. General

- 1). Concrete units shall be manufactured in accordance with BS 8297 and BS EN 13369.
- 2). Give due consideration to the guidelines set out in the British Precast Concrete Federation publications.
- 3). Constituent materials and mix proportion shall produce panels that match the accepted samples.

## b. Cement

- 1). Cement shall be Ordinary Portland Cement in accordance with BS EN 197: Part 1.
- 2). Use of cement replacement materials shall be agreed with the Architect.
- 3). Cement shall be of sulphate resisting type where the concrete units are exposed to soluble sulphates.

## c. Aggregates

- 1). Aggregates used for manufacture of concrete units shall comply with BS EN 12620.
- 2). The aggregates shall be free of deleterious substances that can react with other constituents to adversely affect the concrete.
- 3). Fine aggregate shall be sands from coarse aggregate or dust-free, silt-free, salt-free natural sand.
- 4). Coarse aggregates shall be classified as normal weight.

## d. Admixtures

- 1). Admixtures for use in precast concrete production shall comply with BS EN 934: Part 2.
- 2). The amount and concentration of admixtures employed shall be done only where deemed suitable with other constituents and the production regime of the precast concrete units.
- 3). Calcium chloride or admixtures containing chloride ions or other salts are not permitted.

## e. Water

- 1). Water shall be in accordance with BS EN 1008.
- 2). Only use clean, fresh, potable water that is free of impurities.

## f. Reinforcement

- 1). Reinforcement for concrete shall be scheduled, dimensioned, bent and cut in accordance with BS 8666.
- 2). Stainless steel reinforcement shall be in accordance with BS 6744.

- 3). Carbon steel reinforcement shall be in accordance with BS 4449, BS 4482 and BS 4483 as appropriate.
  - 4). High tensile alloy steel bars for the prestressing of concrete shall be in accordance with BS 4486.
  - 5). Where reinforcement is galvanised, refer to Section Z30.
2. Mortar
    - a. Unless precautions are taken for cold weather working, the use of mortar should be avoided when there is a risk of frost damage.
    - b. Where mortar is used for jointing and pointing, the type used shall be appropriate for the intended use. Refer to BS EN 1996 for guidance on the types of mortar.
    - c. The mortar material shall have mix suitable for the proposed profile and width generally 13mm maximum.
    - d. Mortar and grouts for pocket-fixing components and bedding of small units shall be of proprietary type and comply with the manufacturer's recommendations.
    - e. Refer to Section Z21 for general mortar requirements.
  3. Coatings and Treatment
    - a. Sealers and other treatment shall be clear and compatible type and shall not alter the appearance or diminish the performance of precast concrete units facing and joint material.
    - b. Water repellent sealers and other treatment to precast concrete units and joint material shall be applied to exposed face and not to faces intended for bonding.
  4. Metal
    - a. Refer to Section Z11 for general requirements on metals including but not necessarily limited to steel, stainless steel and aluminium components.
    - b. All metal components shall have protective treatment against corrosion.
    - c. Refer to Sections Z30, Z31, Z32 and Z33 for the relevant treatments and coatings to metal.
  5. Joints
    - a. Movement joints shall be as indicated on the Working Drawings.
    - b. The works shall accommodate all movement of joints in a manner that does not compromise their integrity or appearance.
  6. Thermal Insulation:
    - a. The insulation shall be inert, durable, rot-proof and vermin-proof and not be degradable by moisture, extreme temperatures or water vapour.
    - b. The insulation shall not bulge, sag, delaminate or detach during its installation or in situ during the life of the works.
    - c. Insulation material shall be A1 or A2-s1,d0 to BS EN 13501 in so far as it complies with the relevant Building Regulations.
    - d. Insulation shall be LPCB certified.
    - e. Insulation shall have zero Ozone Depleting Potential (ODP), be CFC and HFC free and have a Global Warming Potential (GWP) of less than five. Refer also to Section A.

- f. Insulation shall be selected to meet the recommendations of 'The Green Guide to Specification' and shall have a minimal environmental impact when assessed using BREEAM criteria.
  - g. The selected insulation shall comply with all relevant British Standards and be BBA certified.
7. Flashings
- a. As indicated on the Design Drawings, aluminium flashings fabricated from minimum 2mm thick sheet shall be provided. They shall be treated with anti-drumming insulation on the protected face.
  - b. Flashings shall be finished to match adjacent panels.
  - c. Externally exposed flashings shall have continuation and interconnecting joints fully complying with the sealant manufacturer's written recommendations for movement joints; simple butt straps shall not be accepted.
8. Breather Membrane
- a. The breather membrane shall be located on the cold side of the cavity insulation.
  - b. The breather membrane shall be water-resistant, water vapour permeable and manufactured from non-woven, spunbonded high density polyethylene and be BBA Certificate approved, with a Class B-s3, d0 reaction to fire in accordance with BS EN 13501.
  - c. Installation: The membrane shall be installed strictly in accordance with the manufacturer's instructions.
  - d. Fix carefully and neatly to provide a complete barrier to water, snow and wind blown dust.
  - e. Horizontal laps to be 100mm, vertical laps 150mm and staggered, to shed water away from the substrate and structure.
  - f. Ensure that the membrane is secured at the reveals/ perimeters of all openings.
9. Vapour Control Layers: High performance reinforced membranes of foil or plastics with a Class B-s3, d0 reaction to fire in accordance with BS EN 13501.
10. Fixings
- a. Refer to Section Z20 for fixings generally.
  - b. Fixing brackets fabricated from mild steel shall be hot dip galvanised, as described in BS EN ISO 1461, after fabrication, with a coating mass of not less than 460 g/ m<sup>2</sup>.
  - c. All fixing brackets for the works shall comprise components of high grade austenitic stainless steel exterior quality, grade 1.4401 to BS EN 10088, BS EN 10250: Part 4, BS EN ISO 683: Part 3, BS EN 10095, BS EN 10029, BS EN 10048, BS EN 10051, BS EN ISO 9445: Parts 1 and 2 and BS 8298: Part 1, BS 8298: Part 2, BS 8298: Part 3 and BS 8298: Part 4 complying with all statutory requirements both as to strength and type and shall be designed to carry all specified dead, live and wind loading under due consideration of any applicable thermal movements.
  - d. All non-visible supporting aluminium sub-constructions shall be mill finished. Aluminium sub-constructions shall be separated from concrete by bitumen paint or similar acceptable method. Austenitic stainless steel to BS EN 10088 may be used in lieu of aluminium for any supporting sub-constructions.

- e. Any sheet steel, cleats, angles, etc. used in the fixing assemblies shall comply with BS 7668, BS EN 10029, BS EN 10210 and BS EN 10025: Parts 1-4 and 6 and rolled sections shall be used wherever practicable or appropriate. Steel sections used shall be hot dip galvanised to the requirements of BS EN ISO 1461 after all cutting, drilling for holes and welding has been completed.
- f. Bolts, screws, nuts and washers used for cladding assemblies and fixing to the structure shall be of adequate strength for their designed purpose and shall be of austenitic stainless steel to BS EN ISO 3506: Parts 1 and 2. All fixings shall be to the acceptance of the Architect and Structural Engineer. All screw fixings and attachments shall be secured against vibrating loose.

#### 11. Sealants and Gaskets

##### a. Sealants

- 1). Sealants shall be as Section Z22.
- 2). Sealant shall not leak or bleed causing any discolouration or staining.

##### b. Gaskets

- 1). Gaskets shall be made of either Ethylene Propylene material (EPDM/EP) or of Silicone. The colour of all gaskets shall be black.
- 2). All room side glazing gaskets shall have factory vulcanised corners.

### 213 CLADDING SUPPORT SYSTEM

- 1. Provide a structural steel cladding support system, as necessary, having due regard for any requirements in excess of primary structure indicated on the Structural Engineer's Documentation and also any requirements indicated on the Design Drawings. The support system shall comply with the Structural Engineer's Documentation, including protective coatings.

### 214 FABRICATION

#### 1. Moulds

- a. Moulds shall material suitable to produce proposed cast units within allowable tolerances.
- b. Ensure that the moulds are robust enough to bear casting and demoulding imposed loads.
- c. Mould shall be constructed to avoid grout loss and allow adequate curing regime.
- d. Damaged moulds shall not be repaired and reused if this would impair the surface appearance of the units.
- e. Maintain in clean, sound condition and inspect for defects before each reuse.
- f. Inform the Architect when each mould is complete and not less than 5 days before commencing casting of units.

#### 2. Manufacture

- a. All stages in the production including the making and testing of test cubes and the maintenance and calibration of all mixing and measuring plant shall be undertaken by firms having suitable experience and competent resources.
- b. Adequate provision for lifting points at all stages including production, transportation and erection and associated stresses shall be incorporated so that they remain concealed in the finished works.

- c. Reinforcement shall be cleaned free of corrosive pitting, loose materials and substances that adversely affect the precast concrete components. Ensure accurate positioning and concrete cover using spacers which shall remain concealed in the finished units.
  - d. Coat the moulds evenly with a suitable release agent, which shall not be allowed to touch the reinforcement or applied facing materials.
  - e. Measure the concrete components by weight within the tolerance limits of BS 8500: Parts 1 and 2 and BS EN 206.
  - f. Mix, place and compact the concrete to distribute fine and coarse aggregate evenly whilst avoiding any form of segregation and bleeding.
  - g. Cure precast concrete units using suitable methods that maintain humidity and temperature range necessary to achieve required precast concrete unit properties prior to and after demoulding.
  - h. Each unit shall be clearly marked or tagged with all relevant manufacture information and identification to ensure their position in the completed works. Where the geometry of the unit does not make it obvious, units should also have an orientation mark.
3. Tolerances for Manufacture: The following tolerances apply to each individual panel manufactured, assembled and ready for installation:
- a. Length/ Width: Maximum allowed deviation of side length shall be  $\pm 2.0\text{mm}$  up to  $3000\text{mm}$ ,  $\pm 3.5\text{mm}$  between  $3000$  and  $6000\text{mm}$ , and  $\pm 6.0\text{mm}$  above  $6000\text{mm}$  of design dimension.
  - b. Thickness/ Depth: Maximum allowed deviation is  $\pm 1.5\text{mm}$  up to  $500\text{mm}$  and  $\pm 3.0\text{mm}$  above  $500\text{mm}$  of design thickness.
  - c. Straightness/ Bow: Maximum allowed deviation of side length shall be  $\pm 4.0\text{mm}$  up to  $3000\text{mm}$ ,  $\pm 6.0\text{mm}$  between  $3000$  and  $6000\text{mm}$ , and  $\pm 8.0\text{mm}$  above  $6000\text{mm}$  of design dimension.
  - d. Squareness: Maximum allowed deviation in the difference in length of the two diagonals shall be  $\pm 2.0\text{mm}$  per  $2000\text{mm}$  of diagonal up to a maximum of  $9000\text{mm}$ .
  - e. Surface Finish: As specified herein. Also refer to Section E50.

## 215 ANCILLARIES

- 1. Lightning Protection and Earth Bonding
  - a. Bonding is required between individual sections of cladding, in accordance with BS 7430, BS EN 62305: Parts 1-4, to ensure continuity between adjacent sections, both vertically and horizontally over the whole façade. Bonding between sections shall have a minimum cross section of  $50\text{mm}^2$ .
  - b. Bonding between the cladding and structural steelwork shall be carried out at intervals as indicated on the Design Drawings. The first level of bonding to the structural steelwork shall be at the highest floor level of each part of the building.
  - c. Provide studs/ bolts on the cladding at bracket positions to the primary structure and secondary steelwork or as otherwise necessary for subsequent connections to be made by the lightning protection contractor.
  - d. All straps/ connections shall be concealed.

## EXECUTION

### 310 WORKMANSHIP

- 1. Generally

- a. All works shall be true to detail with continuous profiles, free from marks, defects, flaws, steps, waves outside specified tolerances or damage of any nature.
  - b. Dimensions and levels of the structure shall be verified.
  - c. All fixing bolts and anchors shall be installed in accordance with the manufacturer's recommended procedures.
  - d. The torque of all bolts to the structure shall be checked by the Contractor and the Architect, duly marked and duly recorded.
  - e. Materials shall be kept dry until fixed. The insulation shall be kept dry during its installation.
  - f. Acceptance shall be obtained from the Architect before drilling or cutting parts of the structure, other than where shown on the Working Drawings.
  - g. Isolating tape, plastic washers or other suitable means shall be used to prevent bi-metallic corrosion between dissimilar metals.
  - h. Bars shall be set out at evenly spaced centres, straight, parallel and truly aligned with other features where shown on the Working Drawings.
  - i. The finished work shall be square, regular, true to line, level and plane with a satisfactory fit at all junctions.
2. Preparation of Backgrounds
- a. Acceptance shall be obtained from the Architect before drilling or cutting parts of the structure, other than where indicated on the Design Drawings.
  - b. Noggings, bearers, etc. required to provide fixing points shall be accurately positioned and securely fixed.
  - c. Co-ordinate the work with trades installing items mounted on or passing through the works and ensure adequate clearances. Verify required clearances with the appropriate trades.
  - d. Do not install works over mechanical or electrical work, which requires inspection and acceptance until such inspection has been made and the work accepted by the proper authority and the Architect. Ensure that insulation, where required, has been completed.
3. On-Site Dimensions
- a. All dimensions shall be checked on Site prior to commencement of the installation.
  - b. The works shall accommodate any given tolerance as well as differences between actual Site dimensions and dimensions shown on the Working Drawings.
4. Setting Out: The Design Drawings provided shall show levels and other data required for setting out components. Responsibility shall be taken to set out the works as indicated on the Design Drawings.
5. Storage and Protection
- a. If site storage is necessary, panels should be arranged in sequence for erection, with markings visible and with adequate access for lifting gear.
  - b. Stacking of units should be arranged to prevent accumulation of trapped water. Storage areas should be clean and dry, level and free from contaminants which could attack or stain the concrete.
  - c. Protection should be provided against staining and accidental damage by storing units away from site traffic. Units should be stacked in the same plane as they are delivered.

6. Damaged Units: Do not repair without acceptance. Such acceptance shall not be given where the units are badly damaged or where the proposed repair would impair appearance or performance.
7. Erection
  - a. Ensure adequate access provision and erection clearances and maintain safety at all times.
  - b. Temporary supports, jointing and bedding materials, fixings and tools shall be pre-positioned at the fixing point. All temporary wedges, shims, spacers and other items not designed for permanent inclusion in the structure shall be removed and the spaces made good as necessary.
  - c. Carry out all quality control testing and inspection procedures giving due consideration to the sequence and durations of all activities including but not necessarily limited to the erection, fixing, adjusting, jointing, pointing, cleaning and protection.

## 311 TOLERANCES

1. Installation
  - a. The works shall be installed to meet the tolerances as specified below. These tolerances shall be adhered to for the works in its completed installed condition. Make due allowance for any specified structural movements and deviations including deformations caused by the installation itself due, for example, to the effect of the self-weight of the cladding on its supporting structure. In this respect, refer to the Project Common Tolerance and Movement Document. In the case of any doubt seek further advice from the Project Structural Engineer regarding the deformations which shall be allowed for in the Detailed Design and installation.
  - b. Level: Set out following horizontal bands, each corner of the panel shall be placed to within 4mm of the design dimension to the corresponding Location Reference Plane. Further, the bottom edge of each cladding panel, based on the mean level of the respective bottom corners, shall be placed to within +/-2mm of the design dimensions from the corresponding Location Reference Plane. Unless otherwise stated, the Location Reference Plane shall be defined as the horizontal plane through the mean level of the tops of the primary edge beam elements or slab edge to which each horizontal cladding panel band is placed/suspended.
  - c. Plumbness: Each panel's reference face (exterior face for external cladding, visible face for single side exposure panels) shall be installed such that the respective offset distances of the top and bottom edges of the panel to an adjacent true vertical line (plumbline) do not differ by more than 3mm or 0.2% of the height of the panel, whichever is less.
  - d. Panel Plan Alignment: The panels shall be installed such that the distances of its respective corners of its reference face to the cladding Location Reference Plane are within 5mm of the Design Dimension and do not differ from each other by more than 3.5mm. This applies both to the top and bottom edges of each panel. Unless otherwise stated, the Location Reference Plane shall be defined as the mean plane of the edges of the primary edge beams or slab edges corresponding to top and bottom widths of each cladding panel.
  - e. Joints: Where adjacent elements are designed to have edges, lines or surfaces which line through their common joint, the maximum allowed step across the joint is the lesser of  $\pm 4\text{mm}$  or  $\pm 15\%$  of the joint width in any direction.
  - f. The works shall be erected plumb and in proper alignment and relation to established lines and grades as shown on the Working Drawings. The erected system shall present true and accurate lines and flat planes. Deviations from lines, planes and verticality shall be limited to long wave formations of minimum wave length of 20m length with a rate of exchange not exceeding 1:750, and a maximum amplitude of 4.5mm. All the above shall be measured from an optical or laser reference line.

- g. All tolerances stated shall be measured and monitored at a mean temperature to be agreed with the Architect. Before work begins on Site the proposed method of dimensional setting-out and cross-checking with adjacent trades and elements, to satisfy the accuracy requirements, shall be submitted to the Architect. The checking of any setting-out or of any line or level by the Architect, or his representative, shall not in any way relieve the Contractor of his responsibility for the correctness thereof.
- h. Alternative tolerances to those specified may be permitted at the Architect's discretion, provided they are agreed in advance of the manufacture of components.
- i. Tolerances shall not be cumulative.

## 2. Site Erection

- a. Horizontal Plan Position: For any element at any level whose position is defined in relation to a primary reference grid, the maximum allowed deviation from the Design Dimension to that reference grid is  $\pm 3\text{mm}$ .
- b. Where a series of elements are arranged in an array of two or more, the maximum allowed deviation of the horizontal distance between any two adjacent elements is  $\pm 3\text{mm}$  from the corresponding Design Dimension.
- c. Verticality: For any element connecting two or more reference levels, the maximum allowed deviation of the relative plan position in any direction of that element at any two successive levels is  $\pm 3\text{mm}$  from the corresponding Design Dimension.
- d. Planarity: Any element or group of elements whose position is defined from a reference plane shall not deviate from the Design Dimension of the reference plane by more than  $\pm 3\text{mm}$  measuring perpendicular to the defined plane.