Building and Construction Authority

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ASSOCIATION OF CONSULTING ENGINEERS SINGAPORE

Guide Book for Site Supervision Plan

Jointly published by **BCA, IES & ACES**

Version 1.0

Sep 2019

History of Amendments

S/N	Brief description of changes	Revision date
1	Version 1.0 – first issue	Sep 2019

ACKNOWLEDGEMENTS

The Guide Book for Site Supervision Plan is jointly published by:

1. Building and Construction Authority (BCA)
2. Institution of Engineers Singapore (IES)
3. Association of Consulting Engineers Singapore (ACES)

FOREWORD

The Guide Book for Site Supervision Plan provides guidance to Supervision Qualified Persons (QP) in preparation of the Site Supervision Plan. The Site Supervision Plan is intended to set out the principles, requirements and operation of a site supervision plan which is expected to be a document setting out parties' expectations for QP and site supervisors (SS) appointed for the project to supervise the carrying out of construction for structural elements and geotechnical aspect of building works. SS shall be accredited with Joint Accreditation Committee (JAC) of the Institution of Engineers Singapore (IES) and the Association of Consulting Engineers Singapore (ACES).

The supervision requirements set out in the guide book are risk-based. The building works with higher risk have more stringent supervision requirements to be provided by the QP and team of SS. Please refer to **Annex 1** on the framework for risk-based inspection which defines the risk level for different type of works.

Site inspections during the construction of buildings are important to ensure structural safety, but effort in assessing potential risk of critical works would reduce most of the potential mishandling during construction. Therefore, a risk based inspection regime takes into account the varying risk of different type of works. Risk based inspection focus on what to inspect and when to ensure building and public safety in an efficient manner.

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Part I
Preliminary

1 Scope

1.1 This Guide Book guides Supervision Qualified Persons (QP) in preparing the Site Supervision Plan.

1.2 The Guide sets out the principles, requirements and operation of a Site Supervision Plan, covering: -

(a) the principles for the preparation of Site Supervision Plans;

(b) the form and content of a Site Supervision Plan;

(c) the level of supervision of various types of building works; and

(d) the requirements for material and construction testing.

1.3 The Site Supervision Plan aims to supplement the provisions of the Building Control Act and building regulations stipulating the duties of the QP and site supervisor (SS) appointed to supervise the carrying out of building works relating to structural elements and geotechnical works.

1.4 The provisions of the Building Control Act and building regulations will take precedence over the Site Supervision Plan prepared by QP where any difference exists.

1.5 For other requirements and guidance on site supervision, please refer to the Code of Practice, the Execution Standards and the relevant circulars issued by Building and Construction Authority (BCA).

2 Objectives

2.1 A Site Supervision Plan sets out the steps and actions for SS to take all reasonable steps and exercise due diligence to:

a.) give full-time supervision to the carrying out of building works relating to the structural elements of Large Building Works (project value more than $7.5mil) to ensure that such works are carried out in accordance with plans of such building works approved under section 5 of the Building Control Act.

b.) provide immediate/periodic supervision to the carrying out of building works relating to the structural elements (refer to **Annex 5: Minimum Level of Immediate Supervision**) of Small-scale building works (project value up to $7.5mil) to ensure that such works are carried out in accordance with plans of such building works approved under section 5 of the Building Control Act.

2.2 SS must have a clear understanding on the minimum level of supervision for each critical structural works.

Large Building Works – project value more than $7.5 mil

Small-scale Building Works – project value up to $7.5 mil

2.3 The goal is to ensure that the structural elements of the building works, including geotechnical works are carried out according to the approved plans of the building works, the provisions of the Building Control Act and Regulations and the project specifications and requirements. As the SS is working under the QP's control and direction, SS shall immediately notify the QP whenever this has not been met or when the building works are not being carried out according to the Building Control Act and its building regulations or any terms and conditions imposed by the Commissioner of Building Control.

3 Site Supervision Plan

Submission

3.1 The Site Supervision Plan shall be forwarded to BCA for BCA's reference within one (1) month after obtaining permit to commence structural works for Large Building Work. QP is advised to forward the Site Supervision Plan to BCA as a correspondence to the permit application.

3.2 QP is advised to ensure that the Site Supervision Plan is prepared having regard to the provisions of the Building Control Regulations, the Building Control Act and any other written law pertaining to the construction of buildings for the time being in force.

3.3 QP is also advised to prepare schedule of material tests in compliance with approved drawings, design requirements and updated/latest material standards for the test frequency and acceptance criteria for use in structural works as part of the Site Supervision Plan.

3.4 Site Supervision Plan is a “live” document. The QP should continue to update the Site Supervision Plan progressively as the construction work progresses. The updated Site Supervision Plan should be kept at site for reference and audit inspections.

3.5 It is advisable that the QP briefs the team of SS on the Site Supervision Plan as soon as possible and the QP must issue a copy of the said plan within a reasonable timeframe having regard to the work schedule onsite. The QP must take into consideration that the paramount objective of the Site Supervision Plan is mean to be adhered to as best possible by the SS and as such, it is recommended that a copy of the Site Supervision Plan is disseminated to the site supervision (SS) team as soon as the permit to commence structural works is issued but in any event, no later than one (1) month from the date of permit issuance. SS must understand the details of supervision requirements stipulated in the Site Supervision Plan prepared by QP before carrying out the supervision of structural works.

3.6 For Small-scale Building Works, the Site Supervision Plan, it is advisable that the QP has a Site Supervision Plan which should be kept at the site at all times during the execution of building works for reference by SS team and QP.

<u>Role & responsibilities</u>

3.7 For clarity, it is advisable that the organisation chart of the SS team is provided in the Site Supervision Plan with the roles, scope and responsibilities of each supervisor clearly indicated. All the SS for large building works shall be full-time including the ERSS, cladding, and barrier works.

3.8 There are various options in the deployment of full-time SS for large building works including the following two options:-.

Option 1: Multiple QPs with One Team of Site Supervision

- One team of SS reports to multiple QPs. The team of SS must supervise all the structural works in the project.

Option 2: Single QP

- Single QP and one team of SS to supervise all the works in the project.

Project parties are to ascertain which option are best suited for their construction project. At all times, provisions of the Building Control Act and building regulations must be complied with.

3.9 The tentative dates for execution of critical structural works in the project should be provided in the Site Supervision Plan. The QP is advised to review and study the approved plans for the project thoroughly and list down the critical works which require QP's inspection before or during the execution of works.

3.10 Critical structural works refer to the building works under the category of "complex building" which were defined in the circular on "Early Pre-consultation of Structural Concept for Complex Buildings" issued on 2 June 2014. Notwithstanding that, QP is advised to review the level of complexity for the project and consider including other critical structural works which the QP thinks necessary for inclusion in the Site Supervision Plan. This is even if they are not stipulated in the circular dated 2 June 2014, e.g. thick section concreting, casting of transfer structure, launching of large span structural steelworks, large span post-tensioned structures, and erection of inclined column.

3.11 Two (2) weeks before the execution of critical structural works, the QP is advised to notify Commissioner of Building Control (CBC) (refer to **Annex 2: Form: BE-NCSW**).

Inspection forms

3.12 It is advisable that site supervision requirements for all structural works are explained clearly in the Site Supervision Plan. A set of inspection forms required to be used and filled by the SS during supervision works ought to be included in the Site Supervision Plan for all types of structural works e.g, concreting, post-tensioning works, structural steelworks, cladding, MET structures, tunnelling works, and ERSS works.

QP's site visit

3.13 QP shall take all steps and exercise due diligence in supervising and inspecting the building works or the geotechnical aspects of any geotechnical building works to ensure that they are carried out in accordance with the approved plan, provisions of the Building Control Act, building regulations or any term or condition imposed by the Commissioner of Building Control.

3.14 QP must visit the site regularly to ensure that the supervision has been carried out effectively by the SS team. The frequency of QP's site visit for each stage of construction works (e.g piling, substructures, superstructures) must take into consideration the complexity of the project and this should be stipulated in the Site Supervision Plan. QP is advised to adhere to the frequency of QP's site visit in the Site Supervision Plan. Regardless of the Site Supervision Plan, the QP must visit the site regularly.

3.15 QP is advised to prepare his inspection report (refer to **Annex 3: BE_INSREP**) after his site visit as evidence of his visits. The QP's site inspection report shall be kept at site at all time for recording and audit purposes. SS are advised to be responsible to keep and manage the QP's site inspection record. The report should include:

a. Inspection outcome for at least one (1) critical activity or element that QP has inspected.

b. Record of instructions or reminders for SS to follow up with a time line.

c. Assessment on site supervision performance by SS. The QP must record any suggestion to improve the supervision works of SS.

d. Assessment on inspection forms recorded by SS. QP shall review the inspection forms progressively every time he/she visits the site.

e. Assessment on material test reports and test certificates e.g., concrete cube tests, steel reinforcement tests, and mill certificates. QP shall review the material test reports progressively every time he/she visits the site.

f. Review on outcome of non-conformity and rectification reports for the completed works. QP shall ensure all structural defects are rectified in a timely manner e.g lower concrete cube strength, concrete defects (honey-comb), and any other deviation from approved plan.

g. Checks to ensure all the structural works completed on site are according to approved plan.

4 Site Supervision Record Book (for all building works)

4.1 Site supervision record book is a document detailing the SS's employment particulars, past and on-going projects. The SS has to ensure that his site supervision record book is kept in a safe place and in a good condition at all times. To prevent loss or damage of the record book, the SS is advised to make regular scanned copies of his record book up to his last recorded project.

4.2 It is advisable that the site supervision record book is updated diligently by SS for every commencement and completion of supervision works in all projects in which he is appointed as a site supervisor. Each project shall be endorsed by the respective project QP (refer to **Annex 4: Form BE-SSRB**).

4.3 When the QP appoints the SS for a new project, the SS should provide scanned copy of pages of all his ongoing projects and one page of his immediate past projects. For example, if the ongoing projects are recorded on pages 4 and 5, the SS has to submit pages 3, 4 and 5 of the record book to the QP, where page three details his immediate past projects. The scanned copy of these 3 pages of supervision record for SS should be enclosed as supporting documents in the permit application.

4.4 For projects classified as Large Building Works (project value more than $7.5 mil), the QP for the new project should carry out checks on the site supervision record book of the SS whom he/she wishes to appoint and ensure that the SS has no other project(s) which are still on-going before his/her official appointment.

4.5 For projects classified as Small-scale Building Works (project value up to $7.5 mil), it is recommended each SS supervises not more than 5 projects at any one time. In the case when the SS has more than 5 on-going projects, the relevant QP must assess whether such an SS will be able to carry out his/her duty to provide immediate supervision for the new project. At all times, both the SS and the QP must comply with their statutory duties with regard to the supervision of the building works onsite.

Part II
Site Supervision Plan
(Small-scale Building Works)

5 Level of Supervision (Supervision Guide)

5.1 SS must understand clearly the level of supervision expected for all structural works. This is to ensure that all critical structural works are fully and properly supervised.

5.2 QPs need not forward the Site Supervision Plan to the BCA for Small-scale Building Works. However, the QP must brief the SS before building works commences on the minimum level of immediate supervision required for each critical structural works (refer to **Annex 5: Minimum Level of Immediate Supervision**).

Part III
Site Supervision Plan
(Large Building Works)

6 Level of Supervision

6.1 A set of checklist corresponding to the level of supervision required for each structural work shall be included in the Site Supervision Plan. The checklist ought to be comprehensive enough to ensure that the SS is able to carry out detailed supervision on all aspect of structural works. The checklist should also comply with SS 515: 2018 Code of Practice for Supervision of Structural Works.

6.2 QP should define clearly in the supervision checklist the requirement of each structural works whether the works require “Continuous” or “Periodic” supervision. SS should supervise the works in accordance with these requirements set by the QP. It is to be reiterated that the SS must still comply with the provisions of the Building Control Act and building regulations.

6.3 Continuous Supervision is full-time observation of works by SS who is continuously present in the area where the building works are being carried out (e.g. concreting, stressing of PT works).

6.4 Periodic Supervision is a full-time intermittent observation of work by SS who is present in the area where the work has been or is being performed and at the completion of the work (e.g. laying rebar).

7 Supervision Checklist

7.1 A set of supervision checklists in this guide has been developed in consultation with QPs based on industry norms and practices.

7.2 QP **shall not** adopt the supervision checklist shown in this guide book as the maximum or only requirements. It is important to note that the checklist only gives guidance on the requirements to be checked by SS for each structural works. In preparation of Site Supervision Plan, the QP is advised to review and expand the supervision requirement for the structural works based on project requirement and level of complexity to ensure that the works are carried out in compliance with the provisions of the Building Control Act, building regulations, plans approved under the said Act and regulations, the relevant codes of practice and project specifications.

Concreting Works

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Material check • verify the steel reinforcement specification/requirement delivered to site with approved drawings, e.g type of reinforcement, ductility class • verify that the couplers or any other cast-in products are the type approved by QP and comply with material standards.	-	√
2	Preparation for concreting • understand the curtailment requirement at supports (e.g pinned, fixed, cantilever) from approved drawings or verify with QP if in doubt for the following: o beam connecting to wall/beam/column o slab connecting to beam/CBP/SBP/Dwall o cantilever beam from column/wall o cantilever slab – to check the required back span for top reinforcement at supports • check the lapping requirement with general notes of approved drawings and EC2. • check the cleanliness of formwork and application of debonding agent. • concrete cover, formwork and support o reinforcement shall be adequately supported by approved spacers and bar chairs to maintain the specified concrete cover o bar chair to support reinforcement for deep transfer plate or similar structures, shall be designed by PE and the calculation to be kept at site. o ensure that the formworks are designed by PE and Certificate of Supervision (COS) is issued and kept at site. • cast-in bolts, bars and anchors	-	√

	○ verify if they have been approved by QP or as shown in approved plans ○ check the embedment length with the approved plans. Check with QP if the information on the embedment length is not found in the approved plans.		
3	Concrete Test • slump test and sampling of fresh concrete for cube specimens	√	-
	• testing at accredited laboratory (SS shall perform intermittent or spot checks for the material test carried out at accredited laboratory)	-	√
4	Installation of couplers • check to confirm that the cast-in couplers are the approved type and installed as per the specification and approved drawings. • required number of couplers shall be verified.	√	-
5	Concrete placement and compaction • check design mix, ensure delivery orders of concrete are endorsed and filed • check that the concrete is from approved batching plants and verify the concrete travelling time to be within allowable duration as specified in the design mix. • ensure no addition of water to improve the workability without QP's written approval • reinforcement shall not be displaced during concreting. Reinforcement projecting from works being concreted or already concreted shall not be bent without approval from QP and shall be protected from accidental deformation and damage • ensure concrete is compacted using approved immersion type mechanical vibrators. Concrete shall be thoroughly worked into all parts of the formworks and between and around the steel reinforcement • check the maximum height for the concrete pour to prevent segregation. Check on the	√	-

	approved method statement or verify with QP. • check the surface treatment at construction joint before concreting. Provision of approved construction joint by QP e.g roughening, checker plate finish		
6	Reinforcement lapping with starter bars • Check to ensure that the rebars are lapped with the cast-in/post-installed “starter bar” or the “starter bar” installed/ connected to the cast-in couplers from the support, in accordance with approved plans. • check for every starter bar connected to the coupler to ensure that they are properly screwed or “locked” to the couplers in accordance with the approved method statement by QP and manufacture’s recommendation.	-	√
7	Curing after casting and temperature monitoring • refer to temperature monitoring regime or method statement approved by QP or concrete specialist • check for any special requirement on curing of completed concrete structures • check the appropriate times (days) to dismantle the formworks.	-	√
8	Post-concreting inspection • in-situ test • inspection for any grout leakage after completion of concreting • check for any “honeycomb” and verify dimension of completed structures after removal of formwork	-	√

Post-Tensioning Works

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Preparation for concreting • check the placement of reinforcement, shear links and bursting reinforcement • check the placement of post-tensioning tendons • check the installation of anchor block/head with approved type. • check that the tendons are free from loose or thick rust, oil, grease, tar, paint, mud or any other deleterious substances. A thin film of rust is permitted subject to QP's written approval.	-	√
2	Material preparation (site mixing) and test • sampling of strand and grout • supervise and ensure that the grout mixing and grouting works are carried out by trained worker or specialist e.g monitor the mixing duration and consider special requirement to maintain the workability and strength of the grout	√	-
	• testing at accredited laboratory (SS shall perform intermittent or spot checks for the material test carried out at accredited laboratory)	-	√
3	Check the stressing equipment/ calibration certificates • calibration carried out by an accredited lab • check the validity of the calibration certificate	-	√
4	Stressing and record of elongation measurement • ensure the elongation is within specified allowable limits as indicated in the approved method statements.	√	
5	Curing after casting and temperature monitoring • refer to temperature monitoring regime or method statement approved by QP or concrete specialist • curing of completed concrete structures	-	√
6	Review stressing records and strand elongation calculations	-	√

Safety Barriers

Supervision Requirements		Continuous (mandatory)	Periodic
1	Compliance with approved drawings • check for material properties • verify member size • verify weld size • check embedment of glass into supporting channel, if applicable • check connection between barrier panels with handrails • check end connection of handrail to support • verify glass type and thickness • check the base structure supporting the barrier i.e. channel, reinforcement details for kerb	-	√
2	Post-installed anchor bolts • check that correct bolts are used. To check with QP if the builder proposed alternative or the bolt types are not indicated in the approved plans. • check the embedment requirement with the approved plans. To check with QP if embedment requirement is not indicated in the approved plans. • ensure that the works are carried out by a trained installer as per BS 8539:2012 Code of Practice for the selection and installation of post-installed anchors in concrete and masonry.	√	-
3	Material test/connection test • refer to schedule of material tests prepared by QP e.g NDT carried out for welding.	√	-
	• testing at accredited laboratory • (SS shall perform intermittent or spot checks for the material test carried out at accredited laboratory)	-	√

Foundation Works (Bored Pile)

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Ensure piling contractor holds valid builder license (SB)	-	√
2	Checking before concreting of piles • concrete cover and reinforcement cage • length of steel casing • concrete mix • pile diameter (diameter of steel cage and pre-bored hole)	-	√
3	Concrete Test • slump test and sampling of fresh concrete including cube specimen	√	-
	• testing at accredited laboratory (SS shall perform intermittent or spot checks for the material test carried out at accredited laboratory)	-	√
4	Boring works • verify soil type against the soil report • refer to appropriate SI borelog • ensure the use of appropriate equipment for rock coring • check for pile verticality • Tremie method –stabilizing liquid for wet piles shall be approved by QP • check pile toe to ensure sound and clean base • check the accuracy of measuring tape (not tampered) provided by main contractor/piling contractor. Supervisor shall use their own measurement tape. • keep record of pile penetration/boring for each pile for as-built submission at later stage	√	-
5	Concreting of piles • supervise concrete placement carried out in accordance with approved method statements. • If applicable, check the alignment or verticality of plunge-in steel section (Kingpost)	√	-

6	Check equipment, test load and witness pile load test <u>Static Load Test</u> • setting up, loading & unloading, dismantling of kentledge. Ensure that the test set up is endorsed by PE • monitor the loading increment during pile load test <u>Dynamic Load Test</u> • supervise and witness the process of every test • endorse and file the test results	√	-
7	Check the vibration and ground movement monitoring during piling work • witness the recording of instrumentation readings by the instrumentation specialist • ensure instrumentation readings are taken in accordance with the frequency as stated in the approved plans. Impact to adjacent properties • to carry out visual inspection on surrounding properties. Report to QP for any potential impact caused by the piling works	-	√

Foundation Works (Displacement Pile)

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Ensure piling contractor holds valid builder license (SB)	-	√
2	Before piling works • check source and details of pile (e.g dimension, concrete grade, reinforcement, splice plate details) • ensure that the ground is prepared to carry the loads/pressures induced by jacking operation without compromising the safety during operation • check validity of calibration cert for jacking machine.	-	√
3	During piling works • check appropriate machines used • supervise welding between two piles and check weld quality • check for pile verticality. Ensure jointed sections of piles are straight, free from dents and corrosion pits. • keep record of pile penetration for each pile for as-built submission at later stage. Jack-in: • check the hydraulic jack pressure and holding time for pile set • refer to approved plan or check with QP Driven type: • check for height of hammer drop, weight of hammer • check for pile set requirement • refer to approved plan or check with QP.	√	-
4	Check equipment, test load and witness pile load test <u>Static Load Test</u> • setting up, loading & unloading, dismantling of kentledge. Ensure that the test set up is endorsed by PE	√	-

	• monitor the loading increment during pile load test <u>Dynamic Load Test</u> • supervise and witness the process of every test Endorse and file the test results		
5	Check the vibration and ground movement monitoring instrumentations during piling work • witness the recording of instrumentation readings by the instrumentation specialist • ensure instrumentation readings are taken in accordance with the frequency as stated in the approved plans. Impact to adjacent properties • to carry out visual inspection on surrounding properties. Report to QP for any potential impact caused by the piling works	-	√
6	Precautionary of ground heave • check SI borelog for presence of soft clay strata • ensure that all measures are in-placed to mitigate possible damages to neighbouring's structure, e.g relief well, settlement markers, inclinometer. • check for requirement of pre-boring before the installation of displacement pile.	-	√

Foundation Works (Shallow Foundation)

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Checking before concreting of footing/raft footing • concrete cover • concrete mix • footing dimension	-	√
2	Site tests • plate load test (to follow approved method statement by QP) Concrete Test • slump test and sampling of fresh concrete including cube specimen	√	-
	• testing at accredited laboratory (SS shall perform intermittent or spot checks for the material test carried out at accredited laboratory)	-	√
3	Excavation and preparation prior to footing construction • ensure that excavation is in accordance with the approved drawings (if applicable) or PE/QP(D)'s design • check that the base preparation/compaction requirement is in accordance with approved drawings.	√	-
4	Concreting of footing/raft • Supervise the concrete placement carried out in accordance with approved method statements.	√	-

Structural Steelworks

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Steelworks fabricated overseas • Suitably trained and experienced SS shall be appointed (e.g StS qualification issued by Singapore Structural Steel Society); and a full-time Independent Testing Agency (ITA) accredited under Singapore Accreditation Council (SAC) Inspection Bodies Scheme should also be appointed to assist the QP in supervising and inspecting the works. [Note: Foreign IB accredited to this Scheme by its local accreditation body that has the relevant Mutual Recognition Arrangement (MRA) with SAC is technically acceptable.] • All elements or materials sampled for testing shall be carried out by laboratories accredited under the Singapore Accreditation Council Laboratory Accreditation Scheme (SAC-SINGLAS), or foreign laboratories accredited by their local accreditation body that has the relevant MRA with SAC. • ensure the fabricator has the appropriate welding facilities, qualified welders and a shelter fabrication yard Steelworks fabricated in Singapore • to confirm that the fabricator is a licensed specialist builder (structural steelwork) • ensure the fabricator has the appropriate welding facilities, qualified welders and a shelter fabrication yard (refer to circular issued on 2nd November 2015 : *Guidelines on Supervision of Structural Steelworks Fabricated Off-site Locally or Overseas*)	-	√
2	Material verification Check structural members or materials are in compliance with approved drawings and accordance to specified standards	-	√

	• source of material, grade • hot rolled / cold-formed • dimension / thickness/ weight • check for steel markings • check that CNC profiling machine is used for pipe connections • check that the members are free from defects e.g warping, twisting, distortion, damaged section, pitting • check that sample material test as specified by QP are carried out (SS shall perform intermittent or spot checks for the material test carried out at accredited laboratory)		
3	Class of structural steel Check that the class of structural steel is in accordance with BC1: 2012 (Design Guide on Use of Alternative Structural Steel to BS 5950 and Eurocode 3). a) For Class 1, check the following - Factory Production Control (FPC) Certificate; - Manufacturer Test Certification (MTC) b) For Class 2, check the following - Manufacturer Test Certification (MTC) - Relevant material tests carried out as per BC1 Appendix B	-	√
4	Bolted Connection • check bolting type: HSFG bolts / Black bolts • bolt grade & type conforming to BC1 • bolts dimension (diameter x length) • washer grade & type • connection joints/splice joints to be constructed as per drawings • bolts tightened to the correct torque • ensure that the bolt extends beyond the nut by minimum 1½ thread • check for defects e.g tilted bolts, holes enlarged by torch cutting; and the respective remedy action. • check embedment length and arrangement of holding down bolts	√	-
5	Welded Connection	√	-

	• check for welding defects, edge preparation, under-cutting, pits, lack of fusion. Check with QP for the remedy action
	• welding procedure, size & length of weld to be according to approved plan & specifications
	• welding electrode strength to comply with BC1
	• weld surface to be clean & free from dust, rust & scales
	• check the certificate of qualified welder
	• check presence of cracks
	• Welding test (%) :
	  o Ultrasonic testing
	  o Magnetic Particle testing
	  o Radiographic testing
	  o Penetration testing
	(Note: All welding tests shall be witnessed by SS, ITA, where applicable.)
	• For failure of welding test, check with QP for the remedial action to be taken		

6	Holding down bolts/Anchor bolts • check the embedment requirement with the approved plans. To check with QP if embedment requirement is not indicated in the approved plans • for post-installed anchor bolts, check that correct bolts are used. To check with QP if the builder proposes alternative, or the bolt types are not indicated in the approved plans • ensure that the post-installed anchor bolt works are carried out by a trained installer as per BS 8539:2012 Code of Practice for the selection and installation of post-installed anchors in concrete and masonry		

7	Erection works
	• check the approved method statement for erection details
	  o Stability and verticality
	  o Alignment of 2 adjoining pieces
	• PE design & Certificate of Supervision for temporary structure, supporting bracings, tie backs are to be submitted and reviewed by QP
		√	-

	• check alignment, level, plumb & correctness of structure • erection sequence is in accordance to QP's design • safe work platform & access to be provided		
8	Painting and Surface Preparation • check that galvanised steel / steel surface is prepared and painted/coated to approved plans and specifications	√	-
9	Corrosion and Fire Protection • details and thickness of materials are in accordance with approved plans and specifications • protection such as coatings and fire protection is to be evenly applied with no damage to the integrity of the coating.	√	-

Mass Engineered Timber

	Supervision Requirements	Continuous (mandatory)	Periodic
	MET (Glued Laminated Timber works/ Cross Laminated Timber)		
1	Pre-erection • check material free from defects ie. bowing, springing, twisting, cupping, end splits • check that CE marking is affixed to material • check for ID of certification Body • check for Factory Production Control (FPC) Certificate, list the certificate no. • list the harmonised product standards • check the adhesive type and verify with approved drawings or check with QP check for species of MET and verify with approved drawings • check for fire performance and verify with the fire performance requirement in the approved drawings. If in doubt, to check with QP. • dimension check and verify with approved drawings • check steel plates/ connections/ screw/ bolt holes pre-installed in accordance with approved plans • check the nails e.g type/size/strength grade • check for moisture content • check all end grains are protected • check calibration certificate of equipment for measuring moisture content • check for approved technical specification for glue/ resins • check for proper storage of material • check moisture content prior to erection • check technical specifications/ ETA for wood screws & bolts • check on wood screws & bolts e.g type/ size/ strength grade • check for steel plates, angles and brackets e.g type/ size/ strength grade • check technical specifications/ ETA for steel plates, angles and brackets	-	√

	• check welder's qualification		
2	During/post erection • install deflection indicator according to QP's instruction	√	-
3	Laboratory Tests • check the test report on finger joint, bending test, delamination tests	-	√

Reinforcement

Supervision Requirements		Continuous (mandatory)	Periodic
1	Material verification To check the materials are in compliance with approved drawings and accordance to specified standards • source of reinforcement • verify reinforcement with the mill certificate • verify and keep the factory production control (FPC) certificate from an accredited certification body.	-	√
2	Material testing (chemical test, tensile test, shear test, bend & rebend test) at accredited laboratory • select the sample for testing • witness the test - SS shall perform intermittent or spot checks for the material test carried out at accredited laboratory • check the results of test	-	√
3	Review test results. Check with QP for acceptance of test results.	-	√

Demolition

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Prior to commencement of demolition • verify that the existing structure to be demolished is as shown in the approved plans. Discrepancies must be reported to QP for review • check that approved demolition works plan and method statements are available at site • check that the protective hoarding, safety screen/netting, covered walkway, catch platform and catch fan are provided • check the installation of sound barrier and dust screen/netting, whose height shall be at least 1 storey higher than the floor where the demolition takes place • check instrumentation monitoring works are in placed • check the requirement of adopting controlled demolition e.g partial demolition, especially at area near to the common party wall to prevent damage to the common party wall • where machine is used, check to ensure it tallies with what is specified in the approved plan, in particular the weight of the machine.	-	√
2	During demolition • check that demolition debris are not accumulated on suspended floor • check that the provision of shoring and propping requirements are adhered for the support of the suspended floor • check and monitor the sequence of demolition to prevent uncontrolled collapse • check to ensure that demolition debris is not piled up to be used as temporary ramp to facilitate movement of machinery between suspended slab. • where machinery is used, check for the allowable or safety zone for movement of machinery on building floor during demolition	√	-

	and in accordance to the approved demolition plan • check on the safe working spaces and exclusion zones for demolition/partial demolition over basement, adequate containment should be provided in the approved plan		
3	After demolition • ensure precautionary measures are enforced on site in accordance with approved method statements and/or approved plans e.g water proofing plaster for exposed common party wall to prevent water seepage to adjacent premises • check on the anchorage details of the existing beam rebar where continuity of the beam from the adjacent structure is loss as a result of the demolition works	-	√
4	Demolition involving post-tensioned structures • check the demolition sequence for post-tensioned structures • precautionary measures for detensioning of prestressed strands to prevent hazard due to possible fly-out of the strands	√	-
5	Demolition involving Highrise (more than 10 storey) • check the requirement of CCTV supervision for high-rise demolition • ensure the demolition sequence is in accordance with approved plan	√	-

Precast Concrete Components

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Pre-installation check • take note the delivery order and check for any concrete chipped off, cracks, honeycombs or broken parts. • check to ensure compliance with approved drawings • check soffit of columns/ wall (no patching around splice sleeves/ connectors) • check the verticality of multi-tier precast column is within acceptable range • check splice sleeves bottles are clean (no blockage) • check the length of dowel bars • check the position and reinforcement size of lifting points • check storage of precast elements	-	√
2	Installation • check for shim plates/ washers e.g with spring • check props secured and braced the columns/ walls • ensure verticality of erected columns / walls • check for correct orientation and correct precast component, according to approved drawings	√	-
3	Splice sleeve / connectors • supervise for grout mixed (SS mortar* for splice sleeve) • witness flow test of grout (SS mortar* for splice sleeve) • supervise grouting process - pumped from lower inlet tube • grout flow continuously at outlet before stopper is inserted • supervise and ensure that the grout mixing and grouting works are carried out by specialist e.g mixing duration and special requirement to maintain the workability and strength. • no excessive blackflow observed	√	-

	(* SS mortar – type of mortar used for splice sleeve)		
4	Horizontal joint • supervise for grout mixed (grout process for horizontal joint) • ensure pressure pump with pressure gauge is used • grout flow continuously at outlet before stopper is inserted • supervise and time grout to maintained at ____psi for ___ min after all outlets are sealed (pressure according to QP's design) • no excessive blackflow observed	√	-
5	Pre-bedding process for horizontal joint • supervise for grout mixed • supervise and ensure that the grout mixing and grouting works are carried out by specialist e.g mixing duration and special requirement to maintain the workability and strength. • ensure shim plates are secured using mortar one (1) day in advance • check for sufficient grout pour • removed all excessive grout	√	-
	Fabrication yard		
6	Pre-concreting checks • check that the shopdrawings are approved and endorsed by QP • check the mould condition, dimensions, openings • check for reinforcement e.g No. / size and spacing • check concrete cover • check for splice sleeve position/ type • check the embedment length of dowel bar, protrusion length of continuity bar (size, number and spacing) • check strand position and elongation • check the dimension & position of block out • check grouting tubes/ pipes & the position	-	√

	• ensure viewing holes are provided at height 255mm from base & in-line with rebars (spiral connectors)		
7	Concreting • supervise the pouring concrete/ concreting • supervise making of test cube • supervise slump test • verify design mix and ensure the delivery orders of concrete are endorsed and filed	√	-
8	Post concreting check • check for curing • check for honeycomb & note any repairs	-	√

Curtainwall & Cladding (Stick System)

	Supervision Requirements	Continuous (mandatory)	Periodic
	Stick system curtain wall / Cladding		
1	**Before commencement of works** • check shopdrawings against BCA approved drawing. Shopdrawings shall be endorsed by QP. • highlight discrepancies to QP, if any (shopdrawings and approved drawings) • witness compatibility test	-	√
2	**Test requirements** • torque wrench test • functionality test i.e. water tight/ air tight • adhesion test • non-staining test/ other lab testing • deglazing test	√	-
	Material tests • SS shall perform intermittent or spot checks for the material test carried out at accredited laboratory	-	√
3	**Site Fixing** • check materials against BCA approved drawing • check type and alignment of steel bracket & runner • check anchor type and size • check drilled holes/ depth and setting out	√	-
4	**Installation** • Installation of transoms and mullions a. check control point and alignment b. check in position screws, washer and bolts c. check cleanliness • Installation of panels a. check alignment of panels b. check fin/capping/gasket engagement c. check bolt/nut properly tighten d. check for setting block, self-weight supports e. check for structural sealant • Installation of retaining devices and fixings a. test for retaining devices (where applicable)	√	-

5	Review of test results. Check with QP for acceptance of test results.	-	√

Curtainwall & Cladding (Unitised System)

	Supervision Requirements	Continuous (mandatory)	Periodic
	Unitised system		
1	**Before commencement of works** • check shopdrawings against BCA approved drawing. Shopdrawings shall be endorsed by QP • highlight discrepancies to QP, if any (shopdrawings and approved drawings)	-	√
2	**Factory fabrication** • supervise the fabrication works at factory • check alignment of bracket and runner • deglazing test • compatibility test • adhesion test • non staining test/ other lab testing • check anchor type and size • check drilled holes/ depth and setting out • check control point and alignment • check the setting-out of screws and bolts • where structural sealant glazing is used - o check for setting block, self-weight supports and retaining devices o check sealant type and bite size o to witness test for retaining devices and fixing	-	√
3	**Erection at site** • supervise the installation of transoms and mullions module. • supervise installation of anchor bolts (including tests) and channels • check alignment of bracket and runner • check fixing of module to main structure • ensure all fixings of claddings to be corrosion-resistant stainless steel fasteners	√	-

PPVC (Steel)

Supervision Requirements		Continuous (mandatory)	Periodic
1	During installation of modules on site • check the verticality for every installation of PPVC module • Verticality tolerances or requirements for every corner and overall height of erected PPVC module should refer to Site Supervision Plan prepared by QP. If it is not specified, please check with QP. • Horizontal gap at every column should be monitored/checked to ensure that the floor to floor height of the next module is not exceeded. Tolerance should refer to Site Supervision Plan prepared by QP. If it is not specified, please check with QP • check that the connection or bolt installation between module is in accordance to approved plans	√	-
2	Supervise the fabrication of PPVC module • pre-welding checking • post welding inspection and non-destructive testing • Mill Certificates/ FPC of steel materials, bolts • Vertical alignment of every PPVC column after assembly • Height of every PPVC column after assembly • the squareness tolerance of the top and bottom frames is to be checked for distortion after assembly (refer to circular issued on 2nd November 2015 : Guidelines on Supervision of Structural Steelworks Fabricated Off-site Locally or Overseas)	√	-
3	Laboratory test • check and ensure that all required tests specified in the approved plans are carried out o SS shall perform intermittent or spot checks for the material test carried out by an accredited laboratory	-	√

PPVC (Concrete)

Supervision Requirements		Continuous (mandatory)	Periodic
1	During installation of modules on site • check the verticality for every installation of PPVC module • check qualification of surveyor • check the connection details between modules (according to approved plans) • check details and requirements for key bars, wire loops, slimbox, slab cable ties etc. • Supervise and ensure that the grout mixing and grouting works are carried out by specialist e.g mixing duration and special requirement to maintain the workability and strength. • Supervising the installation of couplers, shear key bars, wire loops, “slim box”, cable wires and connecting reinforcement	√	-
2	Supervise the fabrication of PPVC module. • concreting • reinforcement (including couplers, wire loops) • acceptance and quality of surface treatment for walls and columns (for composite action). Refer to requirements	√	-
3	Laborator test • check and ensure that all required tests specified in the approved plans are carried out e.g wire loops, cable wire, “slim box” etc. ○ SS shall perform intermittent or spot checks for the material test carried out by an accredited laboratory	-	√

Post-Installed Anchors/Rebars

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Installation of anchor bolts and rebars. • SS shall ensure that the anchor bolts and rebars are installed in accordance with the approved plans • SS shall ensure that the installation of anchors/rebars is in accordance with manufacturer's instructions • installation shall be carried out by trained/competent installer as per BS 8539 Code of Practice for the selection and installation of post-installed anchors in concrete and masonry.	√	-
2	Test of anchor bolts/rebars. • SS shall ensure that testing of anchors are carried out as prescribed by the QP (number or frequency of test) • SS shall ensure that the tests are carried out in accordance with CFA Guidance Note Procedure for site testing construction fixings as specified in BS 8539 • SS shall witness the test	√	-

ERSS Works

	Supervision Requirements	Continuous (mandatory)	Periodic
1	Daily inspection of ERSS Works No fewer than one inspection is to be carried out per day to ensure the works and activities associated with the construction of the ERSS (including excavation) are being carried out in accordance with the approved plans, including the sequence of any excavation.		
2a	Excavations/earth filling (when the instrumentation readings (lateral movements, support loads or settlement) **are within** the alert level) • ensure the excavation profile and sequence is in accordance with approved plan.	-	√ (At least once daily)
2b	Excavations/earth filling (when the instrumentation readings (lateral movements, support loads or settlement) have **exceeded** the alert level) Excavations for cantilever retaining structures	√	-
3	Installation or removal of earth retaining wall including capping beam • ensure the earth retaining wall including capping beams are in accordance with approved plans	√	-
4	Installation or removal of lateral support elements to support the ERSS; including struts and walers, king posts, soil nails, ground anchors and walers, ring beams, temporary and permanent slabs, or any other type of lateral support element • ensure the lateral support element and connection details are in accordance with approved plans • follow sequence of ERSS in approved drawings	√	-
5	Installation of ground improvement or ground strengthening works • ensure works are carried out in full compliance with the specifications shown in the approved drawings	-	√ (At least once daily)
6	Protection measures associated with ERSS works	-	√

	• ensure protection measures are installed in accordance with the details specified in the approved drawings.		(At least once daily)
7	Instrumentation and monitoring • witness the recording of instrumentation readings by the instrumentation specialist • ensure instrumentation readings are taken in accordance with the frequency as stated in the approved plans. Impact to adjacent properties • to carry out visual inspection on surrounding properties. Report to QP any potential impact caused by the excavation works • ensure surplus excavated materials are not stockpiled on site	-	√

8 Supervision for Bored Tunnelling Works

8.1 A guideline or checklist for supervision for bored tunnelling works is shown in the tabulation below. QP should include a detailed supervision for bored tunnelling works in the Site Supervision Plan and ensure that every step for various stages of tunnelling works is carried out accordingly to ensure safety throughout the bored tunnelling works.

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
1	**<u>General</u>**		
a.	Bored Tunnelling works	All permanent and temporary works associated with Bored Tunnelling must be supervised by the QP(S).	QP(S) refers to QP(S)(ST) and QP(S)(Geo)
b.	Bored Tunnelling, instrumentation and monitoring approved plans	QP(S) and his appointed site supervisors (SS) to take all reasonable steps and exercise due diligence in supervising and inspecting the building works or geotechnical building works, to ensure those building works are being carried out in full compliance with details and specifications shown in approved plans. QP(S) to perform duties as stipulated in Building Control Act and Regulations.	Tunnels fall under the category “building works” and “geotechnical building works” in the regulation
c.	Specific conditions of permit	The project parties must comply with the Specific Conditions of Permit for Bored Tunnelling Works.	
d.	Preconstruction and Post-construction survey	It will be prudent for QP(S) to verify that the Builder has carried out the preconstruction surveys prior to the start of the tunnelling works and post-construction surveys after the completion of tunnelling works and when the instrumentation monitoring results have stabilised. The extent of the surveys shall cover the structures within the zone of influence of	

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
		tunnelling works as assessed by QP(D).	
e.	QP(S) to provide regular guidance and direction to site supervision (SS) team	QP(S) must provide guidance, advice and technical inputs as well as make decisions at critical stages. QP(S) is advised to conduct routine technical briefings to the SS team on site supervision matters. The frequency of the technical briefing should be weekly at least for the 1st month of tunnelling works or as and when new staff join the SS team. The frequency can be reduced to monthly when SS team has achieved full familiarity with the tunnelling works at the site.	
f.	Effective communication between QP(S) and SS team	QP(S) is advised to establish and maintain an effective communication plan with the SS team covering incident reporting, breaching of critical limits and deviations from approved plans.	
g.	Prepare and implement site supervision plans on Quality Assurance and Control (QAC).	QP(S) should prepare and implement a site supervision plan in relation to QAC plans that should include trials and construction tests to be performed in accordance with the approved plan. QP(S) to review the test reports to ensure compliance with approved plans and BC Regulations. QP(S) must report to Commissioner of Building Control (CBC) on failure of test as soon as practicable. Failure to report to the CBC as soon as practicable is an offence. QP(S) should work with QP(D) such that QP(D) can develop and recommend appropriate steps,	

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
		measures or remedial works to be carried out.	
h.	Maintain Attendance Logbooks	QP(S) to keep and maintain an Attendance Logbook for recording the daily attendance of the QP(S) and SS Team and the day-to-day activities carried out by the SS at site.	
I.	QP(S) to attend weekly I&M/site meeting	QP(S) should attend Weekly Instrumentation Meeting / Weekly Site Meeting / 100 Ring Look-ahead Meeting / Risk Review Meeting / Safety and Quality Control Meeting to resolve site and technical matters that require his decision.	Builder's Geotechnical Engineer should also attend IM meeting.
j.	Review of drawings	QP(S) in the course of their supervision, must highlight to the QP(D) on any discrepancies and/or missing details in a timely manner.	
k.	Review of Builder's submissions and method statements	QP(S)/SS to review and evaluate Builder's submissions, shop drawings and method statements to ensure works carried out are in accordance to BC Act and Regulations, and approved plans.	
L.	Review and verification of as-built plans	QP(S) to maintain the as-built plans including any deviations that are to be passed to the QP(D) on a regular basis.	
m.	Watchman and emergency safety barricades	When tunnelling or TBM is in close proximity to building/structure/road, QP(S) should ensure that watchman is stationed 24/7 at the ground surface of TBM location with adequate stand-by safety barricades near the TBM location.	

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
n.	Prolonged stoppage	QP(S)/SS to ensure KPI (Key Performance Indicator) are being maintained at all times QP(S) shall implement **Tunnel Annex C-2** for each location of prolonged stoppages.	
2	**<u>Tunnel Segments</u>**		
a.	At Factory	QP(S)^ to apply for a separate permit for casting of tunnel segments at the casting yard. Full-time supervision at the casting yard is to be carried out by SS. The QP(S) is to visit and supervise the work at the casting yard not less than once a month during casting period. SS to:- a) inspect and keep Quality Control (QC) records b) witness tests c) examine for compliance materials, goods and work procedure d) Carry out final inspection before delivery e) Check on the delivery and transportation process to ensure quality of segment is maintained in connection with segment production.	^ - if QP(S) for precast tunnel segments are different from the QP(S) for bored tunnelling works

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
b.	At Site	QP(S)/SS should inspect each tunnel segment and to prepare and maintain a Segment Inspection Report. Any segment not meeting QP(D)'s requirements must be rejected. Repairs and/or making good of segmental lining shall be supervised by QP(S)/SS in accordance to the approved repair plan.	
c.	During installation	QP(S)/SS to perform supervision during each ring built and verify measurements of Ring Build tolerances. If Ring Build tolerances exceed the specified limits during the ring build operation, the QP(S) shall instruct the Builder to rebuild the ring. If cracks occur in segment during installation, QP(S) shall instruct the Builder to replace the particular segment. QP(S)/SS to prepare and maintain Ring Build Report.	
d.	Post installation	QP(S)/SS to perform inspection of each tunnel ring, record and bring to the notice of QP(D) any defects such as out of tolerances, cracks and leakages. QP(S)/SS to ensure repair is carried out in accordance to approved method with consideration given to the design life and long term	

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
		durability. No repair shall be carried out without the supervision of SS.	
3	**<u>Protective measures and Inspection of Surrounding Structures</u>**		
a.	Protective measures on surrounding buildings/structures	QP(S) to ensure protective measures, if specified, are installed on buildings in accordance to the details specified in the approved plans before TBM enters the influence zone of the affected buildings/structures.	
b.	Regular inspection of surrounding structures	QP(S) to carry out inspection on surrounding structures regularly to ensure stability and structural integrity. When a damage is observed or a feedback is received about a damage on an adjacent structure, QP(S) shall: - a) conduct immediate inspection of the affected structure for any damage b) inform QP(D) and assess the structural safety of the building together with QP(D), if serious damage is observed. c) determine and make decision on whether tunnelling work can proceed. d) assist QP(D) in developing the appropriate remedial measures e) instruct Builder to implement immediate measures to remove danger and make the building safe	QP(D) shall submit his assessment report to BCA within 3 working days, on his findings and where applicable, with recommendations on the remedial measures. QP to work with BCA officer if there are building access issues.

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
		f) notify the Commissioner of Building Control	
4	**<u>Instrumentation and Monitoring</u>**		
a.	Installation of instrumentation, taking of instrument readings, protective measures, and timely replacement of faulty instrument	a) QP(S)/SS should give input with respect to the appropriate location of instruments, witness the installation of instrumentation and verify the installation records are in accordance to the details stated in the approved plan. b) QP(S) to verify that the instrumentation readings are taken in accordance to the frequency stated in the approved plan. c) For effective monitoring, QP(S)/SS should ensure that the Builder puts in place adequate protective measures to prevent damage to the instrumentation and monitoring system. d) QP(S)/SS to instruct the Builder to replace any instrument that is damaged or malfunctioning in a timely manner. e) QP(S) to instruct Builder to install vibration meter to verify the vibration readings do not exceed the DIN 4150-3 limits whenever a public feedback on vibration is received within the tunnel's influence zone	*(In addition to BT Circular - Annex 3 ID 26)* *"BT Circular" refers to the Circular – Requirements on Bored Tunnelling Works*
b.	Regular review and analysis of	QP(S)/SS shall assess, analyse and interpret all instrumentation readings,	Daily meeting should be conducted by Senior

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
	instrumentation readings / Regular inspection of the tunnelling works	factual reports submitted by the I&M Specialist Builder, so that safe execution of the tunnelling works is carried out at all time. This shall include review of data analysis processes and methods. QP(S) to establish a plan for SS to perform periodical instrumentation audit which should include site inspections and documentations. At the end of each tunnel shift, SS to submit a Shift Review Report containing a summary review of I&M and KPIs (face pressure, excavation muck etc.) before handing over. Senior RE shall conduct daily I&M meeting with at least the instrumentation specialist engineer and builder's geotechnical engineer to review the instrumentation data, check readings that exceed review levels, and if so, report to QP(S) accordingly, and identify any trends of concern.	RE/RE in the morning to cover previous day's key tunnelling parameters, excavation data, instrumentation readings.
c.	Critical Instruments breaching review levels / excessive ground movement	Where instrument readings for tunnelling works exceed the review level limits, the QP(S) shall investigate and instruct the Builder to implement appropriate action plans to mitigate any safety concern. Where readings of critical instruments (e.g. extensometer, building settlement markers, ground	

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
		settlement marker, tilt meter, piezometer where applicable) exceed the WSL, the QP(S) shall ensure safety, suspend TBM excavation and advancement, and inform BCA, Builder and/or other relevant authorities/agencies immediately. Whenever excessive ground movement (e.g. depression, sinkhole etc.) is observed, QP(S) shall do the same as paragraph 2 above.	
d.	When tunnelling within the control zone of a building/structure in close proximity *(Refer to BT Circular - Annex 3 ID 19 for the definition of control zone.)*	QP(S) to ensure the control zone is marked on the surface. QP(S) to ensure builder implement a transverse ground instrumentation monitoring array to validate TBM KPIs just before going underneath/near a building/structure. QP(S) to ensure the planned CHI is executed before entering the control zone to avoid stoppage within the control zone. During tunnelling within the control zone:- - QP(S) to review I&M results and Tunnelling Key Performance Indicators (KPI) as defined in QP(D)'s drawings	(*BT Circular* - Annex 3 ID 23) (*BT Circular* - Annex 3 ID 24) Refer to BT Circular - Annex 3 ID 27 for the frequency of reviewing I&M results.

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
		- QP(S) to perform assessment of the performance of the tunnelling work and decide whether building is safe for tunnelling to continue; submit summary of monitoring results and assessment reports to BCA. - QP(S) to deploy full time SS and ensure Builder's site staff are positioned full time at the building to observe for any signs of distress on the ground and/or structure. - QP(S)/SS to inspect the building and witness instrumentation monitoring.	Refer to BT Circular - Annex 3 ID 27 for the frequency of submitting the assessment report to BCA. Refer to BT Circular - Annex 3 ID 19 for the frequency of inspecting the building.
e.	Emergency Plan	QP(S) shall identify from the approved plans the building capacity limits of all buildings below which tunnel under crosses. QP(S) to verify that decanting and emergency communication plans have been prepared and put in place. QP(S) to refer to BT Circular – Annex 3 ID 31 for any breach of Building capacity limits	(*BT Circular* - Annex 3 ID 31)
f.	Submission of instrumentation and monitoring results	QP(S) to submit form Annex E (Instrumentation and Monitoring for Excavation Works) monthly to Commissioner of Building Control by the 7th of the following month.	

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
5	**Testing and Verification**		
a.	Ground improvement works	QP(S)/SS shall supervise the ground improvement works in accordance with the approved plans and the method statement. QP(S)/SS shall ensure all information related to ground improvement is recorded. This includes: - a) location of each ground improvement point b) start and end depths c) pressure, volume, withdrawal rate as applicable d) quality control test results	
b.	Tail void grouting	QP(S)/SS to ensure that records of grout volume and pressure are recorded for each ring. QP(S) to discuss with QP(D) and Builder the need for secondary grouting based on the grouting record.	
c.	QAC for soil conditioning (EPBM)	When EPBM is adopted, QP(S)/SS to ensure that testing of soil conditioning for each type of soil is carried out to ensure that it can provide an adequate plug in the screw conveyor and to control cutter head wear.	
d.	QAC for bentonite slurry (Slurry TBM)	When slurry TBM is adopted, QP(S)/SS to ensure that relevant tests are conducted to verify the	

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
		quality of the bentonite slurry for each ring built. Test results to be reviewed and discussed during daily tunnel meeting. QP(S) to audit the test for compliance with relevant standards and procedures.	
6	**<u>Key Performance Indicator (KPI)</u>**		
a.	General requirement (Additional requirement for tunnelling in mixed face condition)	QP(S)/SS to review compliance of KPI during tunnelling and before each ring built. QP(S)/SS to sign off the excavation volume for each ring built while tunnelling in close proximity and /or in mixed face condition.	Annex C-3
b.	Exceedance of KPI	QP(S) to temporarily suspend tunnelling work when persistent exceedance of KPI is observed for more than 5 mins, for the implementation of corrective actions.	
c.	Face pressure	QP(S)/SS to ensure that face pressure is being maintained in accordance to approved plan.	
d.	Excavation volume	QP(S)/SS to verify the excavation volume of each ring advanced. If excavation occurs beyond the limits as defined by QP(D), QP(S) to adopt the actions to be taken in BT Circular – Annex 4	*(BT Circular - Annex 4)*

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
e.	Malfunction of key KPI equipment	QP(S) to suspend tunnelling work when equipment measuring KPI is malfunctioning. Tunnelling work shall resume only when all key KPI measuring equipment are functioning properly.	
7	**Cutter Head Intervention (CHI) – planned and unplanned**		
a.	Tunnel Annex C-2 and Annex C-1	QP(S) to implement Tunnel Annex C-2 for each CHI, and Tunnel Annex C-1 on restart of TBM after the CHI	
b.	CHI monitoring regime	QP(S)/SS to ensure that the necessary instruments are installed before the CHI. For unplanned CHI, as a minimum, ground settlement markers following the planned CHI monitoring regime or equivalent alternatives are to be installed.	
c.	QP(D)s' requirements during CHI	The QP(D)s' requirements should include the following: - a) Compressed air recommendations b) Air pressure step down procedure, if applicable c) Water ingress limits (rate and total volume allowable) d) Maximum CHI duration e) Allowable settlement f) Additional monitoring requirements if any	* - if tunnelling in weathered rock with potential drawdown and in close proximity to existing structure etc.

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
		g) Monitoring frequency h) Need for ground improvement if necessary i) Need for recharge well* QP(S)/SS to monitor closely and to ensure that the above requirements are controlled within the limits specified by the QP(D) and following QP(D)'s recommendations QP(S) / QP(D) to assess and instruct Builder to carry out necessary mitigation measures if the specified limits are breached.	*Refer to BT Circular - Annex 3 ID 11 for the frequency of instrumentation monitoring.*
d.	Face stability	QP(S)/SS to verify the ground condition at the CHI location to be as assumed by QP(D) in the CHI calculation. QP(S) together with QP(D) shall reassess the face stability at intervals not exceeding the requirements in the Specific Conditions of Permit for Bored Tunnelling Works.	
e.	Face inspection	When face inspection occurs, it should be carried out by competent qualified geologist (acceptable by QP(D) and QP(S)) and a face map and photos shall be produced.	
f.	CHI under free air	See remarks.	Refer to item f) of "Specific Conditions of Permit for Bored Tunnelling Works"

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
g.	Post CHI assessment	QP(S) to assess the performance of each CHI prior to allowing the TBM to proceed. QP(D) to assess the performance of each CHI whenever the critical limit (Alert/work suspension limit) is breached.	
8	**Other Bored Tunnelling Associated Works**		
a.	Tunnel break-in and break-out	QP(S)/SS to ensure that the Builder complies with the approved procedure for Tunnel break-in and break-out.	
b.	Tunnel eye support	QP(S)/SS to conduct acceptance check by probe drilling prior to hacking of tunnel eye.	
c.	Tunnel jacking frame	QP(S)/SS to verify the jacking frame member sizes are in accordance to the design after certification by the Builder's PE. PE to inspect and ensure all welding to jacking frame meet the design and welding strength requirements with tests. The tunnel jacking frame shall be monitored by strain gauge.	
d.	Cast in-situ lining	QP(S)/SS shall ensure the Builder provides a good quality cast in-situ lining. Close attention shall be given	

No	Components of Bored Tunnelling works	Duty/Inspection regime	Remarks
		to construction joints, waterproofing, rebar support to ensure a watertight structure.	

9 Material Test

9.1 The QP appointed to supervise the carrying out of any building works shall carry out or cause to be carried out such tests of or in connection with the building works as may be required under the Building Control Act or building regulations. This is to ensure that construction materials comply with the material standards as specified in the approved documents.

9.2 All materials must be tested to confirm its performance, reliability and compliance with code of practices and product technical specifications. Schedule of material test should include the material type, type of test, test method (standard), acceptance criteria, frequency of tests, number of samples per test, test dates etc.

9.3 Any test that is to be carried out at premises where building works are carried out shall be carried out under the direction and supervision of the supervising QP appointed in respect of those building works. All laboratory tests shall be carried out in accordance with the approved standard in a laboratory accredited by Singapore Accreditation Council under the Singapore Laboratory Accreditation Scheme (SAC-SINGLAS). Please refer to regulation 39 of the Building Control Regulations 2003 for more details.

9.4 Schedule of material tests should be included as part of the Site Supervision Plan.

9.5 The taking of any sample for carrying out material tests is advised to be carried out under the supervision and direction of the supervision QP. SS should check to ensure that minimum number of test are carried out to the requirement of the Site Supervision Plan prepared by QP.

9.6 The schedule of material tests in this guide is based on industry norm and is only for QP's reference. This schedule of material tests and the listed test requirements in this guide is to be referred to purely as a general guide. The standards or codes for test methods and acceptance criteria stated in this guide book are for reference only and should not be taken as the latest or the most updated information. The QP shall review, prepare and submit a project specific schedule of material tests to meet the need of the project base on its complexity and scale. It is the QP's responsibility to ensure all the materials to be adopted are compliance with the provisions of the Building Control Act, building regulations, latest relevant standards, codes of practice and product technical specifications.

Structural Works - Concrete

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
1	**Initial test for concrete (normal)[1]** [1] Data from previous tests or long-term experience may be considered as alternative to initial tests.	Compression	EN12390	SS289:Pt4 (SS EN 206-1, SS 544-1, SS 544-2)	1 test per new concrete or concrete family	Refer to Annex A, SS EN 206-1		Before concreting works
2	**Initial test for concrete (waterproofing) [2]** [2] Data from previous tests or long-term experience may be considered as alternative to initial tests.	Compression	EN12390	SS289:Pt4 (SS EN 206-1, SS 544-1, SS 544-2)	1 test per new concrete or concrete family	Refer to Annex A, SS EN 206-1		Before concreting works
		Water Absorption	BS1881:Pt 122	<3% (TR 31)		3 cubes per test (at 28 days)		
		Permeability	Darcy's Theory	$<10^{-12}$ m/s (TR31)				
		Rapid Chloride Permeability	ASTM C1202	ASTM C1202				

		Water penetration	BS12390:Pt 8	<50mm				

Structural Works – Concrete

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
3	**Cement**	Consistency	BS EN 196	SS26 SS477 (PBFC) SS476 (HSBFC) (Current SS EN 197)	1 test per brand/ type	1 sample per test		Before concreting works or trial mix
		Setting time						
		Fineness						
		Comp strength						
		Heat of hydration						

Structural Works – Concrete

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
4	**Aggregate**	Particle Size Distribution	SS31 SS73 ASTM C289 EN1744-1 ASTM C227 ASTM C295 (Current SS EN 12620)	SS31 SS73 ASTM C33 (Current SS EN 12620)	1 test per size	1 sample per test		Before concreting works or trial mix
		Fines Content/Quality						
		Chloride Content						
		Acid Soluble Sulphate Content						
		Moisture Content						
		Potential Alkali-Silica Reactivity (ASR)						
		Shell Content						
		Petrographic Examination						

Structural Works – Concrete

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
5	**Admixture**	pH value	BS EN 480	SS EN 934	1 test per brand/ type	1 sample per test		Before concreting works or initial test
		Total chlorine						
		Water soluble chloride						

Structural Works – Concrete

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
6	**Concrete**	Slump	BS EN 12350	SS EN 206	Every truck	1 per truck	Every casting	
		Compressive strength	BS EN12350	SS EN 206	1 test per 50m^3	One sample: 6 cubes per test (3 at 7 days and 3 at 28 days)		
		Permeability	Darcy's Theory	<10^{-12} m/s (TR31)	1 test per 50m^3	One sample: 3 cubes per test (at 28 days)	Every casting	Marine structure or structure in contact with chloride
		Rapid Chloride Ion Penetration	ASTM C1202	ASTM C1202				
		Water penetration	BS EN 12390:Pt8	SS EN 206				

Structural Works – Concrete

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
7	**Steel Reinforcement**	Tensile	BS EN ISO 15630-1	SS 560	1 test unit at beginning of project and at every 40t	3 pieces per size		Mil certificate and FPC certificates for each batch to be kept at site for each batch delivered
		Bend & rebend	BS EN ISO 15630-1			1 piece per size		
		Chemical	BS EN ISO 15630-1			1 piece per size		
8	**Couplers for Mechanical Splices of Steel Reinforcement**	Tensile test, slip test, high-cycle fatigue test and low-cycle loading test	ISO 15835	BS EN ISO 15835-1, BS EN ISO 15835-3	1 test unit at beginning of project and for each type/brand of coupler	2 pieces per test		Coupler specification for each type/brand to be kept at site and endorsed by QP

Structural Works – Concrete

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
9	**Welded Steel Fabric Reinforcement**	Tensile test	BS EN ISO 15630-2	SS 561	1 test unit at beginning of project and at every 25t	15 pieces per fabric size (1 sheet 1mx1m per fabric size)		Mil certificate and FPC certificates for each batch to be kept at site for each batch delivered
		Bend test	BS EN ISO 15630-2					
		Strength of welded joints	BS EN ISO 15630-2					

Structural Works – Concrete

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
10	**Wire Loop/ Slim box (used in PPVC)**	Chemical Composition	SS475:Pt1 BS5896 BS4486 (EN15630-3)	SS475:Pt2 (cold drawn) SS475:Pt3 (quenched & tempered) SS475:Pt4 (strand) EN10138 (ISO15630-3)	1 test unit at beginning of project and at every 40T	3 samples per test		Copies of manufacturer's test certificate covering each coil shall be kept at site
		Surface Condition						
		Maximum Force						
		Proof Force						
		% Elongation						
		Relaxation						
		Fatigue						

Structural Works – Concrete (Post-Tensioning)

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
11	**Steel for Prestressing Concrete**	Chemical Composition Surface Condition Maximum Force Proof Force % Elongation Relaxation Fatigue	SS475:Pt1 BS5896 BS4486 (EN15630-3)	SS475:Pt2 (cold drawn) SS475:Pt3 (quenched & tempered) SS475:Pt4 (strand) EN10138 (ISO15630-3)	1 test unit at beginning of project and at every 40T	3 samples per test		Copies of manufacturer's test certificate covering each coil shall be kept at site

Structural Works – Concrete (Post-Tensioning)

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
12	**Grout for Prestressing Concrete**	Flowability • Flow Cone • Grout Speed	BS EN 445 BS EN 446 BS EN 447 BS EN 196	BS EN 445 BS EN 446 BS EN 447 BS EN 196	Pre-bagged – 1 initial test On-site mixing – 1 test for every batch of grout mixing	3 samples per test		
		Volume Change • Wick Induced						
		Bleed • Wicked Induced • Inclined Tube (for initial test only)						
		Strength at 7-day and 28-day						
		Homogeneity • Sieve Test						

		Density						
		Density Setting time test (EN196-3)						

Structural Works – Steelworks

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
13	**Structural steel**	Yield	BS EN ISO 6892-1:2016	BS EN 10025 or BS EN 10210 or BS EN 10219	1 test per source	1 test per source		
		Tensile	BS EN ISO 6892-1:2016					
		Notch Toughness	BS EN ISO 148-1: 2016					
		Ductility	BS EN ISO 6892-1:2016					
		Weldability	BS EN ISO 14284					

Structural Works – Steelworks

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
14	**Structural steel welding (NDT)**	Visual Inspection (VI)	BS EN970 BS EN17637		FPBW – 100% RT or UT and 100% MP or PT FW – 50% MP or PT VI for all welds Shop welded connection – 1st 5 connections, thereafter 20% Other minor connections (purlin & side rail) – 10%			
		Magnetic Particle Testing (MP)	BS EN1290 BS EN17638					
		Penetrant Testing (PT)	BS EN571-1 BS EN3452-1					
		Ultrasonic Testing (UT)	BS EN1714 BS EN17640					
		Radiographic Testing (RT)	BS EN1435 BS EN17636-1					
15	**Shear Studs (Weld)**	Hammer Blow To 15 Degree	No Fracture of Weld		Random per batch 10% of Studs			

Structural Works – Steelworks

S/N	Material Type	Type of Test	Test Method	Acceptance Criteria	Frequency of Test	No. of samples per Test	Actual Test Date	Remark
16	**Bolts , Screws, studs (Carbon Steel & Alloy Steel)**	Tensile strength	BS EN ISO 898	BS EN ISO 898	Random per batch	3 per size per batch		Recommended for critical structural elements.
17	**Bolts , Screws, studs (Stainless Steel)**	Tensile strength	BS EN ISO 898	BS EN ISO 3506	Random per batch	3 per size per batch		Recommended for critical structural elements.
18	**High Friction Grip Bolts**	Tensile strength	BS 4395	BS 4395	Random per batch	3 per size per batch		Recommended for critical structural elements.

Part IV

Site Supervision for Fabrication of Precast Concrete and Structural Steelworks

10 Fabrication of Precast Concrete

10.1 QP shall appoint adequate number of full-time site supervisors in accordance with regulation 24 of the Building Control Regulations, to be stationed at precast fabrication yard to ensure that the construction of precast structural elements is in accordance with the approved drawings.

10.2 SS shall carry out the supervision of precast construction works in accordance with the provisions of the Building Control Act, building regulations and the Site Supervision Plan prepared by QP for respective structural works e.g concreting, reinforcement, precast components etc.

10.3 For record purposes, SS is advised to keep a copy of completed form of **Annex 9: Form BE-SPCFY** at site for record and audit check.

Appointment of Licensed Specialist Builder for Precast Concrete Works (SBPC)

10.4 A licensed Specialist Builder for Precast Concrete Work (SBPC) shall be appointed for fabrication of precast structural elements in Singapore.

10.5 If the fabrication of precast structural elements is carried out overseas, a licensed SBPC is also encouraged to be appointed, which means that the fabricator or the company is a registered licensed SBPC in Singapore. Notwithstanding this, the QP still has a duty under the Building Control Act to take all reasonable steps and exercise due diligence in supervising and inspecting the building works or geotechnical building works, as the case may be, to ensure that the building works are being carried out in accordance with the provisions of the Building Control Act, the building regulations, the relevant plans approved by the Commissioner of Building Control and any terms and conditions imposed by the Commissioner of Building Control.

Ready-mixed concrete (RMC)

10.6 The RMC used for the fabrication of precast structural elements shall be of the RMC plants certified by a certification bodies accredited by SAC. Please refer to circular dated 4 January 2010 on Commencement of the Requirement for RMC certification for Structural Works.

10.7 QP and/or SS shall check with the RMC producer to ensure that there are sufficient tests carried out on the aggregates to detect the presence of ASR and other essential chemical tests have been conducted to ensure the suitability of the aggregates for use in the structural concrete. Please refer to circular dated 31 October 2008 on Controlling Total Alkali Content in Structural Concrete to Minimise Risk of Alkali-Silica Reaction (ASR).

Material Tests

10.8 In order for the SS to ensure that the building works are carried out in accordance with the plans approved by the Commissioner of Building Control and any terms and conditions imposed, the SS is strongly advised to ensure that all materials are tested in accordance with the schedule of material test prepared by QP as part of Site Supervision Plan. The material tests shall be carried out by laboratories accredited by SAC.

11 Fabrication of Structural Steelworks

11.1 QP must ensure the use of appropriate steel fabricators (say, accredited by Singapore Structural Steel Society), competent and accredited site supervisors and SAC-accredited Independent Testing Agencies (ITA) for structural steelworks at fabrication yards.

11.2 SS should follow the Site Supervision Plan prepared by QP to ensure that key structural elements are built in accordance with the approved plans.

11.3 QP is advised to comply with the requirements or guidance in Annex A of circular dated 2nd November 2015 on the Guidelines on Supervision of Structural Steelworks Fabricated Off-site Locally or Overseas. Site Supervision Plan shall be prepared to provide acceptable level of supervision for structural steelworks in accordance with the Annex A of circular dated 2nd November 2015.

11.4 QP should not delegate the supervision duty completely to the QSS or ITA and shall visit the off-site fabrication yard to ensure that the Site Supervision Plan has been implemented and to conduct regular spot checks.

11.5 For record purposes, SS is strongly advised to keep a copy of completed form of **Annex 10: Form BE-SSSFY** at site for record and audit check.

11.6 In any event, the supervising QP is under a statutory duty to take all reasonable steps and exercise due diligence in supervising and inspecting the building works or geotechnical building works, as the case may be, to ensure that those building works or geotechnical building works are being carried out in accordance with the provisions of the Building Control Act, the building regulations, the relevant plans approved by the Commissioner of Building Control, and any terms and conditions imposed by the Commissioner of Building Control.

Part V
BCA Site Audit

12 Checklist for BCA Site Audit

12.1 Though not statutorily required to, BCA may conduct site audits at project sites. In order to help the SS team be familiar with the building control requirements for the supervision of a project site, SS may refer to the checklist that BCA uses for site audits (See **Annex 11: Checklist for BCA Site Audit**). The checklist contains the salient aspects of construction supervision checkpoints that the SS team would need to fulfil:

- essential site records
- reporting of tests that failed
- site instrumentation monitoring
- temporary building records
- supervision for critical structural works
- reporting of adverse impact to surrounding properties

12.2 BCA may require the QP or SS team to submit this checklist on a periodic basis.

Part VI
Good Site Practices

13 Site Records

13.1 QP is strongly advised to keep and maintain at site the following documents, books and records:

- attendance of QP and SS
- approved structural plans and approved amendment structural plans.
- QP's inspection report
- Inspection records by SS
- record of repairs to defective structural works
- record of approved method statements by QP
- material tests record and certificates
- temporary staging design and Certificate of Supervision issued by PE
- site supervision plan

14 Recommended Good Site Practices

14.1 SS shall exercise due diligence to ensure the followings are being carried out to raise the standard of site supervision

- Establish a systematic method for filing and reporting to QP of any structural non-conformity.
- Keep track of the list on structural non-conformity, instrumentation (i.e. where AL/WSL has been breached) and non-compliances for material tests. The list shall be displayed in site office for reference.
- Check that the hoarding is erected in accordance with the PE's design and a copy of hoarding drawings and calculation to be kept at site.
- SS shall use own measurement tape for verification of pile depth.
- Study the approved drawings and specification before the inspection.
- Pull-out tests (proof tests or workmanship tests) for post-installed anchor bolts/rebars shall be carried out by SAC-accredited laboratory.
- Pull-out test reports or inspection forms (to be kept by SS, developer, builder, tester) shall be signed by the SS immediately after witnessing of the tests.
- Application of waterproofing plaster to the exposed face of common party wall after demolition works.
- Use of controlled demolition method to reduce the noise and vibration when carrying out demolition works e.g avoid the use of breaker
- Visual inspection on surrounding building works during ERSS or piling works.
- Keep record of pile penetration length/boring for each pile in systematic way for as-built verification at later stage.

Please note that the list above is a non-exhaustive list and the SS is expected to comply with his duty at law as set out in section 10(5) of the Building Control Act.

13.2 For record purposes, QP is strongly advised to keep site records for a minimum duration of 5 years after project completion (i.e. after TOP is obtained).

Part VII
Annexes

Annex 1 - FRAMEWORK FOR RISK-BASED INSPECTION

<table>
<tr><th>RISK FACTOR</th><th>LOW RISK</th><th>MEDIUM RISK</th><th colspan="2">HIGH RISK</th></tr>
<tr><td>Building Classification</td><td>Minor Building Works</td><td>Major Building Works</td><td colspan="2">Major Building Works</td></tr>
<tr><td>Type of Building Works</td><td>All building works mentioned in Fourth Schedule
(non-AC projects)</td><td>All building works except works mentioned in Fourth Schedule
(AC projects)</td><td>High-rise Building##
Complex Structures**</td><td>Geotechnical Building Works
(GBW)</td></tr>
<tr><td>Project Value #</td><td>not exceeding $7.5 M</td><td colspan="3">more than $7.5 M</td></tr>
<tr><td>QP Supervision</td><td>QP(ST)</td><td>QP(ST)*</td><td colspan="2">QP(ST)* and QP(Geo)*</td></tr>
<tr><td>Site Supervisors Requirements</td><td>Resident Technical Officer (RTO)</td><td colspan="3"><table><tr><td>Project Cost</td><td>> $7.5 – $15 M</td><td>> $15 –$30 M</td><td>> $30 – $75 M</td><td>> $75 – $150 M</td><td>> $150 M</td></tr><tr><td>Site Supervisors</td><td>1 RTO</td><td>1 RE</td><td>1 RE + 1 RTO</td><td>1 RE + 2 RTO</td><td>2 RE + 3RTO</td></tr></table></td></tr>
<tr><td>Supervision requirements</td><td>Immediate supervision for

• concreting
• piling
• pre-stressing
• tightening of high-friction grip bolts
• the construction of ERSS
• other critical structural works such as demolition works</td><td>• full time supervision for structural elements of all building works (including demolition works)
• Exc_non-GBW_Annex C-1 and ERSS_Annex E forms for non-GBW works</td><td>• QP’s inspection before or during execution of complex structures
• full time supervision for structural elements of all building works (including demolition works)
• Certificate of Supervision on Pile Load Test (Annex B)
• Certificate of Supervision on Piling Works in two stages [50% and 100% (Annex C)]
• Building settlement monitoring plan & settlement limit (Annex D)
• Exc_non-GBW_Annex C-1 and ERSS_Annex E forms for non-GBW works</td><td>• full time supervision for structural elements of all building works
• checklist for Supervision of Tunnelling works
• Exc_GBW_Annex C-1 and ERSS_GBW_Annex E forms for GBW works

Supervision duties under Eighth Schedule, Part 2 of BC Regulations</td></tr>
<tr><td>Supervision Checklist</td><td></td><td colspan="3">• Concreting works
• Post-tensioning works
• Safety Barriers
• Precast components
• Curtainwall & Cladding (Stick System)
• Curtainwall & Cladding (Unitised System)
• PPVC (Steel)</td></tr>
</table>

	Minimum level of immediate supervision (refer to **Annex 5**)	• Foundation works (Bored Piles) • Foundation works (Displacement Piles) • Structural Steelworks • Mass Engineered Timber • Reinforcement • Demolition works	• PPVC (Conrete) • Post-Installed Anchors/Rebars • ERSS • Tunnelling works (for GBW)

Note:

* For major building works, the QP(ST) shall not be the officer, employee or partner of the developer or builder.

** For building fall under complex structures, refer to Annex A (criteria for complex building) of circular dated 2nd June 2014

For project values more than $7.5 M, refer to Building Control Regulations 24

For buildings more than 10 storey

Notification of CBC on Upcoming Critical Works

(This form should be submitted to BCA at least 2 weeks before the commencement of structural works relating to critical structural elements)

Commissioner of Building Control **Building and Construction Authority** 52 Jurong Gateway Road, #12-01 Singapore 608550 Fax: 63342561	**Project ref no. & title:**

This is to notify Commissioner of Building Control (CBC) that the carrying out critical works of _____ at _____ (location of the critical works e.g storey/gridline) will be on _____(date). The critical works were approved under ST____.

I hereby confirm that I will be carrying out the following works (tick where appropriate):

- ☐ Supervise or witness the execution of critical works by ensuring that the works are carried out in accordance with the approved plan and technical documents (e.g method statements, codes of practice)
- ☐ Inspect the works or visit the site (areas of critical works) prior execution of critical works
- ☐ Brief the builder and site supervision team prior to execution of critical works.

Yours faithfully

_____

(Signature of QP)

Name of Qualified Person: _____

Date: _____

QP's Inspection Report

Project Reference No.:

Project Description:

Inspection Reference No.:

Date of Inspection:

Outcome of Inspection

1. Area of Inspection (gridline/storey/element marking):

- QP's Comments:

- Follow up action by RE/RTO:

2. Area of Inspection (gridline/storey/element marking):

- QP's Comments:

- Follow up action by RE/RTO:

Assessment of Site Inspection forms

1. Improvement on format of site inspection form:

2. Comments on inspection forms filled by RE/RTO:

Assessment on Material Test Reports

1. Failure of material test failure:

2. Follow up action (e.g design check by QP(D) or further structural assessment):

Assessment of Site Non-Conformity Report

1. Outstanding non-conformity/structural defects on critical elements:

2. Follow up action:

QP's Declaration:

I hereby certify that I have checked the building works on site and confirmed that all building works are carried out in accordance with the approved plan.

_____ _____

Name & Signature of QP(Supervision)

Date

Site Supervision Record Book

1. Particular of Site Supervisor:

Name of Site Supervisor	
Site Supervisor Type (RE/RTO)	
Registration Number	
NRIC no./Passport no.	
Registration Address	
Telephone no.	
Mobile no.	
Email Address	

2. I shall regularly update and maintain the accuracy of site supervision record book.

_____ _____

Name & Signature of Site Supervisor

Date

3. Record of Supervision works (to be updated regularly after completion of each project)

Name of RE/RTO:	
RE/RTO Accreditation No.	

S/No	Project Ref. No	Scope of supervision	Date of Permit Issuance	Project Sum	Type of Supervision	Start Date of works	Endorsement by QP	Date of Completion of Supervision works	Endorsement by QP
		(superstructure / ERSS / demolition / barrier / Cladding)	(DD/MM/YY)	($ Million)	(Full time/ Immediate)	(DD/MM/YY)	(to be endorsed within 3 days of start of work)	(DD/MM/YY)	(to be endorsed within 3 days of completion of works)

Type of Critical Structural Works	**Sub-Classification of Works**	**Min Level of Supervision**
Demolition Works	For all type of building regardless of number of floor storeys	Throughout the process
Piling Works	All types of piles	Throughout the process
	Load tests	Start & End of process
	Instrumentation monitoring	To be present when taking readings
ERSS Works	Soil removal	Throughout the process
	Installation of all strutting elements	Throughout the process
	Instrumentation monitoring	To be present when taking readings
Concreting works	Erection of formwork & falseworks	Inspection before laying reinforcement
	Base preparation for footing/raft construction	Inspection before laying reinforcement
	Laying of steel reinforcement	Inspection before concreting
	Concreting	Throughout the process
	Pre-stressing	Throughout tendon stressing and locking
	Precast	Placing of precast units and grouting of joints
	Formwork removal	Inspection of Structural Elements
Steel Works	Verification of steel elements	All elements
	Connections (steel-to-steel & steel-to-concrete)	Every connection
Timber Works	Verification of timber elements	All elements
	Connections	Every connection
Curtain Wall and Cladding Fixings	Pre-installed fixings	Start & before concreting
	Post-installed fixings	100% of total fixing points
Barriers	Glass, aluminium and Steel	Every connection

<u>**List of Structural Non-Conformances**</u>

Project Reference No : ______________________________

Project Title : ______________________________

____

Qualified Person (Supervision):

S/N	Description of Structural Non-Conformance	Date	Notify QP? Yes/No (Date)	QP's Instruction	Follow-up action / rectification	Date of Closure (Inspection and clearance by Supervisor)	Name & Signature of Supervisor

<u>List of Deviation from Approved Plan</u>

Project Reference No : ______________________________

Project Title : ______________________________

____

Qualified Person (Supervision):

S/N	Description of Deviation from Approved Plan	Date	Notify QP? Yes/No (Date)	QP's Instruction	Follow-up action / rectification	Date of Closure (Inspection and clearance by Supervisor)	Name & Signature of Supervisor

Summary of Non-Compliances for Material Tests

Project Reference No : _____

Project Title : _____

_____

_____

Qualified Person (Supervision):

S/N	Material	Material Test	Acceptance level or requirement	Test Results (failed)	Date	QP's follow up action	Name & Signature of Supervisor

Precast Construction at Fabrication Yard

Annex 9: Form BE-SPCFY

Project Reference No : _____

Project Title : _____

_____

_____

Particulars of Precaster

Name of Precaster:	Specialist Builder for Precast Concrete Works* (Yes/No): *For overseas precast plants, please indicate 'Yes' if the precaster is a licensed Specialist Builder for Precast Concrete Work (SBPC) in Singapore
Address of Precast Yard:	Number of Full-Time Site Supervisors appointed by QP (station at precast yard): Names (RE/RTO): 1. 2.
Ready-mixed concrete producer (certified by SAC-accredited Certification Body): Addresses of RMC Plants:	List of Accredited Laboratories for Material Tests Reinforcement: Concrete: Cement/Sand/Coarse Aggregates:
QP's visit to precast yard (dates of visit):	

1. I shall ensure the adequate number of full-time supervisors being appointed at precast fabrication yard and I have briefed the supervisors at precast fabrication yard on the requirements of site supervision plan. A copy of site supervision plan had been issued and kept at the precast fabrication yard for reference.

_____ _____

Name & Signature of Qualified Person Date

Structural Steelworks at Fabrication Yard

Project Reference No : _____

Project Title : _____

_____

_____

Particulars of Steel Fabricator:

Name of Accredited Steel Fabricator: *accredited by the Singapore Structural Steel Society under the Structural Steel Fabricators' Accreditation Scheme	Number of Full-Time Qualified Site Supervisors (QSS) appointed by QP (station at steel fabrication yard): Names (RE/RTO): 1. 2.
Address of Fabrication Yard:	List of Accredited Laboratories for Material Tests:
Full-time SAC Accredited Independent Testing Agency (ITA):	QP's visit to Steel Fabrication Yard (dates of visit):

1. I shall ensure the adequate number of full-time accredited supervisors being appointed at structural steelwork fabrication yard and I have briefed the supervisors at structural steel yard on the requirements of site supervision plan. A copy of site supervision plan had been issued and kept at the structural steelwork fabrication yard for supervisors' reference.

_____ _____

Name & Signature of Qualified Person Date

Building Engineering Group
SITE INSPECTION REPORT

A. Project Particulars

Project Reference Number			
Project Title			
Name of QP(S) – Main works		PE No.	
Name of QP(S) – ERSS		PE No.	
Name of QP(S) – Geotechnical		PE No.	
Name of RE/RTO		HP No.	
Builder Firm			

B. Type of On-Going Works (Please select works that are applicable)

☐ Barrier
☐ Basement
☐ Cladding/Curtain Wall
☐ Demolition
☐ Earth retaining structure/Excavation for cofferdam, trench etc
☐ Ground Support & Stabilization Works
☐ Pile Cap
☐ Piling Works
☐ Post-tensioning/Pre-stressing Works
☐ Precast Concrete Works
☐ Structural Steelworks
☐ Super-structure

C. Inspection Report (Please cross out whichever that is not applicable)

Hoarding

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
01	Are there any protective hoarding erected at the site?	Yes / No / NA	
02	Are the protective hoarding erected at the site adequate and in good and proper condition?	Yes / No / NA	

Signboard

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
03	Is there a project signboard erected at the site and have all the particulars required as in the conditions of the permit issued?	Yes / No / NA	

Start works/Major deviations without plan approval/permit

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
04	Are there plan approval and permit for the works that have commenced?	Yes / No / NA	
05	Is there amendment plan approval for any major deviations detected on site?	Yes / No / NA	
06	Are the approved drawings with watermark available on site?	Yes / No / NA	

Site records

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
07	Are the attendance records of the Qualified Person and RE/RTO kept on site?	Yes / No / NA	
08	Are the relevant test reports kept on site, i.e. Soil Investigation and testing report; Cube test reports; Load test reports; Steel test reports etc?	Yes / No / NA	
09	Are there records of PE's inspection at each strut level and critical stage of the temporary works (Annex C-1)?	Yes / No / NA	
10	Are there records of instrumentation and monitoring reports?	Yes / No / NA	

Failure of test

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
11	Did the QP(S) notify BCA that the construction test has failed to meet the minimum requirements stipulated in the Regulations or any approved code of practice? *Note: RE/RTO to record the tests that have failed in "Remarks".*	Yes / No / NA	
12	Did the QP(S) or QP(D) recommend appropriate steps, measures or remedial works to be carried out for the construction test that has failed to meet the minimum requirements?	Yes / No / NA	

Instrument monitoring

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
13	Have corrective actions been taken for the vibrations readings that has exceeded the limits proposed by the qualified person? *Note: RE/RTO to record the instruments that the readings are exceeded in "Remarks".*	Yes / No / NA	
14	Did the QP(S) notify BCA on the ground movements (lateral deflection/ground settlement) that has exceeded the allowable limits? *Note: RE/RTO to record the instruments that the readings are exceeded in "Remarks".*	Yes / No / NA	
15	Did the QP(S) notify BCA on the building settlement (for projects more than 10-sty) that has exceeded the limit proposed by the qualified person? *Note: RE/RTO to record the instruments that the readings are exceeded in "Remarks".*	Yes / No / NA	

Temporary building

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
16	Are the required plans, calculations, and certificate by PE for the temporary building/standalone worker's quarters comprising 2 or more storeys kept on site?	Yes / No / NA	
17	Is the certificate by PE to certify the floors above and on which the worker's quarter is located in the building under construction have been constructed in accordance with approved plans, kept on site?	Yes / No / NA	
18	Do the Standalone Workers' Quarters or Workers' Quarters in the building under construction comply with room requirements?	Yes / No / NA	

Demolition / Demolition for A&A

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
19	No over-accumulation of demolition debris was observed on the floor slab?	Yes / No / NA	

20	Is the building to be demolished properly isolated from the party wall?	Yes / No / NA	

ERSS

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
21	Are there proper temporary shoring works for the excavations at the site?	Yes / No / NA	

Piling works

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
22	Do the actual penetration depths comply with pile termination criteria in approved plans and are not considerably shorter? *Note: Check if RE/RTO use their own measuring tapes to measure the penetration depths of bored piles. If not, did RE/RTO check the measuring tapes used and how frequent is the check carried out? Please indicate the findings in "Remarks".*	Yes / No / NA	
23	Do the actual rock socketing depths tally with the design rock socketing depth and are not shorter?	Yes / No / NA	

Builder's License

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
24	Is the appointment of licensed specialist builder submitted to BCA? (Specialist Building Works: Piling works (PW) / Structural steelworks (SS) / Precast concrete works (PC) / In-situ post tensioning works (PT) / Ground support & stabilization works (GS) / Site investigation works (SI)) *Note: RE/RTO to record the licensed specialist builder in the "Remarks".*	Yes / No / NA	

Others

	ITEM INSPECTED	FILL IN THIS COLUMN	REMARKS
25	Is any pre-construction survey of surrounding properties done and kept on site?	Yes / No / NA	
26	Are the waterproofing or protection measures to prevent seepage into the exposed party wall provided?	Yes / No / NA	
27	No visible damage in the surrounding area/structures due to the construction activities?	Yes / No / NA	

Other Observation

28	Please note down any other observations not covered under items 1-27.

Progress

29	Progress of Works (Percentage of Works Completed)
NATURE OF WORKS	Progress (%)
Demolition Works	
Piling Works	
Basement Works	
Superstructure Works	

D. Overview Photos (Please attach overview photos of on-going structural works)

E. Non-Compliance Observed on Site (Please attach photos of the structural non-compliances)

S/No.	Description & Details of Non-Compliance Observed On Site	Photographs

D. Particulars of Inspection

Date of this inspection	

Name of Inspecting RE/RTO	Signature
Name of QP(S)	Signature
Name of QP(Geo)	Signature