THE SURVEY STATUS AT NSRRC DURING THE TPS CIVIL CONSTRUCTION

H.M. Luo, C.J. Lin, H.C. Ho, W.Y. Lai, Y.L. Tsai, T.C. Tseng, S.Y. Perng , H.S. Wang, M.L. Chen, K.H. Hsu, P.L.Sung, J.R. Chen, NSRRC, Hsinchu, Taiwan

Abstract

In this paper, the survey status at NSRRC site during the TPS (Taiwan Photon Source) civil construction is described. The TLS (Taiwan Light Source) ring is still under operation in the meantime. In order to maintain the TLS for normal operation and also monitoring the building construction, an expanded survey setups including permant leveling and GPS monuments were installed both on the site and TPS building. Combined with the orignal TLS survey sockets and sensor monitoring system (hydrostatic leveling system and precision inclination sensors) installed both in the TLS storage ring and beamlines, an extensive survey tasks were performed. The ground deformation situation of the TLS and deviation of the TPS building construction are presented.

INTRODUCTION

There are already 18 granite pillars as the fiducial points in the new ring of the Taiwan Photon Source (TPS) at the NSRRC site in Taiwan. The fiducial points located on TPS site have immediate influence on the alignment accelerator because of the accuracy of survey network. In order to improve the alignment accuracy of the magnets and girders position, the precision network method of traverse surveying will be used carefully. TPS is a new 3-GeV ring under construction with circumference 518.4 m and 24 double-bend cells. For stability reasons, the entire building is being constructed half underground at depth 12 m relative to TLS. To position magnets precisely and quickly, a highly accurate system of auto-tuning girders combined with survey network procedures was designed to accomplish the alignment tasks. [1]

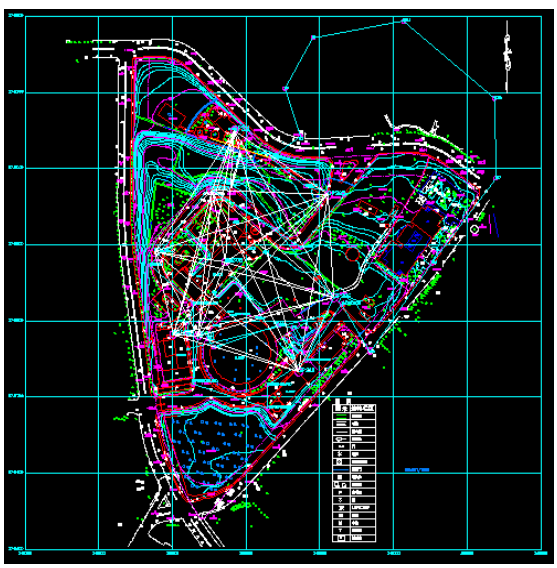
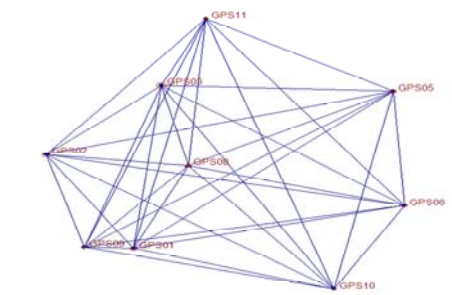


Figure 1: The NSRRC site and survey control network.

SURVEY NETWORK CONTROL

The survey control points of the loop traverse are added and then connect the TLS control points and the TPS points increased as the fiducial points. (shown as fig1) After the network adjustment of the survey, the X-Y plane network of the traverse control points will be offered with the accuracy and external reliability. The precision network of leveling survey also connect with the settlement points of the building as the survey control height Z-axis. For the ground motion studies, the motion has been extensively studied at a large variety of sites because of the relative instability of the ground.[2] These studies have been made using with high precision leveling. Because the TPS ring position is lower than the neighboring terrain, it is difficult to use the method of trilateral- triangulation network adjustment due to the poor accuracy. First, the more reliable coordinates could be getting by GPS network survey. (shown as fig2) Second, to improve the precision and modify the coordinates, the more accurate Total-Station could be used by the instrument TDA under the free station method. Finally, the laser tracker would be used to modify the coordinates again.



Station Coordinate Standard Deviations (Meters)

Station	N	E	Elev
GPS01	0.000916	0.000977	0.002431
GPS02	0.000936	0.001167	0.002760
GPS03	0.001225	0.001345	0.003278
GPS05	0.000704	0.000775	0.001900
GPS06	0.000725	0.000781	0.001872
GPS08	0.000000	0.000000	0.000000
GPS09	0.000280	0.000281	0.000822
GPS10	0.000323	0.000334	0.000587
GPS11	0.000314	0.000321	0.000497

Station Coordinate Error Ellipses (Meters)
Confidence Region = 95.5%

Station	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis	Elev
GPS01	0.002439	0.002273	102-09	0.004874
GPS02	0.002913	0.002325	95-46	0.005532
GPS03	0.003374	0.003024	74-28	0.006570
GPS05	0.001930	0.001752	90-07	0.003808
GPS06	0.001981	0.001766	65-18	0.003754
GPS08	0.000000	0.000000	0-00	0.000000
GPS09	0.000714	0.000683	48-42	0.001047
GPS10	0.000833	0.000804	76-15	0.001177
GPS11	0.000809	0.000771	89-02	0.000996

Figure 2: The accuracy of the GPS survey network.

NETWORK SURVEY ALIGNMENT RESULT

In order to accomplish the stringent alignment tasks of the new TPS project, a survey network system combined with a system of highly accurate auto-tuning girders was designed, simulated and tested as a prototype. From testing of the 1/24 mockup section on installation and the network simulation, this shows promising results. [3] The adjustment accuracy of the traverse network survey added the points connecting with the fiducial points shows as in Fig.3 with the standard deviation. For the leveling network survey, the permanent points (BM) of the leveling are located at the out-side of the TPS periphery. The difference is smaller than 0.2mm relatively as in Fig.4. The ground deformation of the original TLS ring should be slight and sustained by the geodesic vibration because of the massive excavation of the TPS civil construction. The Fig. 5 shows the history variation of the magnetic location compared with the year 2000 from the x, y and z direction.

Station Coordinate Standard Deviations (Meters)

Station	N	E
A007	0.003988	0.006369
A007_1	0.002697	0.005131
A04	0.005387	0.004161
BC001	0.004983	0.006807
D8	0.006476	0.006665
D8_1	0.006035	0.006810
EX07	0.005953	0.006986
GPS01	0.006259	0.006925
GPS02	0.007174	0.006474
GPS03	0.006066	0.006443
GPS06	0.004324	0.006584
M1	0.001817	0.000600
M15	0.003446	0.007158
M16	0.001988	0.005171
M17	0.000523	0.002852
M2	0.002420	0.001609
M3	0.002236	0.002713
M5	0.002666	0.004037
NO02	0.000000	0.000000
NO04	0.000000	0.000000
NSRRC01	0.002778	0.003226
NSRRC02	0.002397	0.003851
NSRRC03	0.002650	0.005326
NSRRC04	0.007401	0.005391
NSRRC05	0.006298	0.006091
NSRRC06	0.006328	0.007470
NSRRC06_1	0.006572	0.007402
NSRRC07	0.005098	0.007826
NSRRC08	0.005130	0.007479
NSRRC09	0.004556	0.007133
P6	0.004753	0.006814
TP1	0.005029	0.006394

Figure 3: The accuracy of the traverse network survey.

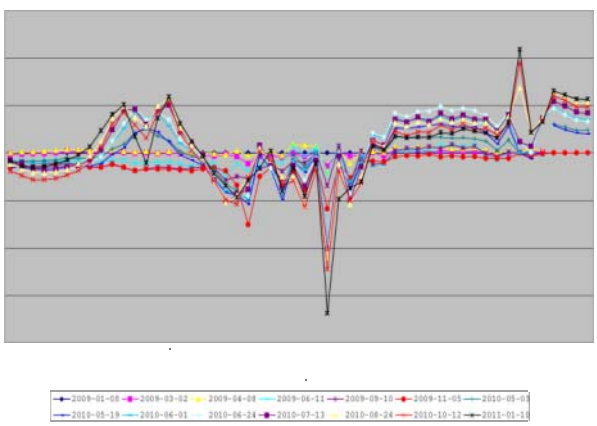


Figure 4: The accuracy of the leveling survey.

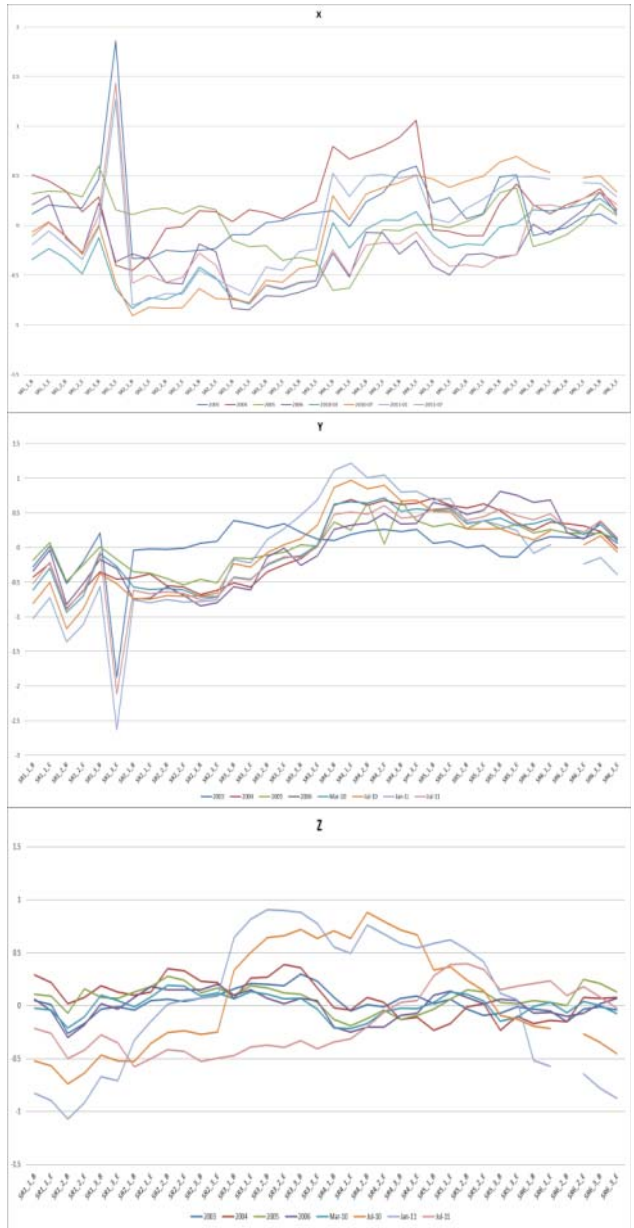


Figure 5: The history variation of the magnetic location.

Each girder system is composed of three pedestals with six cam movers to support and provide six-axis precise tuning. The maximum adjustments of the six-axis adjusting system are designed to be 7.5, 3 and 5 mm in heave, sway and surge directions respectively. [4] The accuracy of the GPS network, TDA network and laser tracker network are 2mm, 0.5mm and 0.03mm respectively to improve the precision and the more reliability. The established control points and network survey of the TPS are shown as in Fig.6. For the survey and alignment of the TPS building construction on the survey sockets of the granite pillars, the coordinates of the fiducial points are shown as in the Fig.7. The result shows that locations of the established half-TPS pillars change up to the weather from winter to summer. The two sides of this half ring extend outward: the maximum is 12mm for the east longitude, the maximum is 8mm for the north

latitude and the maximum is 1mm for the elevation. The middle of this half ring also extend outward: the maximum is 8mm for the east longitude, the maximum is 6mm for the north latitude and the maximum is 0.8mm for the elevation.

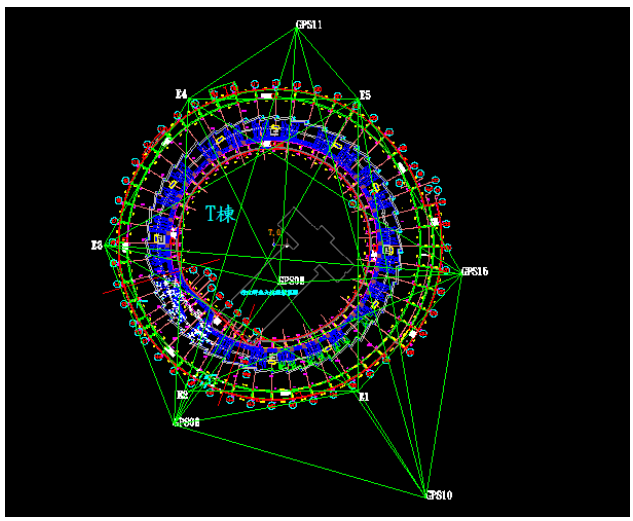
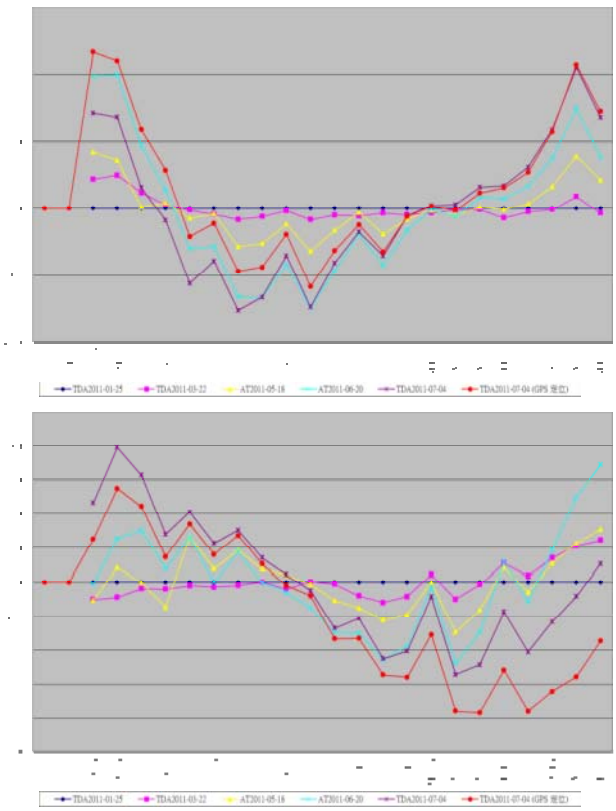


Figure 6: The control points and network survey of TPS construction



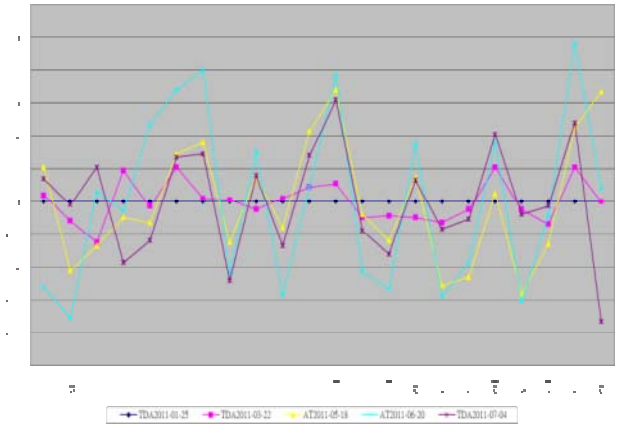


Figure 7: The contrast and modification of the coordinates

SUMMARY

Network of the traverse surveying could be used to improve the reliability to the loop traverse and the permanent points of the leveling survey provide a higher accuracy because of its stability. The operation of the TLS ring has been maintained and already remained stable from the former deformation tolerance of 1.5 millimeters. The change of the coordinates of the fiducial points under the TPS building construction has been shown out the change by the network survey. It requires further observation whether was the change due to the temperature purely.

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