1.6 On-site Inspection of Surveying Instruments

On-site inspection to check that all the surveying instruments work normally has been conducted at each observation station prior to the commencement of the survey in 1999.

1.6.1 On-site inspection of TS

(1) On-site inspection of the range measurement

On-site inspection of the range measurement has been conducted by applying 3-point method using the external geodetic survey monuments (short pillars).

(Refer to Figure 4.)

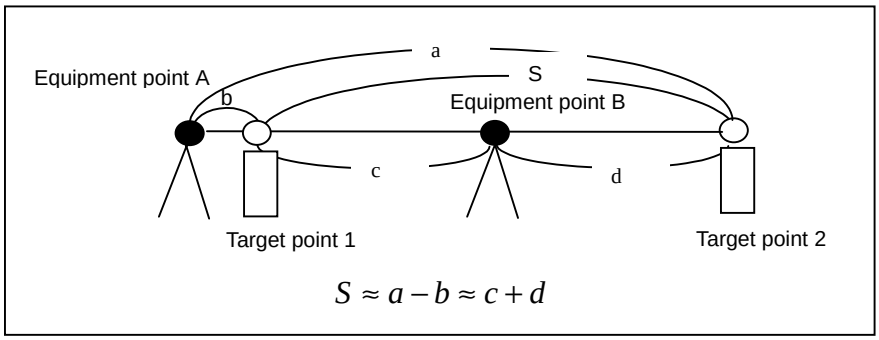

Figure 4 Drawing to explain the concept applied for on-site inspection of the range measurement (3-point method)

Compared to NET2B, the discrepancy was found to be quite significantly large with TC2002. The reason for this large discrepancy was that the reflection sheet used exclusively for NET2B could not be applied for observation using TC2002 and therefore, the inspection had to be conducted, using the reflection mirror (APS34) manufactured by Sokkia. According to explanation from Sokkia, the precision of their reflection mirror (APS34) may be affected slightly when it is used to measure a range that is closer than 30m.

Table 10　Results of the on-site inspection of the range measurement

station	Name of equip-ment	S/N	(a) s (m)	(b) a-b (m)	(c) c+d (m)	(a) – (c) Mean (m)	(a) – (c) Maximum discrepancy (mm)	Inspection date
Koganei	NET2B	31481	29.5935	29.5950	29.5934	29.5940	1.6	10/13
	NET2B	31788	29.5947	29.5946	29.5945	29.5946	0.2	10/13
	TC2002	359698	29.5959	29.5955	29.5974	29.5963	1.9	11/17
Kashima	NET2B	31481	24.5286	24.5282	24.5284	24.5284	0.4	10/23
	NET2B	31788	24.5285	24.5275	24.5285	24.5282	1.0	10/22
	TC2002	359698	24.5289	24.5289	24.5311	24.5296	2.1	10/22
Miura	NET2B	31481	47.9554	47.9557	47.9559	47.9557	0.3	11/12
	NET2B	31788	47.9557	47.9551	47.9566	47.9558	1.5	11/12
	TC2002	359698	47.9569	47.9552	47.9577	47.9566	2.5	11/12
Tateyama	NET2B	31481	8.3884	8.3880	8.3878	8.3881	0.6	11/09
	NET2B	31788	8.3886	8.3882	8.3891	8.3886	0.9	11/09
	TC2002	359698	8.3888	8.3879	8.3902	8.3890	2.3	11/09

(2)　On-site inspection of the angle measurement

On-site inspection of the angle measurement has been conducted by (1) setting TS at the short pillars; (2) collimating other short pillars or long pillars with this TS; (3) measuring the angle of the same target with several other TS's (refer to Figure 5) and (4) comparing the measured values to confirm the performance of the angle measurement.

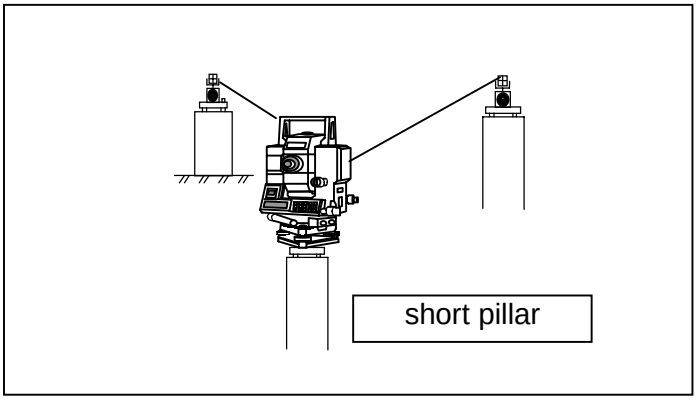

Figure 5　Drawing to explain the concept applied for on-site inspection of the angle measurement

Table 11　Results of the on-site inspection of the goniometric system

Observation station	Name of equipment	S/N	Horizontal angle (deg. ‘ “)	Vertical angle1 (deg. ‘ “)	Vertical angle 2 (deg. ‘ “)	Inspection date
Koganei	NET2B	31481	268.1804	-0.0454	2.1650	10/13
	NET2B	31788	268.1808	-0.0457	2.1650	10/13
	TC2002	359698	-	-	-	11/16
Kashima	NET2B	31481	303.3518	-0.0459	-0.0630	10/23
	NET2B	31788	303.3521	-0.0501	-0.0635	10/22
	TC2002	359698	303.3520	-0.0503	-0.0638	10/22
Miura	NET2B	31481	59.5740	-0.0324	-0.0857	11/12
	NET2B	31788	59.5743	-0.0324	-0.0856	11/12
	TC2002	359698	59.5742	-0.0329	-0.0906	11/12
Tateyama	NET2B	31481	258.1232	-0.1646	-0.1949	11/09
	NET2B	31788	258.1223	-0.1647	-0.1952	11/09
	TC2002	359698	258.1243	-0.1705	-0.2010	11/09

1) At Tateyama station, the discrepancy of the measurement of horizontal angle was found to be quite significantly large. The reason for this large discrepancy was because the target was only 8m away. The actual discrepancy is equivalent to only 0.7mm in distance and can therefore be considered to be within the tolerable range of measurement error.

2) At Koganei station, on-site inspection using TC2002 was not possible because the permission to enter the rooftop of Seiyu Stores’ s where azimuth marker was established, was restricted to a very limited amount of time. Therefore, this inspection was conducted at Miura station one day before the survey was scheduled to start at Koganei station (November 16th).

3) As a result of the on-site inspection of TC2002 for use in Koganei station that was conducted at Miura station, the discrepancy of horizontal angle was found to be 1 second.

1.6.2 On-site inspection of GPS

On-site inspection of GPS was conducted by setting a temporary base line randomly at a location where the sky was open above and comparing the range of the base line measured by GPS and TS. To secure the accuracy of the inspection, the measurements were compared after switching over the position of the antenna of GPS and the position of the reflection sheet and TS to prevent their positions from deviating (refer to Figure 6).

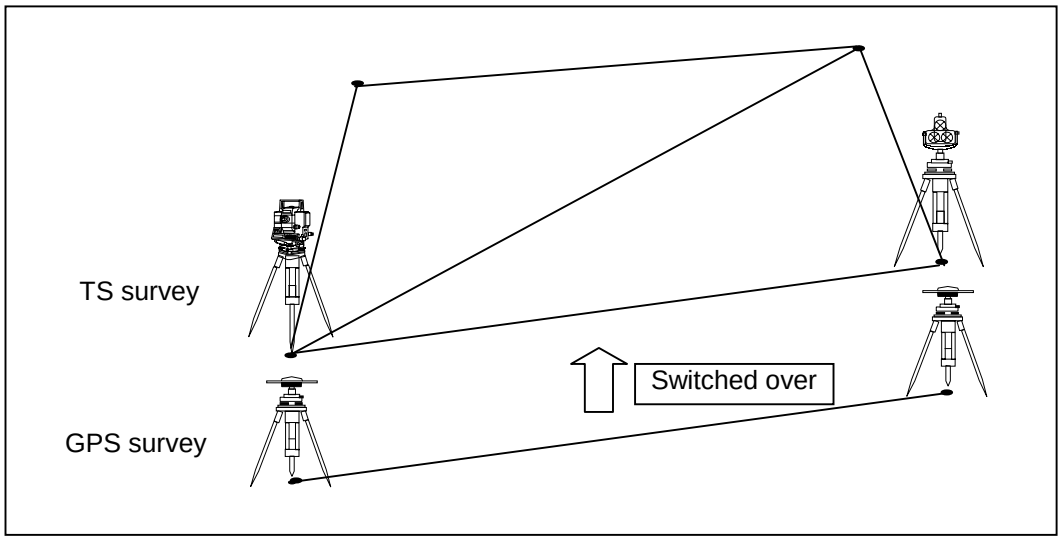

Figure 6 Drawing to explain the concept applied for the on-site inspection of GPS

Table 12　Results of the on-site inspection of GPS

Observation station	Name of equipment	S/N	Base line 1 (m)	Base line 2 (m)	Base line 3 (m)	Base line 4 (m)	Base line 5 (m)	Inspec-tion date
Koganei	GPS	1741, 1746, 6732	62.2393	46.4643	60.2012	-	-	10/13
	NET2B	31788	62.2410	46.4631	60.2012	-	-	
	Discrepancy (mm)		-1.7	1.2	0.0	-	-	
Kashima	GPS	1693, 1741, 1746, 6732	34.4697	43.0530	24.3169	20.6703	24.2735	10/19
	NET2B	31788	34.4687	43.0529	24.3194	20.6706	24.2726	
	Discrepancy (mm)		1.0	0.1	-2.5	-0.3	0.9	
Miura	GPS	1693, 1746, 6732	44.0392	32.3560	43.3745	-	-	11/05
	NET2B	31788	44.0368	32.3559	43.3759	-	-	
	Discrepancy (mm)		2.4	0.1	-1.4	-	-	
Tateyama	GPS	1693, 1746, 6732	15.8045	18.8596	-	-	-	11/08
	NET2B	31788	15.8055	18.8630	-	-	-	
	Discrepancy (mm)		-1.0	-3.4	-	-	-	

The discrepancy of all the base lines that have been inspected was less than 3.4mm when compared with TS measurements. Therefore, the surveying instruments of GPS were all confirmed to be meeting the specifications of required standard performance.

1.6.3 On-site inspection of the level

On-site inspection of the level has been conducted by checking the flat-levelness of the collimation line of the level and the compensator (automatic correction unit) respectively through the application of pile driving check method (refer to Figure 7).

1) Pile driving check method applied here was a method of checking and adjusting the flat-levelness of the collimation line of the level by applying the principle that the deviation of the collimation line increases proportionately as the distance between the level and staff gets farther away.

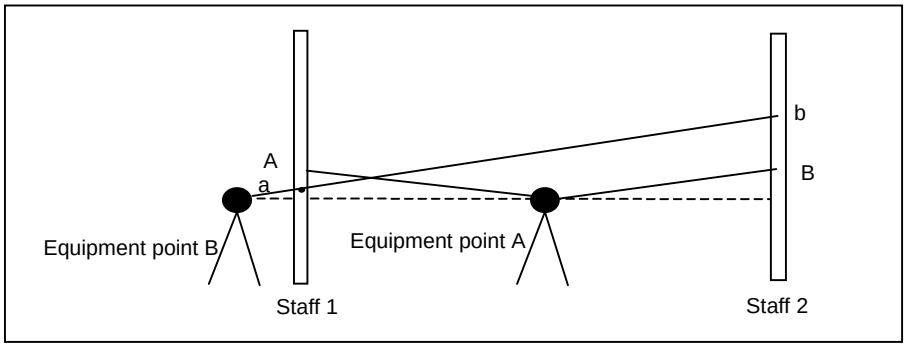

Figure 7 Drawing to explain the concept of pile driving check method

2) Compensator functional check method applied here was a method to compare the observation value gained from a level that has been adjusted to be placed at a position where the bubble is at the center and the observation values gained from a level that has been adjusted to be placed at a position where the bubble is deviated extremely to crosswise/lengthwise directions.

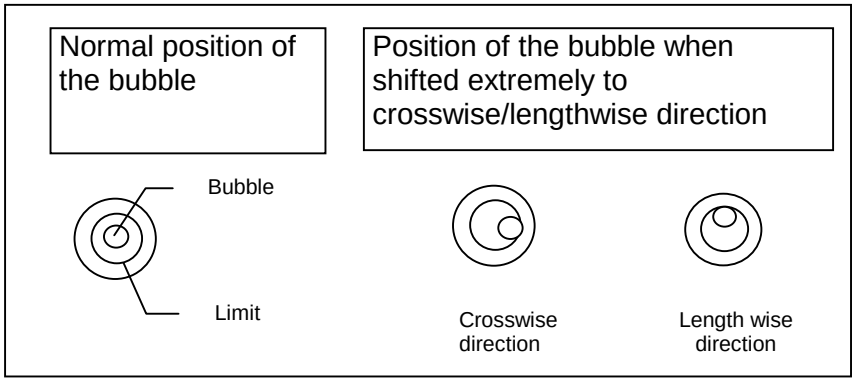

Figure 8 Drawing to explain the concept of compensator functional check method

Table 13　Results of the on-site inspection of the level

Observation station	Name of equipment : S/N	Pile driving check (mm)	Compensator functional check (mm)		Inspection date
Koganei	DiNi11 : 100312	0.13	Crosswise	0.01	10/18
	Invar staff : 12562,12564		Lengthwise	0.01	
Kashima	DiNi11 : 100312	0.01	Crosswise	0.13	10/23
	Invar staff : 12562,12564		Lengthwise	0.02	
Miura	DiNi11 : 100312	0.11	Crosswise	0.15	11/18
	Invar staff : 12562,12564		Lengthwise	0.09	
Tateyama	DiNi11 : 100312	0.04	Crosswise	0.06	11/09
	Invar staff : 12562,12564		Lengthwise	0.01	

(a) The result of the pile driving check showed evidently that the levels used for this survey all meet the standard specifications required for first class leveling.

(b) The result of the compensator functional check showed evidently that the compensators used for this survey all function normally.