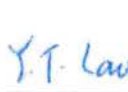









MS Reference Number:	CSHK	CET	MS	G	2024	000014
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METHOD STATEMENT TITLE	Rev. A
Method Statement for General Site Survey Works	

	Prepared by:	Checked by:	Reviewed by:			Approved by:
Signature:						
Name:	YT Lau	HK LEUNG	KF Leung/ WK Hui	MH Isa / WH Lam	MH Isa / Iris Ho	Eric Fong
Position:	Senior Surveyor	Survey Manager	SM/SO	QM/QE	EM/EO	Project Director
Date:	05 Feb 2024	05 Feb 2024	05 Feb 2024	05 Feb 2024	05 Feb 2024	05 Feb 2024

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1. Introduction
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<b>1.</b>	<b>Introduction</b> (Overview of the operation/works)								
	<p>China State Construction Engineering (Hong Kong) Limited (CSHK) has been awarded to carry out construction works for Siu Ho Wan Depot Property Development Oyster Bay Station and Associated Works.</p> <p>The principle methods described in the following sections will be subject to review during construction and may be amended if so required.</p> <p>Scope of Works:</p> <p>The method statement details the procedures to be undertaken for the Control Survey, Initial Land Record Survey, Record and Progress Survey, Setting-out and Survey Check, As-built Record Survey, Settlement Monitoring Survey etc.</p>								
<b>2.</b>	<b>Reference Documents</b> (Identify relevant documents by name and reference number)								
	General Specification for Civil Engineering Works (NEC4)								
<b>3.</b>	<b>Details of Sub-Contractor/Specialist Sub-Contractor</b>								
	N/A								
<b>4.</b>	<b>Responsibilities for Activities described within Method Statement</b>								
	<p>CSHK is responsible to inspect and carry out the construction works. The following persons, as listed in the table below, will attend the specific tool-box talk and be responsible for the activities:</p> <table border="1"> <thead> <tr> <th>Company</th> <th>Name</th> <th>Position</th> </tr> </thead> <tbody> <tr> <td rowspan="2">CSHK</td> <td>Leung Ho Kit</td> <td>Survey Manager</td> </tr> <tr> <td>Lau Yu Tat</td> <td>Senior Surveyor</td> </tr> </tbody> </table>	Company	Name	Position	CSHK	Leung Ho Kit	Survey Manager	Lau Yu Tat	Senior Surveyor
Company	Name	Position							
CSHK	Leung Ho Kit	Survey Manager							
	Lau Yu Tat	Senior Surveyor							
<b>5.</b>	<b>Programme and Working Hours</b> (Start & finish date of operation/works)								
	N/A								
<b>6.</b>	<b>Plant, Instrument &amp; Material</b> (Identify type, model and specification of MAJOR plant & Instrument)								
	<p>All Instrument will be inspected prior to the mobilization on site to ensure that they are in good working condition and comply with the current regulations.</p> <p>The major plants and instrument will be deployed to carry out the works are as follow: -</p> <table border="1"> <thead> <tr> <th>Plant / Instrument</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td>TS16A – 1"</td> <td>1</td> </tr> <tr> <td>LS15</td> <td>1</td> </tr> </tbody> </table>	Plant / Instrument	Quantity	TS16A – 1"	1	LS15	1		
Plant / Instrument	Quantity								
TS16A – 1"	1								
LS15	1								



## 7. Survey Activities / Construction Methods / Construction Sequence Drawings

### 7.1 Horizontal Control:

CSHK shall base on those verified Master survey control stations to establish a first order horizontal survey network. All primary horizontal control stations shall be connected by a closed traverse. At least two Master survey control stations shall be tied at starting and ending observations.

#### 7.1.1 Origin and datum of Survey

- The following survey control stations provided by MTR will be adopted as the origin for horizontal control: MOB01, MOB02, MOB03, MOB101 to MOB119. These master controls, being the base frame of the survey network, will be further broken into primary and secondary controls for daily survey operation.
- Unless otherwise specified in contract document or accepted by MTR, all horizontal coordinates of the works shall be referenced to and expressed in the Hong Kong 1980 Grid system.

#### 7.1.2 Traverse / Network

- All horizontal control stations for works shall be established by control network survey, traverse survey. The accuracy and standard of control network survey and traverse survey are summarized as follows:

		By Bowditch Rule		By Least Squares Adjustment		
		Allowable Angular Misclosure	Allowable Linear Misclosure	Allowable Angle Residual	Allowable Distance Residual	Maximum Traverse Length
Control Network Survey	Primary	N.A.		5"	1:30,000	N.A.
	Secondary			10"	1:15,000	
Traverse Survey	Primary	$10''\sqrt{n}$	$(5+S/15)$ mm	10"	1:15,000 or 5mm (minimum)	2.5 km
	Secondary	$20''\sqrt{n}$	$(10+2S/15)$ mm	20"	1:7500 or 10mm (minimum)	1 km

n : Number of survey stations in the traverse

S : Total length of the traverse in metres

[Reference: Engineering Survey Practice Guides for Works Projects (ESPG\_2023)]

- Traverse legs are to be approximately of equal length and the narrow angles between traverse legs are to be avoided. The distance between two adjacent stations shall be established between 300m and 1000m.
- Control stations shall be made by one of the following types in compliance with the standard currently used by the SMO of Lands Department.

Survey Station Marker	Ground Conditions
(i) Triangulation monument (concrete pillar)	Hilltop
(ii) Picket Box	Open ground
(iii) Survey nail	Kerbstones, pavement, concrete sumps, concrete roof of structure

All control stations shall be installed rigid and secure properly and preserve by CSHK.

### 7.1.3 Bearing and Distance Measurement

- Site reconnaissance will be carried out and record the potential observation at each survey control station before the control survey to be carried out. Based on the site reconnaissance information, pre-analysis will be prepared by using of the survey software to estimate the error propagation of the control network survey or traverse survey designed.
- Precise Total-station TS16A or equivalent / higher standard instrument accepted by MTR will be employed. Instrument specification is 1 second in direction and 1mm+1.5ppm in distance measurement.
- An observation diagram and schedule are prepared to list out all the targets to be observed from each specific stand survey control station. The idea of the schedule is to listed out as many targets as visibility permits so that all known survey control stations will be included from the observation.
- Four arcs of reading on both face left and face right will be observed to all the targets as listed in observation schedule. All directions are to be read in whole circle bearing around the clock. Observation data is to be recorded into Total-station internal memory or removable memory.
- Instrument height, target height and meteorological data shall be recorded.
- Set Zero on ppm is to be applied on the instrument during observation. Temperature and Pressure measurements are to be recorded at both ends of the line during the distance measurement for atmospheric correction on the measured distance.
- The position of the set-up station which is fixed survey control station shall be checked by observing angles and distances to at least two known stations with an included angle and at least one distance measurement.
- Acceptable criteria in direction measurement, Standard Deviation of the Mean,  $\bar{\sigma}$ , of each reduced horizontal observed included angle shall not be greater than  $\pm 3$  second of arc.
- Acceptable criteria in distance measurement, Standard deviation of the Mean,  $\bar{\sigma}$ , of each reduced observed distance shall not be greater than  $\pm 2$ mm. The distance must be measured by an EDM or Total-Station. Each line is measured with at least one pointing with three measures. All necessary corrections shall be applied.



#### 7.1.4 Requirements

- In case the Master survey control stations are found to be damaged or in error, CSHK will inform to MTR.
- Sufficient working space shall be made available around each station to enable the necessary instrument to be erected and operated.
- CSHK shall supply a copy of the field notes in a neat and legible form showing all the point numbers, measurements, observations and sketches of the survey works to MTR for record.

#### 7.1.5 Computation and Accuracy

- All the survey data are logged into the Total-Station internal memory or removable memory card will be transferred to computer for processing in a raw data format.
- The logged data will be re-arrayed and checked against with the field record. The organized electronic data will then be passed to an electronic spreadsheet for data reduction. The computation will be processed as a traverse or network adjustment with survey software such as "StarNet". The software employs least square method to provide best fit adjustment for all survey observation and evaluate the accuracy of control stations.
- A survey report on the establishment of the survey control stations will be submitted to MTR for review and comment. The report comprises all the documents throughout the process of evaluating the co-ordinates of these survey control stations including a copy of field record, electronic observed data and survey software output report.

### 7.2 Vertical Control:

CSHK shall base on those verified Master Benchmarks to establish a precise levelling survey control network.

#### 7.2.1 Origin and Datum of Survey

- The following survey benchmarks provided by MTR will be adopted as origin for vertical control: MOB501 to MOB510, 212019 and 212025. These master controls, the being base frame of the survey network, will be further broken into primary and secondary control for daily survey operation and all vertical levels of the works shall be referenced to and expresses in either:
- Hong Kong Principal Datum (HKPD) which is the height datum generally used in Hong Kong and referred through the benchmarks of Lands Department; or
- Chart Datum (CD) which is 0.15m below HKPD
- All Precise levelling benchmarks shall be surveyed by a closed levelling network which shall be tied to a minimum of two verified Master Benchmarks.

### 7.2.2 Levelling Traverse Observation

- Electronic digital level LS15 or equivalent / higher standard instrument accepted by MTR will be employed with bar code invar staff. Instrument specification is 0.3mm standard deviation per 1 km double run.
- Prior to commencement of every levelling survey, the electronic digital level set must be tested by 2-peg test. If the collimation error exceeds the tolerance of 1mm/30m, then the instrument shall be adjusted until the collimation error falls within this tolerance.
- The levelling survey shall be carried out by double run observation with at least on more benchmark for adjustment or counter checking. Levelling misclosure shall not exceed  $4\sqrt{k}$  where k is total length of distance travelled km.
- The levelling survey shall start from a known station and counter check with another known station.
- The maximum sight distance for each levelling observation shall be 30 meters.
- 0.3m on both ends of invar staff shall not be used to avoid uncertainty resulting from refraction and /or bar-code reading.
- The difference between sum of backsight and sum of foresight distances for each levelling route shall not exceed 2 metres and agreed on site.

### 7.2.3 Computation and Accuracy

- All vertical control stations for works shall be surveyed by levelling or height traversing. The misclosure shall be mathematically adjusted. The accuracy and standards of levelling and height traversing are listed as follow:

	Precise Levelling	Ordinary Levelling	Height Traversing
Allowable Misclosure	$4\sqrt{k}$ mm	$12\sqrt{k}$ mm	$(10 + 10\sqrt{n})$ mm

n : Total number of traverse legs

k : Total distance of levelling route in kilometres

- The maximum misclosure shall meet the standard of accuracy listed as below:
- Levelling route shorter than 1km  
 $\pm 1\text{mm } \sqrt{N}$  (where N is number of set-up)
- Levelling route over 1km  
 $\pm 4\text{mm } \sqrt{K}$  (where K is in Kilometres)

The precise levelling survey control network shall be adjusted by using a method agreed by MTR.

- All the survey data are logged into internal memory or removable memory card. The organized electronic data will then be passed to an electronic spreadsheet for



calculation. Calculation will also be processed with survey software such as Leica Software / StarLEV if required.

- A survey report on the benchmark survey shall be submitted to MTR for review and comment. The report comprises electronic observed data, reduction file, location plan and summary of the established benchmarks.

#### **7.2.4 Requirements**

- In case the Master Benchmarks are found to be damaged or in error, CSHK will inform to MTR.
- CSHK shall construct and maintain enough of Precise levelling benchmarks within works area.
- CSHK shall heighted the above-described benchmarks to the specified accuracy.
- CSHK shall supply a list of levels of all Precise levelling benchmarks for survey works

#### **7.3 Initial Land Record Survey:**

- According to Client Scope S205.2.1, an initial site survey will be carried out within and around the Site and working areas and within all areas lying within a horizontal distance of 50m to the works. The initial site survey should include an initial land record survey.
- An initial land record survey, pursuant to the General specification for Civil Engineering Works clause G1.9.1, of all Site and working areas before the works commence in site and working areas. The survey establishes the precise boundaries, the existing ground levels within the site and working areas at the time of handover, the conditions around the site and working areas and the precise location and condition of all existing features that may require reinstatement. The survey taken by the contractor and accepted with the project Manager before site clearance or excavation and with the prior acceptance of the Project manager.
- A details initial land record survey (topographic survey) of the site shall be carried out after site clearance, and before the commencement of the Works. The purpose of this survey is to verify and record of additional topographic surveys where there is any missing data or where the topography has changed.
- To be informed the MTR's Land Surveyor before the initial survey commencement. A RISC form will also be duly submitted to the MTR's Land Surveyor to record the activity.
- All the surveys data shall be recorded into the instrument internal memory or removable RAM card stored by a Total Station and to be transferred to computer for processing in a raw data format.
- The survey control stations for the initial land record survey will be based on the master survey control stations and benchmarks, which provided by the MTR and those primary and secondary control stations derived from the master control stations and benchmarks. Instrument setup could be directly over know stations with backsight



bearing and distance to at least one ground stations plus a bearing to any one of the ground or triangulation station.

- For free stations setup, backsight with bearings and distances should be observed to at least two ground stations to provide the redundant data for checking on the setup. Instrument height and targets heights should be recorded accordingly. At least two sets of Face right and Face left readings are taken. However, free station setup is only applicable to undertake initial land record survey.
- During the survey, check the bearing orientation by sighting to one of the reference points after taking about every 100 to 200 shots and at the end of observation of each set-up. The check reading shall not significantly differ from the initial reading (say by more than 1 minute). If the discrepancy exceeds 1 minute, all the survey shots observed prior to the check sight to the reference point shall be discarded. The survey instrument shall be checked, re-levelled/reset, if necessary, and the surveyed details shall be re-observed.
- The initial land record survey shall cover all works areas and 50m strip outside the site boundary except otherwise being accepted. The survey shall include all existing features such as street furniture, trees, temporary structures, rail and instrumentations.
- Before completion of work on each setup, check again the backsight and record it into the raw data file to make sure the data is reliable. Once the backsight bearing is out of the allowable deviation- subject to the job nature, the whole survey for this setup is to be re-surveyed again.
- The Initial Land Record drawing shall be produced in MicroStation (DGN) format in accordance with the MTR CADD Drafting Specifications.
- The survey report including the photocopy of all filed sheets, electronic data file and survey drawings will be submitted to MTR.
- All survey Instrument shall be checked and calibrated by manufacturer every of 12 months. The in-house instrument performance test shall be conducted every 3 months or when the instrument newly delivery on site.

#### **7.4 Record and Progress Survey:**

- Record survey and details survey are undertaken to record the status of works or on some specific area for the engineer consideration.
- To be informed the MTR's Land Surveyor before the record and progress survey commencement. A RISC form will also duly be submitted to the MTR's Land Surveyor to record the activity.
- The processing of the data recording and the survey control stations will be similar to those mentioned on the initial land record survey.
- The survey report including the photocopy of all filed sheets, electronic data file and survey drawings will be submitted to MTR. The scale of the survey drawings may be enlarged to suit the engineer requirement and the text size in A4 or A3 paper size print

out shall at least 1.5mm height.

#### **7.5 Setting-Out and Survey Check:**

- Setting out survey is the process of location point or levels of the features (site boundary, road, structure, building, etc as specifies by the Engineer) on ground according to the construction drawing or information provide by the Engineer. Checking of setting out work shall be carried out to ensure the points are set out in accurate positions and levels to comply with relevant survey standard and Engineer's reequipment.
- CSHK shall review and examine the survey requests and Engineer's requirement carefully, choose appropriate survey method and instrument for setting out works/ checking of setting out works.
- CSHK shall work out and submit the setting out data which derived from the latest information and drawings to the MTR's land Surveyor.
- CSHK shall notify MTR's Land Surveyor for survey check by submitting a RISC form in accordance with the Survey inspection Plan when a check survey is required. MTR's land Surveyor may be informed by phone in advance.
- No RISC form or notification will be required if this is only a temporary work which is not relevant to the permanent work.
- Random checking of the major structure shall be carried out to minimize the incautions setting out lines or level on site.
- The survey control station will be similar to those mentioned in the initial land record survey.
- Distance between instrument and setting out point shall normally not exceed 50m in general for the major setting out point / line / level.
- Observe a check the bearing orientation by sighting to one of the reference points at the start of set up for setting out. Check the bearing orientation after setting out every 20 to 30 points or less and at the end of the setup of setting out to check the stability of the instrument. If the check bearing significantly differs from the initial observed bearing (more than 30 second), re-setting out or re-survey check shall be conducted.
- For free stations setup, backsight with bearings and distances should be observed to at least two ground stations to provide the redundant data for checking on the setup.
- The survey result shall be submitted in accordance with the request as accepted with MTR's land Surveyor, eg. Sketch or sketch showing the nature of setting out marks, survey results comparing coordinates/level of the setting out marks, etc.
- The survey report will be similar to those mentioned in the record and progress survey.



## **7.6 As-Built Record Survey:**

- Undertake record surveys for all as-constructed permanent works. The MTR's Land Surveyor will be informed before conducting the as-built survey by a RISC form.
- The processing of the data recording and the survey control stations will be similar to those mentioned on the initial land record survey.
- The preparation of as-built record drawings and monthly survey report shall be produced in MicroStation (DGN) format in accordance with the MTR's CADD Drafting Specifications and PDF format.
- Once any significant discrepancy is found that deviate to the working drawings, it should be immediately reported to the both engineers (CSHK & MTR) to solve the problem.
- The as-built record drawings will be submitted to the engineer periodically and have to maintain a full set of those drawings on site.
- The as-built record mention agreed results of all survey works with deviations value would notify to both Engineer and inspector for their reference.

## **7.7 Settlement Monitoring Survey:**

### **7.7.1 Settlement Monitoring by Precise Levelling**

- The processing of field survey, the data recording will be similar to those mentioned in the Control Survey-Establishing vertical survey control station.
- The levelling of all settlement marks shall be surveyed as a turning point. If the settlement mark is surveyed by intermediate sight method, the mark shall be observed at least twice from different instrument setup. The discrepancy between the surveyed levels of the same settlement marks shall not exceed 1mm and mean value shall be adopted.
- The initial readings of all settlement marks shall be taken as the consistence readings obtained from three independent level runs in first three days and at least one of them joint survey with MTR except otherwise being accepted. The discrepancy between the surveyed levels shall not exceed 1mm and mean value shall be adopted. The initial reading of geotechnical instruments shall be agreed and submitted to MTR
- Temporary Benchmark (TBM) if required shall be established from the vertical survey control stations or benchmarks for the works by levelling which starts and counter check at different vertical survey control stations or benchmarks. The TBM shall be checked regularly with the vertical survey control station or benchmarks.

### **7.7.2 Data Processing, Computation and Report**

- Control Diagram- A diagram of the levelling network based on all the connections between the benchmarks, newly established Temporary Benchmarks (TBMs) shall be prepared and submitted.
- Station sketch-individual diagram of benchmarks / TBMs showing its general location

	<p>with description shall be prepared.</p> <ul style="list-style-type: none"> <li>Instrumentation Sketch – A drawing showing all the settlement marks location and identification together with the benchmarks / TBMs shall be prepared.</li> <li>Survey raw data with field notes and draft settlement monitoring results shall be provided when requested by MTR and / or relevant parties such IMC to witness and observe the survey activities, to check the accuracy of the measurements. Those materials shall be provided as soon as practicable within 24 hours after the readings are taken.</li> <li>Formal settlement monitoring results shall be passed to CSHK construction team for further consolidation with other monitoring results to prepare the instrumentation and monitoring report for submission to MTR and relevant parties if any. The report shall be submitted at intervals specified under the contract or otherwise accepted.</li> <li>In addition, those monitoring results shall also be uploaded into the web-based platform, Unified Web Database (UWD) maintained by IMC within 24 hours after the readings are taken or at intervals otherwise accepted.</li> <li>A complete set of monitoring records shall be kept on site at all times for inspection by MTR.</li> </ul>
<b>8.</b>	<b>Safety (Risk Assessments)</b>
	<p><b>8.1 General</b></p> <ul style="list-style-type: none"> <li>All Surveyor shall attend a site-specific induction course conducted by the Safety Department. The Safety Department shall explain the necessary safety requirements as identified in the Risk Assessment Record and the Site Agent/ Foreman/ Engineer in charge of the work shall explain the system of work to his supervisors and Surveyor.</li> <li>All Surveyor shall be equipped with reflective vests and safety helmets during operation. All Surveyor must go through a briefing by the Site Agent / Safety Officer / Safety Supervisor before commencement of any works. All Surveyor on site shall obtain an approved "Mandatory Basic Safety Training Certificate" and have completed the CSHK Course Worker Safety Course.</li> <li>Toolbox talk training with reference to the recommended safety and environmental control measures after job hazards analysis will be provided to the site personnel prior to commencing works.</li> <li>A pre-meeting will be arranged before commencement of the work among Survey Team / Site Agent and Safety Department to brief the nature of works, the safety aspects and the requirements laid down in the Safety Plan.</li> <li>Safety helmets fitted with chin straps must be worn within the site, safety boots, hearing protectors (if needed), high visibility jackets / sashes, goggles, reflective vest, gloves and full body harnesses for work at height will be provided to all staff working on site. Warning signs and barriers will be erected where necessary.</li> </ul>



	<p><b>8.2 For Works at Operating Railway Area</b></p> <ul style="list-style-type: none"> <li>For surveyors who carried out survey works at operating railway area, should have railway qualification of RSI and be supervised by CP(T).</li> <li>All site staffs should wear the required PPE such as safety helmet, reflective vest and safety boots.</li> <li>Demarcate and barricade the operation zone with reflective cone and work within the barricaded area.</li> <li>For works within live track, authority shall be sought in prior commencement of any operation.</li> <li>Any works within depot or live track shall be carried out in Non-Peak hours.</li> </ul> <p>Refer to Appendix B for Risk Assessment.</p>
9.	<b>Environmental</b> (Environmental aspect & impact identification as well as mitigation measures)
	<p>General works shall be carried out during normal working hours (08:00 to 18:00). No works using PME will be carried out after 07:00pm, on Sunday and public holiday without a valid construction noise permit.</p>
10.	<b>Quality Control</b> (Inspection and Test Plan including hold points)
	<p>Refer to Appendix A for Inspection and Test Plan.</p>
11.	<b>Appendices</b> (Identify and include additional information in the submission package)
	<p>Appendix A - Inspection and Test Plan (ITP) Appendix B - Risk Assessment</p>