

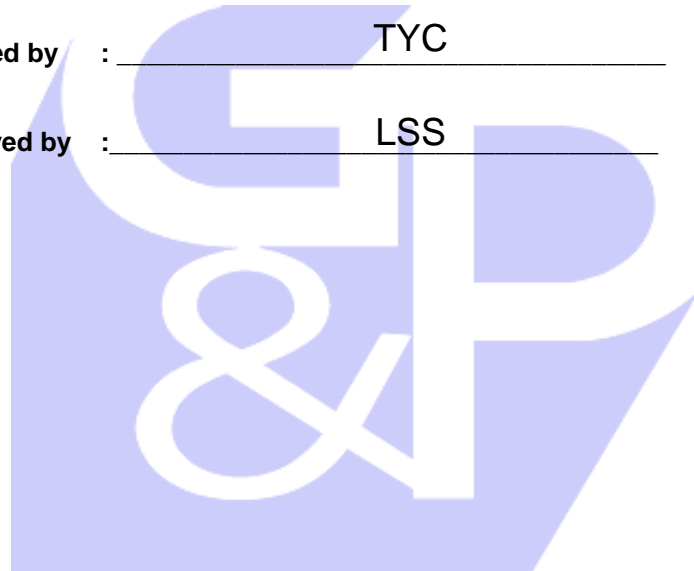


**WORK INSTRUCTIONS FOR ENGINEERS**

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Approved by : \_\_\_\_\_ LSS \_\_\_\_\_



**OP-3-57. CHECKLIST FOR EARTHWORKS  
(ROCK EXCAVATION)**



NO.	CHECKLIST ITEMS	Checked By Engineer	Remarks
	<b>PROJECT</b> Project Name : _____ Project No.: _____		
<b>1.0</b>	<b>Subsurface Investigation (S.I.)</b>		
1.1	Planning: <ul style="list-style-type: none"> <li>• More boreholes to be allocated at areas with massive excavation in terms of vertical and/or horizontal extent, especially along retaining wall alignment, road alignment and potential cut areas beyond the boundaries of the project site</li> <li>• In addition to the boreholes, driller probes / rock probes may be used as a more economical option to establish a more representative rock profile. Alternatively, additional boreholes with wash boring only in soil can be considered.</li> <li>• Levels and coordinates of all boreholes, driller probes and topographical survey shall be set out by a licensed surveyor from an established project Temporary Bench Mark (TBM)</li> <li>• Licensed surveyor should be briefed on the legal implication to ensure high quality survey</li> </ul>		
1.2	During SI works: <ul style="list-style-type: none"> <li>• Record any disturbance to original ground at particular borehole/ driller probe location, such as excavation for access and working platform. This information should also be included in the SI factual report.</li> <li>• Check the reduced levels of all boreholes/ driller probes against topographical plan</li> <li>• Full time supervision should be provided</li> <li>• Borehole: take photographs and inspect quality of recovered rock cores (including frequency of discontinuities), especially at the areas where retaining wall or sub-vertical slope to be formed. It may give an indication of rock fractures and therefore providing adequate provision of slope strengthening works such as rock bolts and shotcrete during the tender stage.</li> </ul>		
1.3	Calibration between the driller probes (in terms of flushed sample recovery, drilling rate, colour of samples and particle size of chipping) to known boreholes MUST be carried out to indicate soil,		

	weathered material and competent bedrock.		
1.4	Map the extent of rock outcrop areas at site, and check whether its profile and extent are incorporated into the topographical plan by the licensed surveyor. This information is important for computation of rock excavation quantity.		
1.5	Driller probe/ rock probe: record rate of penetration vs. depth to establish the zone between weathered and fresh rocks		
<b>2.0</b>	<b>Generation of Rock Contour</b>		
2.1	<p>Rock levels to be used to generate rock contour:</p> <ul style="list-style-type: none"> <li>• For estimation of rock excavation provision, use levels of FIRST encountered rock in boreholes and driller probes, in which boulders are inclusive in the rock excavation. (It is a conservative estimate with consideration of the boulders/ intermediate rock layers may not be removed by excavators)</li> <li>• For estimation of rock levels for foundation design, use levels of COMPETENT bedrock in boreholes and driller probes.</li> <li>• Include spot levels on the rock outcrop in the computation of rock contour</li> </ul>		
<b>3.0</b>	<b>Computation of Rock Excavation Quantity</b>		
3.1	<p>Confirm with C&amp;S consultant/ architect on the followings:</p> <ul style="list-style-type: none"> <li>• Any offset from the design presplitting line as indicated in the earthwork construction drawing (to accommodate services, apron and pile cap construction)</li> <li>• Any overblasting below design platforms, which may be required for construction of foundation or underground services (Usually allow 1m to 2m overblasting below design platform and fill back with soil).</li> </ul>		
3.2	Include rock excavation volume required for retaining wall construction, if any		
<b>4.0</b>	<b>Estimation of Slope Strengthening Provision</b>		
4.1	Provision for rock slope strengthening works in the tender normally consists of rock bolt, rock dowel, shotcrete, horizontal drain, etc.		
4.2	Identify potential rock slopes which may require strengthening work, especially fractured rock.		
4.3	Refer to similar project sites and case histories for		



	better estimation of provisional quantity during tender stage		
<b>5.0</b>	<b>Tender</b>		
5.1	Specification shall specifically classify the identification of soil, weathered material, boulders and rock in excavation work.		
5.2	Provide SI factual reports and interpreted rock contour to tenderers for their information		
5.3	<p>The following items should be included in the tender and is to be highlighted to all the tenderers in the tender clarification meeting:</p> <ul style="list-style-type: none"> <li>• Removal of unstable rock on the presplitted slope/ or beyond design line is not claimable. Instead, the cost of remedy to the specification requirements shall be solely borne by the contractor. The tenderers shall assess and price for the risk in their quoted rate for rock excavation.</li> <li>• Provision of penalty on unnecessary overblast shall be allowed.</li> <li>• Licensed surveyor should be engaged to carry out the survey of exposed rock, etc.</li> <li>• Vibration monitoring at the critical areas shall be provided during every blasting session.</li> </ul>		
5.4	Review provisions of rock excavation and slope strengthening works in the tender if BOQ is produced by others		
<b>6.0</b>	<b>Clarification of Responsibility</b>		
	<p>If site supervision on earthwork is not provided by G&amp;P, G&amp;P shall clarify the responsibility to the client and consultants, as follows:</p> <ul style="list-style-type: none"> <li>• G&amp;P is only responsible to provide necessary information, such as interpreted rock contour.</li> <li>• The client/ supervising consultant should be responsible in site supervision and highlight the potential dispute in rock quantity and strengthening work.</li> <li>• The supervising consultant should be responsible to verify correctness of rock levels, resolve discrepancies if any and certify the contractor's claim</li> </ul>		
<b>7.0</b>	<b>Construction Control</b>		
7.1	TBM shall be checked and agreed by the client/ supervising consultant.		

**G&P GEOTECHNICS SDN BHD**  
**CHECKLIST FOR EARTHWORKS**  
**(ROCK EXCAVATION AND ROCK SLOPE STRENGTHENING WORKS)**

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7.2	Joint survey by the contractor and client/ consultant's supervising personnel to be carried out before rock blasting is conducted. Licensed surveyor shall be engaged to carry out the survey.		
7.3	The site supervising personnel and contractor shall check the rock levels against G&P's interpreted rock contour, and highlight any discrepancy to the consultant. (Recommendation: it is considered as discrepancy if level difference is more than 1m)		
7.4	The contractor shall submit the joint survey to the consultant within the specified time frame for review and approval		
7.5	If discrepancy is found, an independent surveyor shall be engaged to verify the joint survey		
<b>8.0</b>	<b>Tender for Rock Slope Strengthening Works</b>		
8.1	The following issues should be highlighted to the tenderers: <ul style="list-style-type: none"> <li>• The tenderer shall estimate and allow sufficient time frame for slope strengthening work in their work programme based on provisional quantity in the tender.</li> <li>• The contractor shall commence the slope strengthening work after the consultant's instruction is issued to them. Any delay due to late in starting work is not entitled for extension of time.</li> </ul>		
8.2	In order to prevent dispute, method of measurement for shotcrete should be as follows: <ul style="list-style-type: none"> <li>• Unit of shotcrete shall be in m<sup>2</sup>. Shotcrete thickness as specified in the drawing shall be used as the basis for computation of shotcrete quantity. The tenderer shall price in his rate for wastage and filling up any potential irregularity on the slope surface due to blast damage and natural fracture of bedrock.</li> </ul>		
	<b>Signature by Engineer</b>		