

**GEO Technical Guidance Note No. 30 (TGN 30)
Updated Intensity-Duration-Frequency Curves with Provision for
Climate Change for Slope Drainage Design**

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1. **SCOPE**

- 1.1 This Technical Guidance Note (TGN) promulgates a set of updated Intensity-Duration-Frequency (IDF) curves, which supersede the IDF curves given in Figure 8.2 of the Geotechnical Manual for Slopes (GCO, 1984).
- 1.2 Any feedback on this TGN should be directed to Chief Geotechnical Engineer/Standards & Testing of the GEO.

2. **TECHNICAL POLICY**

- 2.1 The technical recommendations promulgated in this TGN were agreed by the GEO Geotechnical Control Conference in May 2023.

3. **RELATED DOCUMENTS**

- 3.1 GCO (1984). *Geotechnical Manual for Slopes, Second Edition*. Geotechnical Control Office, Hong Kong, 295 p.
- 3.2 Tang, C.S.C. & Cheung, S.P.Y. (2011). *Frequency Analysis of Extreme Rainfall Values (GEO Report No. 261)*. Geotechnical Engineering Office, Hong Kong, 209 p.
- 3.3 DSD (2018). *Stormwater Drainage Manual, Fifth Edition*. Drainage Services Department, Hong Kong, 193 p.
- 3.4 DSD (2022). *Corrigendum No. 1/2022 of Stormwater Drainage Manual*. Drainage Services Department, Hong Kong, 10 p.

4. **BACKGROUND**

- 4.1 An update to the frequency analysis of extreme rainfall intensities in the study of Tang & Cheung (2011) using the rainfall data recorded by 85 GEO raingauges between 1984 and 2020 has been completed. The methodology and key assumptions presented in Tang & Cheung (2011) are adopted. This TGN recommends updated IDF curves for slope drainage design developed based on the updated frequency analysis.
- 4.2 DSD (2022) recommends an update on the provision to cater for effects of climate change on the rainfall intensity for drainage design. A review of DSD's suggestions has been carried out with consideration given to implications on slope drainage design. Recommendations pertaining to the update of the projected climate change effects in slope drainage design are made.

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5. **TECHNICAL RECOMMENDATIONS**

- 5.1 For slope drainage design, the design mean rainfall intensity shall be determined according to the IDF curves given in Figure 1 of Annex TGN 30 A1 with the inclusion of projected increase in rainfall intensity as described in para. 5.2 below. The corresponding formulae are given in Table 1 of the Annex.
- 5.2 Except for temporary slope drainage design, the mean rainfall intensity given by the IDF curves shall be increased by 28.1% for incorporating the climate change effects projected up to the end 21st century.
- 5.3 The updated IDF curves and the projected rainfall increase for climate change effects shall be applicable to the design of surface drainage provisions for new slopes. For existing slope drainage provisions, there is no urgent need to review or upgrade them, except for those with obvious deficiency as observed during rainfall. Where an existing slope is to be upgraded or improved, the opportunity should be taken to review the adequacy of the prevailing drainage provisions using the updated IDF curves and the projected rainfall increase for climate change effects.
- 5.4 The IDF curves given in Figure 1 of Annex TGN 30 A1 were developed for slope drainage design purposes. Their application for determining return periods of rainstorms is not recommended.

6. **ANNEX**

- 6.1 TGN 30 A1 – Updated Intensity-Duration-Frequency Curves

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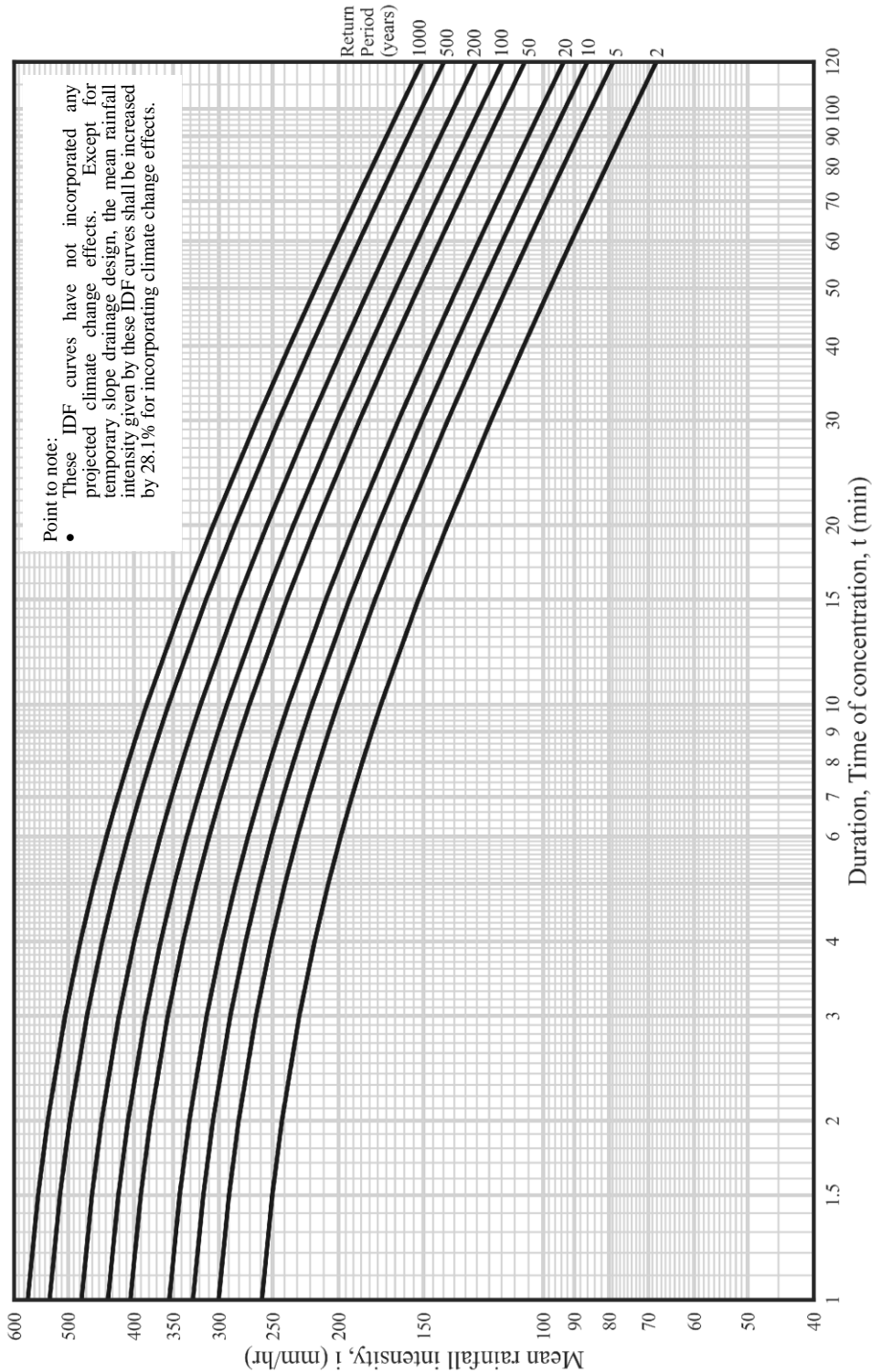


Figure 1 – Updated Intensity-Duration-Frequency Curves

- Notes:
1. These IDF curves are to supersede those given in Figure 8.2 of the Geotechnical Manual for Slopes (GCO, 1984).
 2. The mathematical formulae of these IDF curves are shown in Table 1 of Annex TGN 30 A1.

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Table 1 – Mathematical Formulae of Updated Intensity-Duration-Frequency Curves

Return period (years)	Storm constants		
	<i>a</i>	<i>b</i>	<i>c</i>
2	570	5	0.44
5	660	5	0.44
10	720	5	0.44
20	780	5	0.44
50	890	5	0.44
100	960	5	0.44
200	1050	5	0.44
500	1170	5	0.44
1000	1260	5	0.44

$$i = \frac{a}{(t + b)^c}$$

where i = mean rainfall intensity (mm/hr)
 t = duration, time of concentration (min)
 a, b, c = storm constants

Note: The above storm constants have not incorporated any projected climate change effects.