

# Volume 2

City of Toronto



Union Station - Hostile Vehicle Mitigation

Technical Specification  
Supply & Installation of  
Anti-Terror Precast Concrete Blocks



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## **SPECIFICATION PART 2**

### **GENERAL PRELIMINARIES**

#### **INTRODUCTION**

1. This specification should be read in conjunction with the following (included in the tender documents):
  - a. Project Manual - Volume 1 – Union Station– Waterproofing at Cab Stand issued by NORR
  - b. Tender Drawings issues by NORR
  - c. Tender Drawings issued by DGA
  - d. Civil Drawings issued by Toronto Engineering & Construction Services
  - e. City Of Toronto - Standard Specification for Road Works - as a reference
2. The project consists of the construction of hostile vehicle mitigation (HVM) measures around Union Station within Toronto City Centre. The scheme is to provide protective measures along the frontage of Union Station (Front St. West, York St. and Bay St.)
3. The measures being deployed consist anti-terror concrete blocks, by Townscape Products UK. Other North American suppliers may be available to supply the UK tested products.
4. The sites are located in built-up areas with both vehicular and pedestrian traffic. Appropriate vehicle traffic and footpath diversions are required to protect the members of the public from the works being undertaken at no additional cost. An approved scheme of Traffic Management will be required. Liaison with City of Toronto regarding traffic management shall be the responsibility of the Contractor. Vehicular access shall be maintained for emergency access and to enable deliveries. The contractor shall plan a rolling programme of road closures in consultation with the City of Toronto.
5. It shall be the Contractors responsibility to apply for the necessary permits not limited to traffic management and footpath diversions etc, and comply with the requirement for ensuring the works and any obligations from these requirements are met to the satisfaction of the Project Manager and the Highways Authority (City of Toronto).
6. Pedestrian access shall be maintained to all residential premises at all times and to businesses during business hours. Pedestrian and cycle access is to be maintained as a through route at all times, unless health and safety of pedestrians and cyclists may be put to risk. Suitable signage shall be used to divert members of the public. Contractor to use 2023-07-13\_Union Station Wayfinding Program – Standards' attached to the Specification.
7. The Contractor shall provide a Public Liaison Officer for the duration of the contract to work with City of Toronto's communications team to manage communication with residents, businesses and stakeholders directly affected by the works as well as the wider community. The role will be the 'face of the project' during the construction phase and involve regular face to face communication as well as written communications.
8. The Contractor, or any agent or servant in their employ shall not give any information concerning the works for publication in the press or broadcast on radio, television, cinema screen, or elsewhere without the written approval of the Project Manager.

#### **CONSTRAINTS**

9. The Contractor shall aim to limit the disturbance to the local communities and businesses. Pedestrian access to all premises must be available at all times for residential properties and during business hours for commercial premises.

10. The Contractor shall liaise with the City of Toronto event safety advisory group to agree on the necessary measures to ensure the safety of the members of the public during public events held in the city.
11. Utility drawings are provided for each location, refer to the detailed design drawings. The services identified are typically water, gas, telecoms and electricity. It is the responsibility of the Contractor to confirm the location and depth of the services and the protect them during its operations.
12. The Contractor should be aware that additional services may be present within the working area and must take care to protect them during the operation. In some cases, on-site remedial measures may be required to the Works when unknown services are discovered.
13. There are a number of locations where utility ducts shall be cast into the foundations. The Contractor shall be responsible for liaising with the utility provider to ensure the ducts are installed correctly. At tender stage, it is anticipated that no utility diversion will be necessary. It shall be the responsibility of the Contractor to provide a suitable excavation and to co-ordinate and manage the works within the overall contract programme.
14. Initial discussions have taken place between the design team and the utility companies and they are aware of the works.
15. City of Toronto will enforce a construction embargo on the dates of major events in Union Station vicinity. The Contractor shall be aware of local events that could affect traffic management and work plans. This includes events at the Scotiabank Arena, which frequently draw large crowds in and around Union Station. The contractor's work schedule should include provisions for potential restrictions or pauses in construction activities to accommodate these events at no extra cost.
16. All construction activities shall be planned and scheduled in consideration of seasonal events to minimize disruptions. The contractor shall proactively communicate construction schedules and any necessary adjustments to stakeholders and event organizers well in advance. Flexibility in construction timelines shall be maintained to accommodate unforeseen changes in event schedules or requirements.

## **SITE EXTENT AND LIMITATIONS ON USE**

### **EXTENT OF THE SITE**

17. Subject to the other provisions of the contract, the extent of the site shall be as shown on the drawings. The Contractor shall note that the site extents do not include for:
  - (I) traffic management layouts.
  - (II) temporary signing as required by City of Toronto
  - (III) lands owned or occupied by third parties where such lands are permitted to be accessed to execute and complete the works.
18. In addition, and subject to the agreement of the City of Toronto and written approval of the Project Manager, the extent of the site shall include areas required for local traffic control measures by the Contractor, as and when necessary.

## **LIMITATIONS ON THE USE OF THE SITE**

19. The site shall be used solely for the execution and completion of the works, including but not limited to remedying of defects in the works.
20. The Contractor shall maintain the site in a clean and tidy state by removing rubbish and other debris arising from the works to a tip or temporary storage area off site. All materials for the works shall be stored neatly. On completion of the works the contractor shall remove all surplus materials and leave the site in a clean and tidy condition. A tidy site policy is required at all times.
21. The Contractor's attention is drawn to the fact that the sites are located in a heavily-pedestrianised city centre location and the need to address and mitigate construction risks to members of the public. The contractor shall also manage operations to reduce disruption to the station as far as is practically possible.
22. Materials shall not be stored at sites when no works are taking place.
23. The Contractor shall ensure that all areas of land, which have been temporarily occupied, shall be reinstated to the satisfaction of the affected landowner, occupier and the relevant authorities, utilities, service providers and private utility services and other companies. All areas outside the limits of the site which are used or occupied by the contractor shall be restored to their original condition on completion of the works. Such restoration shall include any necessary cleaning and reinstatement of the surface.

## **TTC STRUCTURE**

24. The works are to take place in areas where underground structures are present under the public highway. The contractor shall take steps to identify extents of these structures and provide protective measures as necessary.

## **HOT WORKS**

25. The contractor must implement a 'fire watch' during all hot works and maintain watch for one hour after completion of the works. A hot works permit system shall be implemented which records completion time of hot works and closing out of the 'fire watch'.

## **NOISE**

26. The Contractor shall consult with City of Toronto with regards to the proposed methods of works, the plant and equipment to be utilised, the phasing of the operations and the steps proposed in order to minimise noise. The Contractor shall obtain the written agreement of the City prior to the commencement of works on the site to such methods and steps, and shall obtain consents or other approvals where required by the City all associated costs shall be borne by the Contractor.
27. Prior to the commencement of any works in connection with the project, the Contractor shall comply with the requirements of the Canadian Environmental Protection Act 1999. No works shall commence

on site until the local environmental health department have approved the contractors policy, subject to such conditions as they consider reasonable.

28. Once approved, the approved document shall be complied with in full; any amendments to the methods of operation required as the project progresses shall be discussed with the local environmental health department, and their agreement in writing shall be gained prior to any variations taking place.
29. It is for the Contractor to agree the measurement locations in detail with the City of Toronto, together with the measurement frequency and duration of measurement exercises. The Contractor shall take cognisance of the noise sensitive nature of the city centre urban environment at all sites.
30. For pricing purposes only, it is considered that the following noise limits can apply (measured 1m from any façade):

Mon – Sun Daytime 1000-1600 Evening 1600-2300	72dB(L <sub>Aeq</sub> ) measured over any 60mins period	93dB(L <sub>Aeq</sub> ) max measured over any 15mins period
Mon - Sat Night 2300-0600	69dB(L <sub>Aeq</sub> ) measured over any 60mins period	90dB(L <sub>Aeq</sub> ) max measured over any 15mins period before midnight only
Sun Night 2300-0600	60dB(L <sub>Aeq</sub> ) measured over any 60mins period	81dB(L <sub>Aeq</sub> ) max measured over any 15mins period before midnight only

31. In order to ensure that the works progress within the noise limits noted above, the Contractor shall arrange to undertake noise measurement during the works. All measurements shall be undertaken by a specialist sub-contractor who is a full member of the Canadian Acoustical Association, with relevant post qualification experience in noise assessment. The specialist shall also be involved in the investigation of complaints, should any occur.

## VIBRATION

32. The contractor shall be aware, City of Toronto By-Law 514-2008, that construction activities can cause vibrations in adjacent buildings; especially older buildings. People working in such buildings can also sense vibration.
33. The Contractor shall select and utilise methods of working and items of plant so that the maximum measured ground vibrations do not exceed a peak particle velocity of 1mm per second at any occupied property and 3mm per second at any other property or structural element. The Contractor shall take cognisance of the adjacent buildings and glass window frontages.

34. In exceptional circumstances the Contractor may exceed the specified limit of ground vibration, providing the Contractor demonstrates that he intends to take all reasonable measures to mitigate the nuisance and obtains the prior written approval of the Project Manager.
35. The Contractor shall monitor vibration if any of the following occur:
  - (I) there is reasonable concern that the limits might be exceeded.
  - (II) there are complaints from the public.
  - (iii) when required by the supervisor.
36. Such monitoring shall be undertaken by a specialist sub-contractor.

#### **ACCESS**

37. Pedestrian and cycle access must be maintained at all times, unless health and safety of pedestrians and cyclists may be put to risk. Suitable signage shall be used to divert members of the public.
38. The Contractor shall note that traffic restrictions and traffic control required to carry out any necessary remedial works shall be to the standard required for the main works and all traffic control costs required for such remedial works shall be borne by the contractor.
39. Each goods vehicle used by the Contractor or Subcontractors in connection with the contract shall have documentation giving the operator's license number, name, and address.

#### **TRAFFIC SAFETY AND MANAGEMENT**

40. The contractor is responsible for the traffic safety, management and all associated works.
41. The Contractor shall ensure the workforce complies with the requirements of OSHA with respect to the wearing of high visibility garments and in this respect these shall be worn in areas defined as being the contractors site.
42. All vehicles over 1.5 tonnes unladen weight used within the works, including those delivering materials, shall be fitted with exterior mounted audible warning devices, capable of being heard over a distance of 20 metres at ambient noise levels. The device shall operate automatically when the vehicle reverses within the site. Any vehicles over 1.5 tonnes reversing within the site, except paving machines and rollers, shall only do so under the individual supervision of a specifically designated marshall walking alongside the rear of the vehicle.
43. The Contractor shall give the Project Manager 3 days notice of their intention to implement, modify or remove any traffic management layout.
44. The Contractor shall appoint a traffic safety and control officer (TSCO) for the duration of the works. When the traffic management operations are undertaken by a sub-contractor the TSCO shall not be a

member of the sub-contractor's staff. The TSCO shall also be responsible for agreeing all traffic safety method statements, etc. with the Project Manager.

45. The Contractor shall take cognisance of local events that may impact on the traffic management proposals. The Contractor shall be aware of the events taking place, including at the Scotia Bank Arena throughout the year as it often results in large crowds in and around Union Station.

### **PROGRAMME OF WORKS**

46. The Contractor shall provide the programme in the form of a Gantt chart produced as a result of a "critical path analysis" and shall comply with the constraints stated or implied in the contract. This shall be updated every four weeks. It shall show the level of detail appropriate to each stage of the works and all activities and restraints, each of which shall be given a short title. All events shall be numbered and annotated with the earliest and latest event dates. The programme shall be supported by bar charts for particular activities or time scales at the request of the Project Manager.
47. Additionally, and notwithstanding any other provision of the contract, the Project Manager shall have the right to require the Contractor to provide a bar chart for any part of the works and the Contractor shall comply with such requirement at the cost of the Contractor.
48. Bar charts shall list the location and description of activities to which they refer and show for each listed activity a horizontal bar indicating the start, duration and stop date of that operation plotted to a horizontal scale of time.

### **RISK TO HEALTH AND SAFETY**

49. The works are to take place in the shared public highway; the Contractor shall appoint a site security manager to facilitate a safe and secure site and deal with any potential public conflicts / nuisance throughout the works period.
50. The Contractor is to ensure that each operative undertakes a specific site induction including an introduction from the site security manager.
51. The Contractor should ensure that there are sufficient barriers, screens etc and pedestrian signage to safely divert vehicles and all non-motorised user groups around the work areas.
52. The contractor shall ensure that all operatives wear the correct PPE at all times during the works.

### **PRIVATELY AND PUBLICLY OWNED SERVICES AND SUPPLIES**

53. The following live services have been identified on site:

- Telecoms
- Electric cables
- Gas
- Surface water / foul water drainage
- Data Cables
- Potable Water
- Fire Hydrant Main

Services location plans have been obtained from the relevant utility provider as well as survey data, which has been overlaid on to the DJ Goode and LEA technical drawings.

54. Details of services and supplies affected by the Works are shown on a separate plan in the contract drawings for each location. Limited information about the preliminary enquiries that have been made with Statutory Undertakers and the potential for the alteration of services and supplies affected by the Works is included in the Utilities Summary document.
55. The Contractor shall make arrangements with the statutory undertakers, utility companies and others concerned, for the co-ordination of their work with all work which needs to be done by them or their contractors concurrently with the works.
56. Private services to individual properties have not generally been listed or shown on the drawings. The Contractor shall make arrangements with the statutory undertakers and others concerned for the phasing of all necessary disconnections and diversion of private services affected by the works.
57. The Contractor only with the prior consent of the authority concerned can remove disconnected apparatus.
58. Before any excavation commences, CAT / Genny scanning is required, and the contractor should ensure that a ground penetrating radar (GPR) survey has taken place. Where cables / pipes are identified, the Contractor shall excavate by hand to confirm the exact cable/pipe location. Should any unidentified cable or pipe be discovered then the contractor should contact the Project Manager, to agree the necessary action.
59. The details of these arrangements relate to the minimum diversion or protection works necessary and carried out with minimum trench depths, lengths, etc. If the Contractor wishes to change the routing and timing of any alterations (eg. to suit their programme or method of working) they shall advise the Project Manager of their intentions and shall include the Supervisor in any discussions with the relevant authority.
60. Any temporary service diversions, other than those shown in the contract, required by the Contractor for the execution of the works, shall be agreed with the appropriate authority; if slewing and / or lowering is beneficial to the works (both cost and time wise) then this must be agreed with the Project Manager via the Supervisor.
61. The Contractor shall, at all times during the progress of the works, afford facilities to properly accredited agents of any authority for access to all or any of their apparatus situated in, over or under the site, as may be necessary for inspecting, reporting, maintaining, removing, renewing or altering such apparatus in connection with the construction of the works for any other purpose whatsoever.

**RETENTION OF MATERIAL ARISING FROM SITE CLEARANCE**

Item	Requirement
Curbs	Set aside for reuse (some will need to be recycled / disposed)
Pavers, setts and block paving	Set aside for reuse (some will need to be recycled / disposed)
Existing street and direction signage	Set aside for reuse (some will need to be recycled / disposed)

**PERFORMANCE AND TECHNICAL STANDARDS**

62. The Works shall be constructed in accordance with the requirements of the relevant local Codes and Regulations for materials, design and workmanship.

Unless otherwise stated any City of Toronto, Ontario Provincial or Canadian National Standard or other publication referred to in this Specification shall be the most recent edition incorporating the most recent amendments published before the last day for returning tenders.

63. Any materials and products stated within this documentation are given as a guide to appearance and quality only. Alternatives may be put forward by the tenderers, but these must be made clear within the tenderers' bid submission. Alternatives must at least meet the design and performance criteria for the named material or product and shall only be deemed to be accepted by the Project Manager when approval is given in writing. If required by the Project Manager, the Tenderer shall obtain independent verification that the proposed alternative material or product provides the necessary equivalent standards.
64. Tenderers must ensure that materials and installations give rise to a finished product that is capable of withstanding the local environmental conditions.
65. It is the Employer's policy to minimize the adverse environmental effects of its projects and operations. Recycled or recyclable products are to be preferred whenever they are available. Projects shall be carried out to minimize the consumption of energy; to avoid the consumption of products associated with the destruction of tropical rain forests or threatened animal species; to avoid the emission of pollutants, harmful radiation or ozone layer depleting chemicals and to avoid the use of noxious substances.

#### **SPACE REQUIREMENTS**

66. The exact spatial requirements of the site are set out in the tender drawings and no deviation from these shall be undertaken without prior written approval from the Project Manager.

#### **SETTING OUT**

67. The Contractor shall be responsible for the true and proper setting-out of the Works and for the correctness of the position, levels, dimensions and alignment of all parts of the Works and for checking and verifying to its satisfaction all the data relating thereto supplied to it in writing or otherwise by the Project Manager and for the provision of all necessary instruments, appliances and labour in connection therewith. If at any time during the progress of the Works any error shall appear or arise in the position levels, dimensions or alignment of any part of the Works, the Contractor on being instructed so to do by the Project Manager shall at its own cost rectify such error to the satisfaction of the Project Manager. The checking of any setting out or of any line or level by the Project Manager shall not in any way relieve the Contractor of its responsibility for the correctness thereof and the Contractor shall carefully protect and preserve all bench-marks, pegs and other things used in setting-out the Works.
68. All setting out marking must be reviewed by the Project Manager prior to the commencement of any excavation.

#### **SURVEY**

69. Surveys of the construction areas have been carried out to identify buried utilities as well as topographical features. The data is presented on the detailed design drawings.

Diversion of utilities is not expected and the alignment of the measures has been positioned to ensure that no impact on utilities occur.

#### **MATERIALS AND WORKMANSHIP SPECIFICATION**

##### **GENERAL**

##### **Workmanship**

70. Workmanship shall be of a high standard throughout, commensurate with the nature of the Works, particularly with regard to accuracy of dimensions, lines, plans levels and the quality of surface textures. The Contractor shall do everything necessary to ensure that the specified standard of finish is achieved.

### **Materials and Prefabricated Items**

71. All materials and prefabricated items shall be manufactured and tested in conformance with the specified requirements. When evidence of conformance depends solely on inspections and tests performed by a Sub-Contractor, manufacturer, supplier or independent testing authority, the Contractor shall ensure that such evidence is satisfactory and that appropriate records are maintained.
72. No materials or prefabricated items shall be used in the Works until it has been verified that they comply with the specified requirements.
73. Where appropriate, all materials and prefabricated items shall bear the manufacturers name, brand name, or any other data that may be required to verify the exact nature of the material item and relate it to the specified requirements.
74. Where applicable, materials and prefabricated items shall bear the Canadian Standards Association (CSA) marking or other appropriate certification mark.
75. Transportation, handling and storage of material shall be controlled to prevent misuse, damage or deterioration.
76. The Contractor shall operate procedures for the identification and isolation of materials and prefabricated items that do not comply with the specified requirements.
77. Works test certificates shall include, whenever applicable, the location in the Works or the delivery or batch which the sample represents.
78. Materials selected by the Contractor shall be of the best quality manufactured as a minimum to the relevant City, Provincial or National Standards relevant to their type and use.

### **Standards and Tests**

79. Wherever, in respect of any City, Provincial or National Standards, Supervision and Control is available, all materials required to comply with that standard, or the containers of such materials, shall be marked with the CSA marking.
80. This requirement shall not apply where the Project Manager is satisfied and confirms to the Contractor in writing that CSA-marked materials are not readily available. In such a case, the Contractor shall submit to the Project Manager test certificates, furnished by the supplier or manufacturer of the materials, indicating compliance with the relevant City, Provincial or National standard.

### **Sub-Contractors**

81. At the time of tender, the Contractor shall submit to the Project Manager for their approval, a list of their proposed Sub-Contractors, suppliers and sources of materials required for the execution of the Works.
82. Names of additional Sub-Contractors, suppliers and sources may be submitted by the Contractor during the execution of the Contract, but no source of supply shall be changed without the Project Manager's approval, in writing.

### **Materials Samples**

83. Each Sub-Contractor and supplier must be willing to admit the Project Manager, or other Employer's representative, to its premises during normal working hours for the purpose of obtaining samples of the materials in question. Alternatively, if required by the Project Manager, the Contractor shall deliver the samples to the Project Manager's office. Samples shall be taken in accordance with the relevant City, Provincial or National standard where applicable. Materials subsequently supplied shall conform within specified tolerances to the quality of the samples which were supplied to the Project Manager.

### **Variations**

84. Variations to the materials specified or shown on the drawings may be permitted subject to the Contractor submitting full details of their proposals before related work begins. Such submissions shall be subject to the approval of the Project Manager in writing.
85. All submissions should be accompanied by evidence to demonstrate that the material complies with the requirements of the Specification.

#### **Inspection and Testing**

86. The Contractor shall be responsible for carrying out, or arranging to be carried out, all inspections and tests required to verify that the Works comply with the specified requirements.
87. The Contractor shall operate a system for identifying the inspection status of the Works at all stages.
88. The Contractor shall present adequate notice (not less than 5 days) to enable the Project Manager to be present, if so desired, at whatever inspections or tests are performed by the Contractor, Sub-Contractors, manufacturers and suppliers, and others.
89. A copy of all inspection records and reports shall be issued to the Project Manager for information and comment not more than five working days after the completion of the tests.

#### **Inspection Equipment**

90. The Contractor shall be responsible for providing; controlling, calibrating and maintaining survey, inspection, measurement and test equipment suitable to demonstrate that the Works comply with the specified requirements. This or similar equipment shall be made available to the Project Manager or other Employer's representative whenever required for the examination of the Works.

#### **Non-conforming Work**

91. Where, in the opinion of the Project Manager, any of the finished work or materials or workmanship fails to comply with the Specification, that part of the Works will not be accepted by the Employer.
92. Any work which the Project Manager judges to be inferior in respect to an approved sample or trial panel or to be unacceptably different from parts of the Works already constructed, or which is subsequently stained or damaged, will not be accepted by the Employer.
93. All such work shall be cut out and removed from the site and replaced or otherwise dealt with in an approved manner by the Contractor.

#### **Protection of the Works**

94. The Contractor shall be responsible for ensuring where appropriate that new work is adequately protected at the completion of each day and during periods of inclement weather.
95. All work exposed to view in the finished Works shall be protected from spillage, stains and other damage until completion of the project / hand over to the Employer.
96. The Contractor shall take all necessary actions to maintain the Works free from water where it may be detrimental to the Works. The Contractor shall obtain all necessary approvals from any interested parties to their proposals for disposal of water from the Works.

#### **Dimensional Accuracy**

97. Before work begins on site, the Contractor shall submit its proposed methods of dimensional setting out, bearing in mind the methods of construction and checking that will comply with the accuracies required. The Contractor shall be responsible for the protection and maintenance of all setting out.
98. The Contractor shall be responsible for co-ordinating the specified or agreed constructional accuracies with any Sub-Contractor or supplier and shall notify the Project Manager of any inadequacies or discrepancies before the related work begins on site.

The permissible inaccuracies given in the Specification below are to be applied to measurement of the Works at the completion of the elements.

99. Where two or more different tolerances can be derived by calculation or from the drawings for the same dimension, the least tolerance shall apply. Tolerances shall not be treated as cumulative.
100. Alternative tolerances to those specified may be permitted, providing these are submitted for written approval by the Project Manager before work begins on site. Where this change involves alterations to details already prepared, the Contractor shall include for provision of revised details in accordance with their proposals. Any such details shall be submitted for written approval by the Project Manager before the related work begins on site.

**Setting Out**

101. At every structural level the Contractor shall establish both a datum level and a horizontal reference grid in forms agreed with the Project Manager and with the following degrees of accuracy:

**Elevation**

102. Vertical dimension between any two datum levels: 3mm or 0.05% of the vertical distance between the two datum levels, whichever is the greater.

**Plan**

103. Dimension between any two intersection points on any reference grid: 3mm or 0.03% of the distance between the two points, whichever is the greater.

**Plumb**

104. Verticality of any point on any reference grid above the corresponding point on any lower reference grid: 3mm or 0.05% of the vertical distance.

**Level**

105. No intersection point on any reference grid shall be above or below any other point on the same grid by more than 3mm or 0.05% of the distance between the two points, whichever is the greater.

**Progress Photos**

106. Progress photographs are required but not limited to the following:
  - Excavation.
  - Installation of steel reinforcement.
  - Formwork.
  - Concrete work.
  - Installation of precast units.
  - Reinstatement of surface coverings.

## **EARTHWORKS**

### **General**

107. Materials and workmanship shall be in accordance with the City of Toronto Standards:

- TS 2.10 Construction Specification for General Excavation.
- TS 206 Amendment to OPSS.MUNI 206 – Construction Specification for Grading.
- TS 501 Amendment to OPSS.MUNI 501 – Construction Specification for Compaction
- TS 1010 Amendment to OPSS.MUNI 1010 -Material Specification for Aggregates – Base, Subbase, Selected Subgrade, and Back Fill Material.

### **Standards:**

108. All relevant Standards incorporated in the above publication shall apply.
109. Excavation shall be carried out, as far as possible in the dry. The Contractor shall submit proposals for diverting or removing water entering the excavations, for the approval of the Project Manager.
110. The Contractor shall inspect and approve all sub-grade material beneath the foundations in accordance with the relevant City of Toronto Standard. The Contractor shall arrange for any 'Soft Spots' to be removed and refilled and compacted with suitably approved material.
111. The Contractor shall submit their proposals for the fill material to the Project Manager for approval, in writing.
112. It is likely that excavated material will be acceptable for use as back fill. However, any contaminated soil found shall be removed from site by the Contractor and disposed of in an approved manner. Records of disposal shall be issued to the Project Manager. All back fill shall be well compacted to meet the requirements of TS 206 for pedestrian walk ways with some vehicle movements where highlighted.

## **ROADS AND PAVEMENTS**

### **General**

113. Materials and workmanship shall be in accordance with the relevant City of Toronto Standards, as noted in 110 above.

### **Standards:**

114. All relevant City, Provincial or National standards shall apply.
115. The Contractor shall install and maintain all necessary traffic signals and road danger lamps, during the installation of the Works.
116. The Contractor shall reinstate the roads and pavement areas to match the existing finishes to the City of Toronto areas, all to the Project Manager's and Highways authority satisfaction.

## **CURBS, FOOTWAYS AND PAVED AREAS**

117. Existing curbing which has been taken up shall be reused and tied in flush with the Heald Matador unit.
118. Existing paved areas shall be reinstated like for like unless stated otherwise on relevant drawings.
119. Where tactile and paving stones become damaged and needs to be replaced, the Contractor shall replace like for like and submit details of the proposed replacement stones to the Project Manager, and City of Toronto for written approval. The stone paving slabs are imported, and therefore any replacement slabs may have a significant knock-on effect causing delays within the programme. Therefore, utmost care shall be taken when handling the paving slabs.

## **ROAD DRAINAGE**

120. In general, the roads are curbed and are drained with the use of a series of road-gullies. Where these become damaged and need to be replaced the Contractor shall submit details of the proposed replacement curb and channel blocks to the Project Manager and City of Toronto for written approval.
121. The Contractor shall also ensure that the road drainage system has not become damaged by the Works and shall be responsible for rectifying any damage that may have occurred during the installation of the Works.

## **EXISTING SUB-STRUCTURES**

122. The extents of the TTC structure in the construction areas have been identified during the trial hole works and are shown on the drawings. These structures shall remain in place as part of the works. The Contractor shall make considerations for this not being damaged as part of the works.

## **DUCTS AND CABLE TRENCHES**

123. It is the Contractor's responsibility to liaise with all Utility companies and to confirm with them their specific requirements for ducting and trenches.
124. Additional services are also expected to be encountered such as Gas, Water (both foul, surface and mains), and Telecommunications. The position of these utilities has been established by the Employer as far as practicable with the use of ground penetration survey, details are provided on the detailed design drawings.
125. The Contractor shall not interfere with, or cause damage to, any existing drain pipe, culvert, buried service, duct or the like.
126. It should be noted by the Contractor that there is a potential for unknown underground services to be present in the area of the Works, these could still be live and care shall be taken when excavating.

## **REINFORCED CONCRETE WORK**

### **General**

#### **General Standards and Tolerances**

127. All work shall be constructed strictly in accordance with this Specification and other working drawings and documents issued by, or approved by, the Project Manager. Work which is defective shall be removed and reconstructed or rectified to the Project Manager's satisfaction at the Contractor's own expense and no undue delay will be accepted in making such rectifications. The Contractor will also be responsible for any consequential losses caused by defective materials or workmanship.
128. The work shall be constructed strictly in accordance with the profiles, dimensions and levels, etc., shown on the drawings and working documents. The acceptance of any work which is not built exactly in accordance with the information approved by the Project Manager shall be solely at their discretion. The Project Manager reserves the right to check work constructed by the Contractor at any time they consider appropriate but there is no duty on their part to make such checks and any errors which are not detected in this way shall not relieve the Contractor of their obligations to carefully check all aspects of the work as construction proceeds to ensure that it corresponds exactly to that required by the Contract. No tolerances or deviations will be accepted by the Project Manager which have any

significant effect upon the Works or its relationship with other elements, such as maintaining clear pavements widths in accordance with City of Toronto requirements.

129. A schedule of permitted structural tolerances forms Appendix A of this Specification.

#### **CONCRETE GRADES.**

130. Concrete grades must be as follows:

131. All concrete shall be cured for a period of at least 7 days before any loading is applied to the foundation and must be in accordance with the product manufacturer's specification.

#### **MATERIALS**

132. Cement

- a) Ordinary or Rapid Hardening Portland Cement shall be from an approved manufacturer and shall comply with TS 1350, OPSS 1301, and associated referenced standards.
- b) Sulphate Resisting Portland Cement shall be from an approved manufacturer and shall comply with TS 1350, OPSS 1301, and associated referenced standards.
- c) Other types of cement shall not be used without the written approval of the Project Manager.
- d) Cement shall be delivered to site in the original manufacturer's containers which must be sound and unbroken, or in approved bulk containers. Cement shall be protected from deterioration and will be condemned if affected by dampness aeration or other factors.

133. Aggregates

All aggregates shall be of naturally occurring materials and shall comply with OPSS 1001 and OPSS1002 Samples of proposed aggregates shall be submitted by the Contractor to a nominated laboratory and tested in accordance with this Specification.

The Project Manager may require the Contractor to draw and test samples of the aggregates from the stockpiles in accordance with this Specification.

Aggregates shall be stored on a well-drained, clean, hard surface in separate bunkers or so that mixture of the various gradings and other contaminations are prevented.

134. Water

Water used for concrete or curing shall comply with OPSS 1302 and shall be clean and free from chemical and organic impurities.

135. Reinforcement

Reinforcement shall be from an approved source and shall be kept clean and free from rust.

- a) Mild Steel Reinforcement shall comply with OPSS 1440.
- b) High Yield Steel Reinforcement shall comply with the requirements of OPSS 1440 and shall only be hot rolled high yield deformed bars.
- c) High tensile fabric reinforcement shall comply with ASTM A1064 and be made from deformed high yield steel bars complying with CSA G30.18.

The Project Manager may inspect the manufacturer's works or supplier's depot at any time and instruct the Contractor to carry out sample tests on reinforcement in a nominated laboratory before and/or after delivery in accordance with this Specification.

136. Tying Wire

Tying wire for steel reinforcement shall be 1.6mm diameter steel or annealed soft iron wire.

137. Cover Blocks and Spacers

Concrete cover blocks and plastic spacers shall be designed to maintain the correct clear cover of concrete over steel reinforcement. They shall be as small as possible consistent with their purpose, and of a shape acceptable to the Project Manager.

Cover blocks made from cement, sand and small aggregate shall match the mix proportions of the surrounding concrete so far as is practicable with a view to being comparable in strength, durability and appearance.

**CONCRETE**

138. **Designed Mixes**

a. The Contractor shall produce Designed Mixes as necessary and as defined in TS 1350, to the following grades: -

b. **Table 1 - Concrete compressive strengths**

Concrete Grade	Characteristic Compressive strength at 28 days (N/mm <sup>2</sup> )
<b>C20</b>	20
<b>C25</b>	25
<b>C30</b>	30
<b>C35</b>	35
<b>C40</b>	40
<b>C50</b>	50

140. The compressive strength specified shall be determined in accordance with this Specification.

141. Designed concrete mixes shall be subject to the following conditions: -

142. The minimum cement content shall be as defined in CSA A23.1 for the appropriate grade of exposure unless stated otherwise.

(l) In addition to the above, unless specifically noted, concrete of grades C30 and above shall contain a cement content of not less than 300kg/m<sup>3</sup>.

143. The concrete shall be of the required workability for proper compaction by vibration.

144. The nominal maximum aggregate size for Designed Mixes shall be 20mm unless stated otherwise on the drawings.

145. The Contractor shall submit to the Project Manager full details of the mix design for approval.

146. The maximum total chloride content out of the concrete mix arising from the cement, aggregate, and any other source shall not exceed 0.1% chloride ion by mass of cement when determined in accordance with OPSS 1350 and CSA A23.1

147. The total acid soluble sulphate content of the concrete mix, expressed as SO<sub>3</sub> shall not exceed 4% of the mass of the cement in the mix.

148. Control of Alkali-Silica Reaction – Comply with the relevant specifications.

149. **Standard Mixes**

150. The Contractor shall produce Standard Mixes in accordance with the requirements of TS 1350.

151. Standard Mixes shall be subject to the following conditions: -

152. The nominal maximum aggregate size for Standard Mixes shall be 20mm unless stated otherwise on the drawings.
153. The concrete shall be of the required workability for proper compaction by vibration.
154. **Ready Mixed Concrete**
155. Ready mixed concrete shall comply in all respects with this Specification.
156. All materials used shall comply with this Specification and be tested in accordance with the relevant British Standards or equivalent, the cost of such tests being the responsibility of the Contractor.
157. The Contractor shall not place an order with the supplier without the prior written approval of the Project Manager who may carry out inspections of the works of the proposed supplier. All arrangements between the Contractor and the supplier concerning the purchase of the concrete shall be conducted in accordance with TS 1350 and CSA A23.1.
158. The Contractor shall make and test preliminary and works cubes in accordance with this Specification irrespective of any cubes made by the supplier.
159. The following records concerning each delivery of ready mixed concrete shall be kept by the Contractor and be available for inspection on site at any time:
- i. The date and time when the concrete materials are mixed at the supplier's works.
  - ii. The registration number of the truck and depot of origin.
  - iii. The date and time of arrival of the truck on site.
  - iv. Time of adding water to dry materials if truck mixed.
  - v. Time when placing of concrete is completed.
  - vi. Quality or details of mix.
  - vii. Precise description of where concrete is placed in the structure.
  - viii. Whether test cubes taken.
  - ix. Slump.
  - x. Total volume of concrete delivered.
160. Copies of all such records shall be sent to the Project Manager on completion of the reinforced concrete construction.

## **TESTING OF MATERIALS**

### **General**

161. When instructed in writing by the Project Manager, the Contractor shall place official orders for the following preliminary and routine testing of structural materials, and any such other materials as may be directed, with an independent testing laboratory nominated by the Project Manager.
162. The Contractor shall be responsible for all costs involved in: -
- a. Testing materials, proposed as in alternative to those specified or replacement sources of supply.
  - b. All unsatisfactory tests.
163. All laboratory test certificates shall be distributed as directed by the Project Manager.

### **Preliminary Testing of Aggregates**

164. The Contractor shall immediately advise the Project Manager of the aggregates it proposes to use in the Works and the Project Manager reserves the right to call for the following tests to be carried out in the nominated laboratory: -
165. Determination of
- i) The Initial Drying Shrinkage

- ii) The Wetting Expansion
  - iii) The Drying Shrinkage
  - iv) Young's Modulus
166. Of concrete manufactured from the proposed aggregates in accordance with the Contractor's Designed Mixes. (All testing carried out in accordance with CSA A23.2)
167. Subject to the Project Manager's acceptance of the results of the above tests, or their agreement to the source of the proposed aggregates, the Contractor shall instruct the nominated laboratory to carry out the following tests on samples of the proposed aggregates:
168. Determination of
- i. Shape
  - ii. Surface texture
  - iii. Flakiness index
  - iv. 10% fines
  - v. Aggregate impact value
  - vi. Shell content
  - vii. Chloride ion content
  - viii. Relative density
  - ix. Water absorption
  - x. Grading
  - xi. Silt, clay and dust content
169. Sampling and testing of aggregates shall be carried out in accordance with the Ministry of Transport, Ontario Laboratory Testing Manual.
170. Tests will be required on representative samples of all aggregates proposed for use including, where applicable, those for pre-cast concrete work manufactured off site, ready mixed concrete, etc.
- 171. Preliminary Testing of Concrete - Trial Mixes**
172. If instructed by the Project Manager, the Contractor shall supply and deliver samples of the materials proposed for the Works to the nominated laboratory where preliminary test cubes shall be made from concrete manufactured in accordance with the Contractor's Designed Mixes.
173. In respect of each quality of concrete, three separate batches of concrete shall be made. The workability of each batch shall be determined in accordance with TS 1350 for the appropriate specified workability. Three samples will be required for 7, 28 and reserve samples. One set from each first 10 cubic metres per grade and thereafter 1 set per 50 cubic metres will also be required.
174. Cubes shall be prepared, cured and tested in accordance with TS 1350. Compliance with the characteristic strength for preliminary testing of concrete shall be assumed if
- a. The average of the nine individual 28-day cube strengths exceeds the specified characteristic strength by 30% for concrete of grade C20 and above, and
  - b. For all grades of concrete, the strength achieved by any individual preliminary concrete test cube when tested at 28 days is not to be less than the specified characteristic strength.
175. The Project Manager may permit the use of such mixes prior to the results of the 28-day test being available, subject to favourable results of the 7-day tests.
176. It is anticipated that concrete will have achieved not less than two thirds of its characteristic strength at 7 days.
177. If the results of such tests fail to achieve the conditions given in either a) or b) above, the Contractor shall submit revised mix designs to the Project Manager in accordance with this Specification. Costs incurred in the subsequent mix redesign shall be the responsibility of the Contractor.

### **Routine Testing of Aggregates**

178. The moisture content of all aggregates shall be determined as requested but at least once daily and adjustments made to the amounts of water and weights of aggregates to compensate for any variations in moisture content and to maintain the free water/cement ratio at the correct design value.
179. The gradings of coarse and fine aggregates shall be checked by the Contractor at least once weekly to ensure that the gradings on site comply with those used in the production of preliminary mixes in accordance with this Specification. If site batched aggregates are to be used, standard sieves shall be maintained on site and be available to the Project Manager at any time.
180. All sampling and testing of aggregates shall be carried out in accordance with CSA A23.A.

### **181. Routine Testing of Concrete Cubes**

182. Concrete cubes shall be made, cured and delivered by the Contractor to the nominated laboratory all in accordance with CSA A23.2.
183. Cubes shall be clearly and indelibly marked for identification and delivered damp, well protected and in good condition. The cubes shall be tested in the laboratory, using approved apparatus, in accordance with CSA A23.2. In respect of each of the first two placings of each quality of concrete specified, random concrete samples shall be taken and a set of 9 works test cubes shall be made. Three cubes from each set of nine shall be tested by the nominated laboratory at intervals of 7 and 28 days. The sampling rate thereafter of concrete will be in accordance with one of the following: -

*a. Sampling Rate I*

Take one set from each first 10 cubic metres per grade.

*b. Sampling Rate II*

Take one set from each 50 cubic metre thereafter.

In respect of each set of 9 cubes, 3 are to be tested at 7 days, 3 are to be tested at 28 days, and 3 are to be reserve samples.

Where there may be a lapse of two weeks or more between successive placements of the same grade, samples should be taken from every placement.

Where applicable, pre-cast concrete suppliers shall comply with the above sampling and testing rates.

The Contractor shall provide and instruct the laboratory to include on their test certificates the following details concerning each specimen tested: -

- (i) Mark of cube
- (ii) Date of casting
- (iii) Date of test of cubes
- (iv) Quality of concrete
- (v) Slump
- (vi) Section of work represented by test cube

184. Concrete Strength determined from routine concrete cube tests
185. For the purpose of strength assessment from routine cube tests, a "test result" is defined as the average strength determined from three 7- or 28-day test specimen results of the same concrete sample.
186. Compliance with the specified characteristic strength for routine testing of concrete shall be assumed if:

187. The average strength determined from any group of four consecutive "test results" exceeds the specified characteristic strength by  $3N/mm^2$  for concretes of grade C20 and above and in any group of four consecutive "test results" only one "test result" shall be permitted to be below the specified characteristic strength and the value of this "test result" shall not be less than the specified characteristic strength minus  $3N/mm^2$  for concretes of grade C20 and above.
188. In addition to the above no individual 28-day test specimen is to be less than 85% of the specified characteristic strength.
189. It is anticipated that acceptable concrete will have achieved not less than two thirds of its characteristic strength at 7 days.
190. Where quantities of concrete are such that four "test results" are not achieved, the Project Manager shall decide on the compliance of the concrete based upon the test results available.
191. If the results of the above tests fail to comply with the above requirements the Project Manager may:
  - Condemn the defective portions of work.
  - Instruct the Contractor to cut samples of concrete from the finished work for testing, in locations to be directed by the Project Manager.
  - Instruct the Contractor to carry out load tests on the elements as directed. The test procedures and standards of acceptance imposed may be in excess of those specified in the relevant Code of Practice.
192. Carry out other tests as specified.
193. All costs and delays incurred in such tests shall be the responsibility of the Contractor.
194. After obtaining unsatisfactory cube "test results" during the progress of the Works the Contractor shall substitute redesigns for the defective mixes to be confirmed by tests in accordance with this specification. The Project Manager may permit an increase in cement content as a temporary measure pending confirmation of the redesigned mix test results. All additional costs thus incurred as a result of changing mix proportions and design shall be the responsibility of the Contractor.

#### **Routine Testing of Concrete Workability**

195. Workability of concrete shall be determined in accordance with TS 1350, adopting the methods appropriate for the specified workability. Results of such tests shall be submitted to the Project Manager.
196. Workability shall generally, where appropriate, comply with the limits indicated in TS 1350 and CSA A23.1.
197. The Project Manager may, from time to time, request additional workability tests on concrete. Such tests shall be carried out in the presence of the Project Manager or their representative on site in accordance with CSA A23.2. Apparatus as defined in CSA A23.2 for testing shall be kept on site and maintained in good order by the Contractor.

#### **Testing of Steel for Reinforcement**

198. All hot rolled materials shall be subject to routine inspection and testing by the manufacturer in accordance with OPSS 1440. A record of test results of materials confirming to this standard shall be kept by the manufacturer in compliance with the relevant standard. In addition, a certificate of compliance shall be kept by the manufacturer.
199. The records shall be available for inspection by the Project Manager.
200. The Project Manager may also select samples of reinforcement for testing at any time before delivery or during progress of the work. In this event, the Contractor shall cut three test pieces from each sample and send one piece to the nominated laboratory for testing. The two remaining pieces shall be retained

for testing as directed by the Project Manager, in the event of this initial testing proving unsatisfactory. The laboratory shall be instructed to carry out the following tests in accordance with the appropriate British Standard: -

- (i) Yield Point
- (ii) Elongation
- (iii) Bend Test
- (iv) Ultimate Tensile Strength (mild steel only)

## **MIXING, TRANSPORTING, PLACING AND CURING OF CONCRETE**

### **Gauging and Mixing**

201. All gauging and mixing shall be carried out in accordance with TS 1350 and CSA A23.1 and the following additional conditions: -
- Records of monthly calibration of batching plant shall be kept on site for inspection by the Project Manager who may call for additional checks as required.
  - The Contractor shall take adequate precautions to prevent loss of materials by spillage during transfer from batching hoppers to the mixer.
  - The Contractor shall not add any substance to the concrete, other than those specified, without the prior written approval of the Project Manager.
  - All mixing shall be carried out in power driven machines fitted with water supply devices capable of being controlled so that the correct quantity of water is delivered to each batch in one continuous operation. The practices of discharging partial quantities of water at the discretion of the mixer operator and of mixing concrete by hand are not permitted.
  - Mixing plant shall be thoroughly cleaned after being out of use for more than 30 minutes and between using different types of cement and/or different types of additives.

### **Storage of Concrete cubes**

202. Concrete cubes that have been created for testing shall be stored in similar conditions to that of the reinforced concrete structure. The Contractor shall ensure that if RC elements are covered / protected from environmental conditions, the test cubes shall also be treated the same. This shall ensure that the concrete cube strength is representative of in-situ structure.

### **Transporting**

203. Concrete shall be transported from the mixer to its final position as quickly as possible in skips, chutes, barrows or other approved methods avoiding segregation and contamination. Details of any system involving pumps, chutes and conveyor belts must be submitted to the Project Manager for approval in writing before any such plant is used.
204. All plant and tools used for transporting concrete must at all times be kept clean and free from accumulated deposits of concrete.
205. Ready mixed concrete shall be transported to site in suitable truck mixers. Delivery from the truck mixer to final placing of concrete shall take place within 1.1/2 hours of the time when the cement first comes into contact with the wetted aggregates or 1 hour if the air temperature is less than 5 deg.C or above 27 deg.C.
206. In the case of concrete mixed at the supplier's plant, the concrete shall be continuously agitated by rotating the truck mixer drum during transit and whilst awaiting discharge.

207. No plant or tools used in the transportation of concrete shall be cleaned and washed within or adjacent to the Works or site. The Contractor must avoid the contamination of rain water drainage, footpath and road surface at all times.

#### **Placing and Consolidation**

208. All concrete shall be placed in layers not exceeding 450mm thickness avoiding segregation, and the consolidation of each layer completed before further concrete is placed.
209. The concrete shall be consolidated by means of mechanical vibration and be worked carefully around reinforcement and against formwork to ensure thorough compaction.
210. Vibration shall be carried out in accordance with OPSS 904. Generally, vibrators are to be of the internal poker type but where external vibrators are proposed the prior approval of the Project Manager must be obtained, in writing.
211. After being placed and compacted the concrete must be left undisturbed during setting and an accurate record shall be kept on site by the Contractor, showing dates and times when the various portions of the work were concreted and a copy of such records sent to the Project Manager on completion of the reinforced concrete construction.

#### **Curing and Protection**

212. All newly placed concrete shall be protected to prevent avoidable loss of moisture from the surface for at least a period of 7 days (or 3 days for Rapid Hardening Portland Cement).
213. Newly placed concrete shall be protected from all weather conditions and damage from workmen, plant, overloading, or any other cause. Concrete in foundations and other underground work shall be protected from contamination by falling earth during and after placing. Concrete placed in ground containing damaging salts shall be kept free from contact with ground water during placing and until the concrete has attained the specified characteristic strength. Ground water around basements, etc., shall be kept down to an approved level by pumping until the concrete has reached its characteristic strength and until there is no danger of flotation due to hydrostatic pressure.

#### **Hot Weather Working**

214. During hot weather, concreting shall be carried out as quickly as possible and, immediately after placing, exposed surfaces and shuttering shall be covered and kept moist by approved means to reduce and control evaporation. Cement shall not be allowed to come in contact with water at a temperature greater than 60-degree C.
215. Rapid Hardening Portland Cement shall only be used during hot weather (above 25-degree C daily peak temperature) when approved by the Project Manager.

#### **Cold Weather Working**

216. A maximum and minimum thermometer and a soil or concrete thermometer shall be kept on site at all times and site records of temperatures maintained on site for inspection by the Project Manager.
217. When the air temperature is below 2°C measured on a rising thermometer or below 5 °C measured on a falling thermometer, concreting will not be permitted except at the risk of the Contractor, who must prevent the concrete from freezing.
218. The Contractor shall comply with the recommendations of TS 1350 and shall ensure that the temperature of the concrete never falls below 5°C.
219. The Contractor shall take responsibility for any damage to concrete construction resulting from frost action, including frost heave, where concrete is in contact with the ground, and freezing water in bolt holes, pockets, etc.

#### **FORMWORK**

### **General**

220. Formwork shall be accurately constructed so as to give finished concrete corresponding to the shapes, lines, grades and dimensions shown on the drawings, in accordance with this Specification.

### **Construction**

221. The Contractor shall design and construct the formwork and its support in accordance with OPSS 919 or equivalent, sufficiently strong and rigid to support the load of the concrete and any other loads without deformation, deflection or leakage. Immediately before concreting, the inside faces of the formwork are to be cleaned out and all loose matter shall be removed.
222. The formwork may be treated with an approved release agent in accordance with this Specification.

### **Removal of Formwork**

223. Formwork shall be struck without vibration or shock loading and precautions taken to prevent damage to finishes, arises, mouldings, etc.
224. The Contractor shall be entirely responsible for all costs arising from the demolition and reconstruction or rectification of any concrete damage due to incorrect or premature removal of formwork and/or propping.

### **Fixings and Indentations**

225. Except where indicated on the drawings or otherwise specified, no openings, chases, holes, conduits, etc., shall be formed in, or cast into, the concrete without the prior approval of the Project Manager. No fixings, lugs, plugs etc., shall be of such a size, style and in such a location as to weaken the concrete.
226. Fixings shall not be inserted by means of explosives without the prior approval of the Project Manager and such fixings will not be permitted on outer faces and/or where rusting could ensue.

### **Supports left in Concrete**

227. No shuttering supports or other similar fixings shall be left permanently embedded in the concrete without the prior written approval of the Project Manager.

## **LOADING OF FOUNDATION DURING CONSTRUCTION**

### **Contractors Plant Loading**

228. Full details of all plant, such as vehicles, cranes, etc., or other constructional equipment which will impose any load or force on the foundations during the works, shall be submitted to the Project Manager for approval in writing before the work commences. Where it is necessary and possible to strengthen the structure to accommodate such additional loads, the Contractor shall be responsible for any additional costs involved including those of the Project Manager and for making good any damage to the permanent foundation.

## **REINFORCEMENT OF CONCRETE**

### **General**

229. The Contractor shall be responsible for providing on site such skilled bar benders and bending machines, etc., including stocks of reinforcement, as are necessary to ensure that minor variations to reinforcement can be dealt with expeditiously and without incurring avoidable delays.

### **Bending and Fixing**

230. The bending of steel reinforcement shall be carried out cold and comply with OPSS 905 and CSA-S6.

231. Welding of reinforcement is not permitted without the prior written approval of the Project Manager.
232. High yield reinforcement shall not be straightened or re-bent in any circumstances.
233. Before placing concrete, all reinforcement shall be free from loose mill scale, rust, oil, dirt, grease, etc. and shall be accurately fixed as indicated on the drawings. Bars shall be wired together and adequately supported to prevent movement during concreting. Pre-pour inspections are to be carried out and recorded by a competent engineer, the inspections are to be made available to the Project Manager if requested.

#### **Cover**

234. Approved spacer clips or spacing blocks in accordance with this Specification shall be used where necessary to maintain the specified cover but shall not be used in exposed faces, fair faced concrete or where other special finishes are specified, without the prior approval of the Project Manager.

#### **JOINTS IN CONCRETE**

##### **General**

235. All joints are to be accurately located, straight and well aligned, and truly vertical or horizontal or parallel with the setting out lines of the foundation.

##### **Construction Joints**

236. Unless otherwise specified, construction joints shall be made in places of low shear stress and generally at right angles to the direction of main reinforcement.
237. Shuttering for joints shall be designed so as to prevent undue leakage of cement or concrete. After striking, any concrete which has leaked shall be removed and the face of the concrete grit blasted or needled to remove all laitance and loose material. Immediately before concreting resumes, the face of the existing concrete must be well soaked with water.

##### **Designed Joints**

238. All expansion, contraction, isolation and other designed joints shall be indicated on the Contractor's drawings in respect of form and position.

#### **FINISHES TO CONCRETE**

##### **Release Agents**

239. The use of release agents or mould oils is permitted subject to the following conditions: -
240. The Contractor shall ensure that the density and durability of the surface of the concrete is not impaired by the application of releasing agents.
241. The Contractor shall be responsible for ensuring that the release agent used is compatible with any intended applied finishes to the surface of the concrete.
242. No site mixing of emulsions or oils will be permitted. Storage and application should be strictly in accordance with the manufacturer's recommendations.
243. Formwork for all exposed concrete surfaces shall be treated with the same agent.

##### **Formed Finishes**

244. Formwork for concrete shall be designed and constructed in accordance with this Specification to produce the finishes specified below.

Class F1 – No extra requirement

Class F2 – The irregularities in the finish shall be no greater than those obtained from the use of wrought thickness square edged boards arranged in a uniform pattern. The finish is intended to be left as struck but imperfections such as fins and surface discolouration shall be made good.

Class F3 – The resulting finish shall be smooth and of uniform texture and appearance. The formwork lining shall leave no stain on the concrete and shall be so joined and fixed to its backing that it imparts no blemishes. It shall be of the same type and obtained from only one source throughout any one structure. The Contractor shall make good any imperfections in the finish. Internal ties and embedded metal parts shall not be used.

Class F4 – The requirements for Class F4 are as for Class F3, except that internal ties and embedded metal parts shall be permitted.

Class F5 – The resulting finish shall be smooth and of uniform texture. Any blemishes and imperfections, such as discolouration and fins, shall be made good. Provision for the embedment of metal parts in the Permanent Works on a regular spacing, shall be allowed.

245. Required in-situ concrete finish shall be F1.

#### **Horizontal Surfaces and Tops of Slabs**

246. The Contractor shall be responsible for ensuring that the finish of horizontal surfaces and tops of slabs is compatible with any applied finishes specified in the Contract Drawings.
247. Where no applied finish is specified, horizontal surfaces and top surface of slabs shall be steel floated to a smooth surface at the levels or falls shown on the drawing.

#### **Repair of Defective Work**

248. If, in the opinion of the Project Manager, any concrete is voided or honeycombed to such an extent that the design, stability or durability is affected in any way then the Contractor shall demolish and replace the work at its own expense. Other areas of honeycombing shall be cut out and made good with fine concrete of the specified quality as directed by the Project Manager.

#### **Retarding Agents**

249. No retarding agents shall be used without the prior written approval of the Project Manager.

**APPENDIX A**  
**CONCRETE BLOCKS**

**PRE-CAST REINFORCED CONCRETE WORK**

**General**

250. Pre-cast concrete work shall generally comply with the relevant clauses of this Specification.

**Execution of Work**

251. All units shall be made at a pre-cast works (Townscape Products Ltd, UK) as specified. The Project Manager may visit the Works at any time to carry out inspections, but such inspections do not relieve the Contractor of its liability for replacing materials which fail to comply with this Specification.

**Testing**

252. If required, facilities shall be provided by the Contractor for testing units to breaking point and for studying deflections, etc. All units broken during testing will be paid for at the Contract rates unless found defective.
253. If instructed by the Project Manager, the Contractor shall supply and deliver samples of the pre-cast unit to the nominated laboratory where initial surface absorption tests shall be carried out in accordance with TS 1350 and CSA A23. The test report shall be distributed as directed by the Project Manager.

**Reinforcement**

254. The Contractor shall assemble a specimen reinforcement cage for each type of unit to ensure that the specified concrete cover is maintained with the reinforcement as detailed and scheduled.

**Finishes to Pre-Cast Concrete**

Colour – Prestige Yorkstone Buff.

Concrete Grade C50

Supplier: Townscape Products, Fulwood Road South, Sutton in Ashfield, Notts UK NG17 2JZ

Test samples shall be provided by the Contractor for the approval of the Project Manager.

Finish – Buff

Surface coating: Protective anti-graffiti finish – PSS20 - Initial coat: 1 Finishing coat: 2.

A sample of the above concrete finish must be supplied with 30 days of award of contract for the approval of the Project Manager. All exposed faces shall comply with the specified finish detailed above. The Contractor shall not commence manufacture of the pre-cast units until the test sample has been approved in writing by the Project Manager

**Construction Joints**

255. Pre-cast units shall be made in one continuous operation unless otherwise agreed with the Project Manager.

**Marking**

256. All units shall be clearly and indelibly marked for identification purposes on an unexposed face.

**Lifting and Movement of Units**

257. The Contractor shall submit details of the proposed lifting assembly for the Project Manager's approval. The Contractor shall be responsible for all damage to units resulting from early handling, lifting, loading and transporting operations and shall replace at his own expense any units so damaged.

**Transporting Units**

258. Units shall be carefully protected from damage and overstressing during transit.

**Delivery of Units**

259. Adequate lifting facilities shall be provided on site to avoid damage during delivery. All units delivered to site may be inspected by the Employer or Project Manager before installation and defective units will be rejected. However, failure to carry out such inspections or to observe errors shall not relieve the Contractor of its responsibilities in these respects.

Suitably designed plant or equipment shall be used to prevent damage during hoisting operations.