9.3.3.10 The Contractor shall make allowances in his programme for all pile tests including the design of the test piles, adding any additional reinforcement required based on the test load, all necessary instrumentations for the test including those within the test pile, the submission of test reports, the Engineer's review period and the time for issue of any revised foundation information. All associated costs incurred for the test pile including the above shall be borne by the Contractor.

9.3.3.11 The Contractor shall carry out pile penetration depth verification for each pile prior to casting, taking into consideration the soil strata encountered during boring, to ensure all piles installed satisfy the pile design capacity.

9.3.3.12 The Contractor shall submit to the Engineer all as-built details of bored piles / micropiles records including soil conditions encountered during boring plotted on A1 size drawings. The as-built drawings shall include the eccentricities of bored / micropile piles and shall be endorsed by the Contractor's Registered Surveyor.

9.3.3.13 The Contractor shall submit mitigation proposals for as-built piles that have exceeded the allowable eccentricities or deviations requiring re-design. The proposals shall be designed and endorsed by the Contractor's PE. All incurred mitigation proposals requiring review or design change to the permanent structures shall be administrated via Design Change Request process with no cost or time claim from the Contractor.

9.3.3.14 Within twenty-eight (28) days after completion of all bored pile/micropile works, the Contractor shall submit to the Engineer and BCA the records and as-built drawings of the bored pile / micropile works, showing the penetration length, the location and type of load tests.

9.3.3.15 Crosshole sonic logging (CSL) testing shall follow the requirements of the LTA M&W Specification for C&S Works. As a minimum, the ultrasonic profiles reported shall present both the First Arrival Time (FAT) and calculated Reduction in Energy (attenuation (dB) or relative energy) plotted relative to the reduced level of the deep foundation element. Both FAT and Reduction in Energy evaluation criteria shall be stated in the report. Interpretation must contain proper engineering judgement and experience and is to be made by an engineer with specialized experience in this field subject to the Engineer's acceptance. Filtering or smoothing of the processed results shall be kept to an absolute minimum and must also be presented in the report.

9.3.3.16 All pile test reports, including pile test interpretation reports, shall be endorsed by a PE and submitted to the Engineer for acceptance.

9.3.3.17 Where Ultimate Load Test are carried out on Bored Piles to represent Barrette Piles, a reduction factor shall be applied to the characteristic shaft friction , subjected to the Engineer and Accredited Checkers (AC) approval.

9.3.5.6 The Contractor shall not deviate from the accepted drawings without the prior acceptance of his PE and the Engineer.

9.3.5.7 The Contractor's PE shall inspect, certify and issue a "Permit to Load" for the completed formwork structure twice, once prior to reinforcement bar fabrication and once immediately before concreting work.

9.3.6 Earth Retaining or Stabilising Structure (ERSS) and Ground Improvement work

9.3.6.1 The ERSS schemes shown on Authority's drawings are reference schemes and have been developed to facilitate the construction of the works. The Contractor shall develop the full design and be fully responsible for the design, submissions and erection of all the work. The Contractor shall engage a PE to be responsible for the works.

9.3.6.2 Ground improvement works shall be designed and installed whenever required to limit movements, to ensure water-tightness of the ERSS and for the construction of other works.

9.3.6.3 All ground improvement works necessary for the construction and completion of the Works including the relevant testing and any related instrumentation and monitoring works to evaluate the ground improvement works shall be deemed to be included in the Contract Price.

9.3.6.4 The Contractor's attention is drawn to the reference design of Temporary Works scheme shown in the Authority's Drawings. The Contractor shall comply with the minimum requirements specified in this section to develop his own Temporary Works scheme and shall be responsible for the detailed design of the Temporary Works based on the given criteria. Any changes to this reference Temporary Works scheme resulting from compliance with BCA, statutory, relevant authorities and Authority's requirements shall be deemed included in the Contract Price.

9.3.6.5 The Authority's requirements of ERSS at CR16 station are:

(a) Minimum wall thickness of ERSS wall Type 1 to be 1.5m as shown in the Authority's Drawing CR206-LTA---CR16-XX-G-TMP-DR-LPL-3011;

(b) Diaphragm wall for station and entrances ERSS (unless otherwise accepted by the Engineer);

(c) Construction Method <u>for station box</u> except for launch shaft, shall be topdown;

(d) Where there is presence of rock, GIV or better, or SIII or better, above the FEL, the ERSS wall penetration shall be at least 2m below FEL;

9.3.10.2 Vehicular restraint system of Normal Containment Level in accordance with TD19/06 shall be provided at the supports of the proposed HCL, as specified in BD51, **Clause 6.13**.

9.3.10.3 The high covered linkway should be of structural frame system using rigid moment connections, with cross-bracings and ties to ensure robustness and stability of the whole linkway. The cross-bracings and ties should be permanent and form part of architectural feature.

9.3.10.4 Three-dimensional frame effect shall be considered in the design with "pinned" supports to be constructed using at least four (4) numbers of bolts. The foundation should be optimised for the ease of construction, e.g consider the use of pad footing, and avoid utilities diversion.

9.3.10.5 Cross-bracings / ties should be provided at roof of HCL and between the two (2) columns at each side of the road. Rigid moment connections should be provided between the columns and the roof.

9.3.10.6 The construction shall maximise prefabrication in the factory with minimum welding and other manual work on site. The connection should preferably be bolted for on site assembly.

9.3.11 Mandatory Use of Ground Granulated Blastfurnace Slag (GGBS) in Permanent Reinforced Concrete Structures

9.3.11.1 Ground Granulated Blastfurnace Slag (GGBS) shall be provided to partially replace cement in all permanent reinforced concrete structures, except for bored tunnel segmental linings. For bored tunnel segmental linings, the requirements in M&W Specifications Chapter 16 shall prevail.

9.3.11.2 The type of cement adopted for concrete shall be CEM-III, with a minimum replacement level of 36%. GGBS shall comply with the requirements in SS EN 197-1 and SS EN 15167.

9.3.11.3 Notwithstanding Clause 9.3.11.2, the Contractor shall adopt concrete with higher replacement level of GGBS in his design to fulfil constructability and durability requirements in accordance with LTA Materials & Workmanship Specifications and/or other Codes and Standards, whichever is more stringent.

9.3.12 Amendments to Authority's Civil Design Criteria for Road and Rail Transit Systems

9.3.12.1 The Contractor shall refer to Appendix Y of the Particular Specifications for the amendments to Authority's Civil Design Criteria for Road and Rail Transit Systems.

9.4 Building and Construction Authority (BCA) Environmental Sustainability Code and Green Mark (GM) Submission

9.4.1 The Contractor shall be the leader to coordinate and comply with requirements for meeting the Minimum Environmental Sustainability Standards under the latest Code for Environmental Sustainability of Buildings, Building Control (BC) (Environmental Sustainability) Regulations, together with his appointed QP & PEs.

9.4.2 The station is required to achieve GM Platinum certification based on the latest version of the BCA GM for Transit Stations.

9.4.3 The Contractor shall engage a GM Accredited Professional acceptable to the Engineer, with recognised degree in relevant field and at least five (5) years of relevant experience in the design of rail transit projects and conversant with BCA GM requirements.

9.4.4 The Contractor shall ensure that all design, GM features and documentation fully comply with the pre-requisite requirements and meet the necessary elective criteria to obtain the GM Platinum award.

9.4.5 The Contractor, together with his appointed QP & PEs, shall lead all BCA GM related submissions and be responsible for collating all the necessary GM documentations / evidences required during the Building Plan (BP) stage (for code compliance) as well as the certification and verification stage for GM Award.

CONTINUED ON PAGE PS-9-17

9.11.2 The Contractor's QP (Architect) shall carry out detailed design in compliance with all statutory requirements and prevailing codes of practices. All changes in compliance with all statutory requirements shall be deemed included in the Contract Price.

9.11.3 The Contractor shall refer to **Clause 7** of the Particular Specification to provide adequate design provision / structural loading above the roof slab.

9.11.4 Floor levels shown in the Tender Drawings are for reference only. The Contractor shall ensure that the floor finishing thickness is coordinated and sufficient for all requirements for floor finishes, services, drainage channels, falls and gradient to drainage outlets and all other technical requirements.

9.11.5 The Contractor shall refer to the Authority's Design Criteria and drawings for the approximate sizes for M&E plantrooms. The Contractor shall take reference from the approximate sizes specified therein, further coordinate with the Authority's In-house Designers and SWCs to finalize the M&E room sizes and station layout and submit to the Engineer for acceptance.

9.11.6 The Architect shall liaise with the Contractor's alignment engineer to ensure that all architectural / structural elements (including but not limited to all fittings within station) comply with the structure gauge clearance requirements including vehicle throw effects, in accordance with **Clause 9.2.1.9** of the Particular Specification.

9.11.7 The Contractor shall note on specific design requirement for access hatches on BOH room at platform connecting to the underplatform cable chamber. The access hatch shall have minimum of 25% of perforation as specified in **Clause 7** of the Particular Specification. The Contractor shall coordinate and ensure the final access hatch details is approved by the M&E Consultant.

9.12 Design for Retail Shops and Advertising

9.12.1 General

9.12.1.1 The Contractor shall work with all relevant parties to incorporate the commercial design requirements into their design and submit a Commercial Recommendation Report for the Engineer's acceptance.

9.12.2 Retail

9.31.1.3 The Contractor shall ensure that there is a minimum clearance of 4800mm above the Top of Rail (TOR) for the trainway clear height, subject to further coordination with SWC.

9.31.1.4 The Contractor shall ensure fixing of linkway roof panels is designed by a PE and meets the below requirements:

a. Maximum screw spacing - 300mm c/c

b.Maximum rafter spacing - 2m c/c

c. Screws used to fix roofing to have an ultimate pull out capacity of 4.0kN

9.31.1.5 The Contractor shall take into account in his design, the presence of utilities / services and existing foundations that are in the path of the works, any constraints or effects imposed by the existing works and services in the surrounding areas and works of other nearby contractors. He shall design the works to avoid these utilities / services and existing foundations and make recommendations on protection where applicable. All protective works shall be deemed to be included in the Contract Price.

9.31.1.6 The Contractor shall comply with the following requirements for his proposed structural scheme:

(a) All structures required for new construction, widening, upgrading or alteration of existing structures shall be within the road reserve;

(b) All road facilities such as footpath, drainage, signage etc. affected by the Works shall be designed to be reinstated within the road reserve as shown in the Authority's Drawings;

(c) Headroom over at-grade carriageways for both temporary and permanent pedestrian overhead bridges shall not be less than 5.7 metres;

(d) All proposed structures overcrossing park connectors and drains shall provide minimum headroom of 2.4 metres;

(e) All proposed retaining structures shall be located at least 300 millimetres away from the drains; and

(f) Existing traffic layout shall not be affected permanently by the proposed design.

9.31.2 Drainage and PUB requirements

9.31.2.1 The Contractor shall obtain PUB's approval for any works that impact on the flow and drainage capacities.

9.31.3.2 The capacity and flow of the sewer system shall be designed to comply with PUB's requirements and the Code of Practice. The Contractor shall obtain approvals from the relevant authorities on the proposed sewer systems and shall submit all relevant calculations endorsed by his PE to PUB and the Engineer for acceptance. The Contractor shall obtain approvals from PUB and other relevant agencies for any works that impact on the flow and capacities. All costs associated with the necessary submissions, design, construction and compliance with relevant authorities' requirements shall be deemed to be included in the Contract Price.

9.31.3.3 The Contractor shall liaise with PUB, relevant agencies and all interfacing Contractors on the levels, coordinates of manholes etc to provide all interfacing requirements for the connection of the proposed sewer system to DTSS link sewer manhole.

9.31.3.4 The Contractor shall liaise and work with PUB and relevant agencies to handover the sewer network from manhole MHA onwards to manhole MH4A for their maintenance after the completion of construction.

9.31.3.5 The Contractor shall note that the sewer scheme, piping, gradient requirements and location of last inspection chamber shown in the Authority's drawings are for reference. It is deemed included that the Contractor shall be responsible to coordinate and develop the full minor sewer system design based on the latest requirements of relevant authorities and agencies throughout the Contract Period to guarantee the performance of the system.

9.31.4 Construction Methodology and Temporary Works

9.31.4.1 The Contractor shall take into account the construction method/ sequence of new structures, strengthening or modification of existing structures and widening and extension of existing structures and at grade carriageway when planning for the temporary works. The Contractor shall follow the construction sequence as indicated in the approved construction drawings and no deviation is allowed unless accepted by the Engineer and approved by QP(D), QP(S) and any other relevant authority.

9.31.4.2 The Contractor shall assess the ground condition and site constraints to develop an acceptable construction methodology to minimise impact on traffic, adjacent structures / developments, utilities and services, and existing infrastructures.

9.31.4.3 The Contractor shall note that no temporary falsework shall be erected on or protrude onto the existing roadway, including the centre median on the carriageways. During construction stage, the headroom over existing at-grade carriageways shall not be less than 5.7 metres to the temporary works.

9.31.4.4 The Contractor shall note that the construction sequence shall take into account of constraints posed by any on-going contracts on site.

9.31.5 Key Security Requirements for MRT Stations

9.31.5.1 CR16 Maju station shall be designed as interchange (future) station and correspondingly comply with all relevant security requirements and standards by Ministry of Home Affairs (MHA)/ Centre for Protective Security (CPS) andalso as stipulated in Particular Specification Appendix AE.

9.31.5.2 The design parameters / requirements stipulated in Particular Specification Appendix AE have obtained approval from MHA/ CPS. The Approved Security by Design (SBD) reports will only be furnished to the successful tenderer for information and reference.

9.31.5.3 The structural requirements stipulated in SBD reports is for reference only and shall be considered to be the minimum provision for CR16 Maju station. The Contractor shall comply with all structural design requirements including security requirements.

9.31.5.4 If the Contractor proposes changes to structural layout, column configuration and/ or member sizes of key structural members from the approved SBD reports, the Contractor shall resubmit and obtain approval from MHA/CPS, any relevant government agencies and Authority before the commencement of any works at site. The Contractor is reminded of longer time required for this resubmission and approval, and the time and cost required shall be deemed to have been included in his Contract price.

9.31.5.5 The Contractor shall engage a qualified Security & Blast (S&B) consultant to review and certify that his design complies with all relevant security requirements and standards by MHA/CPS. The time and cost required shall be deemed to have been included in his Contract price.

9.32 Assessment of Existing Structures

9.32.1 The Contractor shall assess all existing structures affected by his Works. The capacities of existing structures shall be assessed in accordance with the latest Authority's CDC and relevant codes of practice.

9.32.2 In the event that the existing structural capacity is assessed to be inadequate, the Contractor shall propose appropriate strengthening measures/schemes and submit to the Engineer for acceptance. All the cost related to the strengthening works, if required, shall be deemed to be included in the Contract Price.

9.32.3 The structural assessment report for the existing structures shall be duly endorsed by the QP and checked by the AC prior to submitting to the Engineer. The report shall include, but not limited to:

9.34.2 The Contractor's QP(D) shall coordinate with the AC and submit Checklist Form A1 and Form A2 as attached in **Appendix AG** of the Particular Specification. The Checklist shall be endorsed by both the QP(D) and AC and submitted to the Engineer for record for ST submission and at all Design Submission stages; Preliminary, Pre-Final and Final stages. All elements designed and checked shall be clearly identified.

9.34.3 For structural submissions, the Contractor shall further package according to the categories of elements / scope individually in separate Design Acceptance Requests (DAR).

9.34.4 The Contractor shall comply with the key dates for design submissions specified in **Appendix B** of the Particular Specification.

9.34.5 The Contractor shall present his preliminary, pre-final and final design to the Engineer for review and acceptance prior to submitting the same for the Authority's approval. The Contractor shall allow sufficient time in his programme for the reviewing process towards obtaining Authority's acceptance and shall not be entitled to any extension of time or compensation due to compliances with the Authority's requirements.

9.34.6 The Contractor shall plan his preliminary, pre-final and final design for Engineer's acceptance in parts and ahead of Contract Key Dates to suit his programme. BCA Structural Plan (ST) submissions for the construction elements that requires coordination with Architecture, Mechanical, Electrical, and other aspects shall only be made after acceptance of Pre-Final Design submissions, unless otherwise accepted by the Engineer.

9.34.6A The Contractor shall not be entitled to any extension of time or compensation for amendments to ST Submissions (arising from compliance to the Authority's or relevant authorities' requirement) approved ahead of the acceptance of the Final Submission.

9.34.7 All hard copies of design and construction submissions, including correspondence, shall be accompanied with soft copy files in the relevant format (BIM models in native format, IFC, Micro-Station, PDF, Word, Excel, PPT, etc.) and comply with **Appendix I** of the General Specification. This applies to all submissions, including programme, quality plans, method statements, safety submissions, etc. If the documents or drawings are submitted by letter, they shall also be accompanied by soft copy files. Soft copy files of all presentation slides shall also be submitted.

9.34.8 The Contractor shall note that all drawings including but not limited to Structural Plan submission and as-built drawings are to be submitted in the SHD format. The Contractor shall make the necessary conversion from Public Work Department datum format shown in Authority's Drawings to SHD format for all submissions. All necessary conversion is deemed included in the Contract Price.

9.34.9 Acceptance by the Engineer of the Contractor's design proposals or of any subsequent revision thereof by the Contractor shall in no way relieve the Contractor of his entire responsibility for the adequacy and practicality of the proposals. The cost of all necessary remedial works, be it temporary or permanent, ordered by the Engineer as a result of any of the following inadequacy discovered at any time:

(a) in the Contractor's design proposal or

(b) revised proposals due to the Contractor's failure or inability to provide and complete the Works

shall entirely be the Contractor's responsibility and shall be borne by him irrespective of whether such remedial work is performed by the Contractor or by other parties authorized by the Engineer.

9.35 Design Coordination

9.35.1 The Contractor shall arrange and attend all coordination meetings as requested by the Engineer. The Contractor shall record all minutes of design coordination meetings. The minutes of meetings for each meeting shall be submitted to the Engineer for record.

9.35.2 The Contractor shall be responsible for all timely submissions to the Engineer and all relevant authorities and shall ensure that sufficient time is available for review and acceptance by the Engineer prior to construction.

9.35.3 Notwithstanding the pressure requirements for the underground RTS structures as stipulated in CDC 2019 Clause 3.2.4, the Contractor shall coordinate, verify and interface with Authority's In-house Designers in order to meet their requirements. The Contractor shall design the non-load bearing wall system to be reinforced concrete wall to meet the pressure requirements but not limited to the following rooms:

Affected Rooms	Requirement
OTEF/SEF Fan room	± 4.5 kPa
OTED & OTEF Plenum	± 1 kPa
AHU Rooms (Public Area)	± 3 kPa