

# **Accuracy Standards of Control Survey**

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## **Introduction**

This document states the accuracy standards of control survey conducted by the Geodetic Survey Section of Survey and Mapping Office of Lands Department. The control survey shall adhere to the defined accuracy in order to achieve uniformity of quality control standard for control networks of Hong Kong.

## Accuracy Standards of Horizontal Control Station Surveyed by Terrestrial Survey Method

Class	Class description	Assessment criteria for Least Squares Adjustment		Assessment criteria for traverse computation using Bowditch Rule	
		Allowable residual of distance measurement	Allowable residual of angular measurement	Allowable linear misclosure	Allowable angular misclosure
1	Main Triangulation / Trilateration	1: 120,000	2"	---	---
2	Minor Triangulation / Trilateration	1: 60,000	4"	---	---
3	Main Control Traverse	1: 30,000	5"	1 : 30,000	$5''\sqrt{n}$
4.1	Minor Control Traverse (Class 4.1)	1: 15,000 or 5mm (minimum)	10"	1 : 15,000	$10''\sqrt{n}$
4.2	Minor Control Traverse (Class 4.2)  <u>Note :</u> The origin of Class 4.2 station is Class 4.1 station.	1: 15,000 or 5mm (minimum)	10"	1 : 15,000	$10''\sqrt{n}$
5	Traverse (Class 5)	1: 10,000 or 10mm (minimum)	20"	1 : 10,000	$20''\sqrt{n}$
6	Traverse (Class 6)	1: 7,500 or 10mm (minimum)	30"	1 : 7,500	$30''\sqrt{n}$

**Remark**

n = Number of control stations of the traverse

## Accuracy Standards of Vertical Control Station Surveyed by Terrestrial Survey Method

Class	Class description	Allowable difference between forward and backward run	Misclosure of level loop / level line  or Residual of the height difference between stations (assessment criteria for Least Squares Adjustment)
1	Precise Levelling (Class 1)	$4 \sqrt{K}$ mm when $K \geq 1$ $0.9 \sqrt{N}$ mm when $K < 1$	$4 \sqrt{K}$ mm when $K \geq 1$ $0.9 \sqrt{N}$ mm when $K < 1$
2	Precise Levelling (Class 2)  <u>Note :</u> The origin of Class 2 benchmark network is determined by GPS / cross harbour levelling. (e.g. benchmark network in Lantau Island)	$4 \sqrt{K}$ mm when $K \geq 1$ $0.9 \sqrt{N}$ mm when $K < 1$	$4 \sqrt{K}$ mm when $K \geq 1$ $0.9 \sqrt{N}$ mm when $K < 1$
3	Ordinary Levelling	$12 \sqrt{K}$ mm	$12 \sqrt{K}$ mm
4	Precise Levelling and Trigonometrical Heighting	---	$12 \sqrt{K}$ mm
5	Trigonometrical Heighting (Class 5)	---	$30 \sqrt{K}$ mm
6	Trigonometrical Heighting (Class 6)	---	$50 \sqrt{K}$ mm

**Remark**

K = Total distance run between stations in km.

N = Total number of set-up

## Accuracy Standards of Horizontal Control Station Surveyed by GPS

Class	Class description	Residuals of horizontal components of baseline ( $V_{Lat}$ , $V_{Long}$ ) shall be less than $2\sigma$ .  where $\sigma = \sqrt{[a^2 + (b \cdot L)^2]}$ $L =$ length of baseline
1	Regional Geodetic Control Stations for connection to International Terrestrial Reference Frame	a = 3 mm b = 0.01 ppm
2	Satellite Positioning Reference Station Network	a = 3 mm b = 0.2 ppm
3	GPS Control Network / Triangulation Station / Trilateration Station	a = 3 mm b = 1 ppm
4	Main Control Traverse / Minor Control Traverse	a = 5 mm b = 1 ppm
5	GPS Control Station (Class 5)	a = 10 mm b = 3 ppm

### Remark

$V_{Lat}$  = Residual of latitude component of GPS baseline

$V_{Long}$  = Residual of longitude component of GPS baseline

## Accuracy Standards of Vertical Control Station Surveyed by GPS

Class	Class description	Residual of vertical component (ellipsoidal height) of baseline ( $V_{EH}$ ) shall be less than $2\sigma$ .  where $\sigma = \sqrt{[a^2 + (b \cdot L)^2]}$ $L =$ length of baseline
1	Regional Geodetic Control Stations for connection to International Terrestrial Reference Frame	a = 9 mm b = 0.03 ppm
2	Satellite Positioning Reference Station Network	a = 9 mm b = 0.6 ppm
3	GPS Control Network / Triangulation Station / Trilateration Station	a = 9 mm b = 3 ppm
4	Main Control Traverse / Minor Control Traverse	a = 15 mm b = 3 ppm
5	GPS Control Station (Class 5)	a = 30 mm b = 9 ppm

### Remark

$V_{EH}$  = Residual of vertical component (ellipsoidal height) of GPS baseline