

**GEO Technical Guidance Note No. 53 (TGN 53)
Supplementary Guidelines for Foundation Design and Construction**

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1. SCOPE

- 1.1 This Technical Guidance Note (TGN) updates the technical guidelines for foundation design given in the Geotechnical Engineering Office (GEO) Publication No. 1/2006 (GEO, 2006).
- 1.2 Any feedback on this TGN should be directed to the Chief Geotechnical Engineer/Planning & Development of the GEO.

2. TECHNICAL POLICY

- 2.1 The guidelines promulgated in this TGN were agreed by the GEO's Geotechnical Control Conference (GCC) on 24 April 2025.

3. RELATED DOCUMENTS

- 3.1 BD (2017). *Code of Practice for Foundations* 2017. Buildings Department, Hong Kong, 111 p.
- 3.2 GEO (2006). *Foundation Design and Construction (GEO Publication No. 1/2006)*. Geotechnical Engineering Office, Hong Kong, 376 p.

4. BACKGROUND

- 4.1 GEO Publication No. 1/2006 gives the technical guidelines on the presumed values of allowable bearing capacity for igneous rocks of different weathering grades. The recommendations were based on the Code of Practice for Foundation (CoPF) published by the Buildings Department in 2004. In 2017, BD published the second edition of the CoPF (CoPF 2017) with the addition of new Category 2 Rocks, described as meta-sedimentary rock of material weathering grade III or better, and with not less than 85% TCR of the designated grade. The method for determining the TCR has also been updated in the CoPF 2017.
- 4.2 As a consequential change, the revision of GEO Publication No. 1/2006 is underway to align the technical standards. However, it is considered desirable to publish supplementary guidelines on foundation design, whenever they are ready, that could contribute to improved practice and result in substantial saving in terms of construction cost and programme.

5. SUPPLEMENTARY TECHNICAL GUIDELINES

5.1 FOUNDATIONS FOUNDED ON IGNEOUS BEDROCK

- 5.1.1 Over the years, instrumented pile loading tests have been carried out for piles founded on various rock formations, which included the comprehensive pile testing programme for the

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Airport Railway, West Rail, the West Kowloon District Development and private development at Sai Sha. GEO has collected and analysed these pile test data for improving knowledge and practice in foundation engineering. The instrumented pile loading test results indicate that there are substantial safety margin of the proven bearing capacity and shaft friction when compared with the recommendations given in the publication. Hence, updated guidelines on the presumed allowable bearing capacity and bond friction on igneous rocks are derived.

- 5.1.2 The presumed allowable bearing capacity as given in Table 1 should supersede the Table 6.6 of the GEO Publication No. 1/2006. The use of the presumed values should be subject to the conditions given in the notes to Table 1. In addition, the presumed allowable bond/friction for piles socketed into igneous rocks of different weathering grade is also given in the same table.

5.2 FOUNDATIONS FOUNDED ON JOINTED ROCK MASS

- 5.2.1 GEO Publication No. 1/2006 provides guidance on determining the allowable bearing pressure on a jointed rock mass based on Rock Mass Rating (RMR) method, which correlates to the deformation modulus of the rock mass (Figure 6.7). When using the allowable bearing pressure from Table 6.5, it is not required that the RMR of all rocks within the zone of influence should be of the same or better rating. The allowable bearing pressure can also be determined by specifying an acceptable settlement. For structures that are not particularly sensitive to movement, the acceptable settlement can be taken as the larger of 1% of the pile base diameter or 30 mm. The effect of foundation loads on the rock mass is significantly reduced at depths greater than twice the pile base diameter. Hence, for the purpose of assessing the allowable bearing pressure, the minimum depth for computing RMR should be at least twice the pile base diameter or 5 meters, whichever is greater. Table 2 should replace Table 6.5 of the GEO Publication 1/2006.

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Table 1 – Presumed Allowable Bearing Capacity and Shaft Friction for Foundations in Igneous Rocks

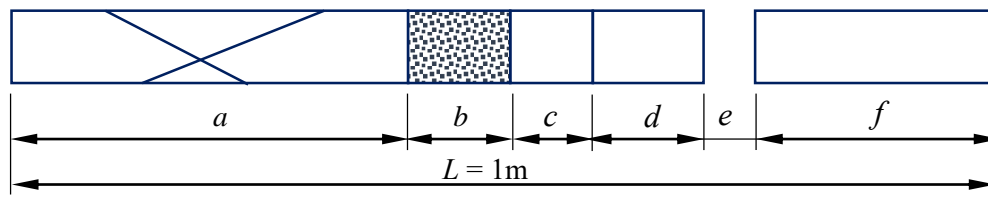
Category	Description of Igneous Rocks	Presumed Allowable Bearing Pressure (kPa)	Presumed Allowable Bond or Friction (kPa)
1(a)	Fresh to slightly decomposed strong to very strong granite or volcanic rock of material weathering grade II or better, with 100% TCR of the designated grade which has a minimum UCS of rock material not less than 75 MPa (or an equivalent point load index strength PLI50 not less than 3 MPa)	12,500	1,000 (under compression or transient tension) 800 (under permanent tension)
1(b)	Fresh to slightly decomposed strong granite or volcanic rock of material weathering grade II or better, and with not less than 95% TCR of the designated grade, which has a minimum UCS of rock material not less than 50 MPa (or an equivalent point load index strength PLI50 not less than 2 MPa)	10,000	
1(c)	Slightly to moderately decomposed moderately strong granite or volcanic rock of material weathering grade III or better, and with not less than 85% TCR of the designated grade, which has a minimum UCS of rock material not less than 25 MPa (or an equivalent point load index strength PLI50 not less than 1 MPa)	7,500	700 (under compression or transient tension) 560 (under permanent tension)
1(d)	Moderately decomposed, moderately strong to moderately weak granite or volcanic rock of material weathering grade III or better, and with not less than 50% TCR of the designated grade.	3,000	300 (under compression or transient tension) 150 (under permanent tension)

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Notes to Table 1:

- (1) The presumed values for allowable bearing pressure given are for foundations with negligible lateral loads at bearing level.
- (2) The self-weight of the length of pile embedded in soil or rock does not need to be included into the calculation of bearing stresses.
- (3) Minimum socket depth along the pile perimeter is 500 mm for categories 1(a) and 1(b), and 300 mm for categories 1(c) and 1(d).
- (4) TCR of the designated grade is defined in Figure 1.
- (5) The TCR of the designated grade should be proved to a depth at least 5 m into the specified category of rock. This requirement is deemed to be complied with if the rock underneath the minimum socket depth as mentioned in note (3) above has a length of at least 5 m which can be divided into a number of segments (in consecutive manner) such that (a) each segment is 1 m; and (b) the calculated TCR in accordance with Figure 1 of each segment should satisfy the required percentage of TCR of the designated grade.
- (6) The bearing surface of rock on which the foundation will be rested should be of the designated category and no rock core within 600 mm depth from the pile base is logged as “non-intact” in accordance with GEOGUIDE 3.
- (7) Weathering grades and non-intact condition are defined in GEOGUIDE 3.
- (8) The point load index strength of rock quoted in the table is the equivalent value for 50 mm diameter cores.
- (9) The use of presumptive values does not preclude the requirement for consideration of settlement of the structure.
- (10) Concrete or grout should have a minimum characteristic compressive strength of 30 MPa.



$$\text{TCR of the designated grade} = \frac{a+c+d+f}{L}$$

1. *a*, *c*, *d* and *f* are materials of the designated grade or better.
2. *b* are materials inferior than the designated grade.
3. *e* are materials washed away during drilling.
4. The maximum continuous length of materials washed away/inferior to the designated grade, $b+e$, should not be greater than 300mm
5. TCR of the designated grade should not be confused with TCR of the core run shown in the site investigation report, which is equal to $\frac{a+b+c+d+f}{L}$

Figure 1 – Determination of TCR for the Designated Grade of Rock

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Table 2 – Allowable Bearing Pressure Based on Computed RMR Value

Parameters	Rock Mass Rating (RMR)			
	< 40	50	70	88
Allowable bearing pressure, q_a (kPa)	3,000	5,000	10,000	14,500

- Notes:
- (1) For $RMR < 40$, the rock mass should comprise at least 50% of moderately decomposed, moderately strong to moderately weak rocks. Refer to Table 2 of Geoguide 3 (GCO, 1988) for classification of the strength of rock materials. In common granitic and volcanic rocks in Hong Kong, this corresponds to a weathering grade better than IV.
 - (2) The allowable bearing pressure can also be assessed by specifying an acceptable settlement at the base of the pile using the correlation between deformation modulus and RMR as given in Figure 6.7.
 - (3) Interpolate between allowable bearing pressures for intermediate RMR values greater than 40.
 - (4) The ratings for individual parameters are given in Table 6.4.
 - (5) This table is applicable where the stability of the rock mass is not subject to the effect of adversely oriented discontinuities.
 - (6) If allowable bearing pressure, q_a , determined by RMR is greater than σ_c , use $q_a = \sigma_c$.