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MANUFACTURING AND INSPECTING SUPPORTING TABLES FOR FRONT END IN TAIWAN PHOTON SOURCE

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Abstract

Taiwan Photon Source is the second accelerator constructed by National Synchrotron Radiation Research Center with energy 3 GeV and 500 mA beam current. In order to install and support front end components those table are designed and constructed. The results of manufacturing and inspecting tables are one of the primary factors that will directly affect the final confining aperture to the end users.

Those supporting table has six types and are all designed and simulated by Solidworks. Different alignment and measurement tools are utilized to inspect these tables. In addition, some results of final post-installation measurement and vibration test are also reported.

INTRODUCTION

The Taiwan Photon Source (TPS) is the second accelerator in Taiwan, with a circumference of 518 m. It is located in Hsinchu, Taiwan. This study describes the stand in the front end of TPS to support a variety of components assembled in the front end area, such as X-ray Beam Position Monitor (XBPM), High Heat Load Components (HHLC), vacuum pump and cavity. The figure below shows the design of the front end, with a total length of approximately 10.242 meters.

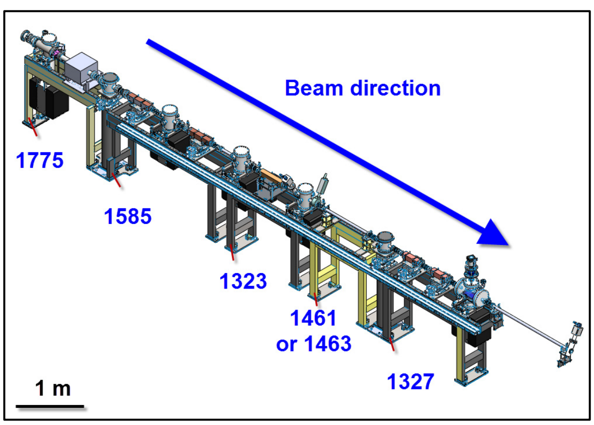

Figure 1: Design Prototype Newly Built on the Front End Area.

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EXPERIMENTS

Introduction to the Equipment for Stand Testing and Handling

The measuring instruments in Figure 2 in this study are employed to check the mechanical dimensions of stands, such as mechanical arm [1] and laser alignment tool [2] for mechanical geometry, shape and surface roughness, with the measurement benchmark erected on the top of a marble.

Figure 2: Measurement and erection of laser alignment tool.

RESULTS AND DISCUSSION

Stand Measurement Results

This chapter shows the measurement results of stand via a laser alignment tool. The direction of X in Figure 3 is represented by red and that of Y by blue.

In this study, we have measured 25 stands, with the quantity and serial number shown in the following table, which is too large to display in full.

Table 1: Quantity of Stands Manufactured

Serial Number	Quantity
-1775	5
-1585	5
-1327	5
-1323	5
-1461	3
-1463	2

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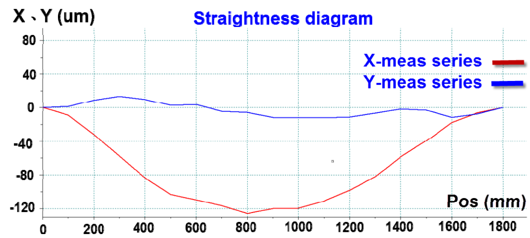

Figure 3: Measurement results of Stand 2FE-1-SUP-0A-1323-4 on side A.

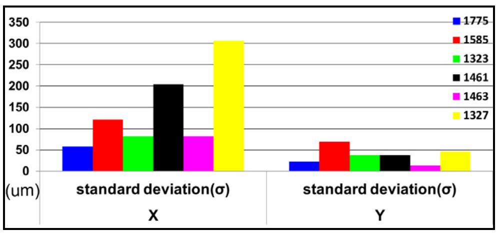

Figure 4: Statistical results on the standard deviation of the front end stands.

Due to the large number of stand measurements, a statistical method is employed in this paper to present the measurement results. For example, among the standard deviation results in Figure 4, a slightly high error of Stand 1327 resulted in an increase in the overall standard deviation. In addition, the stand data distribution can be obtained through the standard deviation and mean value according to the 68-95-99.7 rule in statistics, and will not be described further in this paper.

Stand Deformation Simulation

In the study, the stand needs to be assembled after testing. The components that the stand holds may cause deformation of stainless steel strips due to the high weight, so the stand variations are stimulated in the chapter.

In the Figure 5, a simulation for Stand No. 1327 involves components such as two slits, fixtures, HMS and IP, as shown in Figure 5 Table 2 shows the load parameters and deformation results.

Table 2: Stand Load and Change (Simulation)

Deformation	Gravity	Gravity +slit*1	Gravity +slit*2	Gravity +slit*2+ HMS
load (kg)	159.91	207.61	255.31	451.31
Max (μm)	3.571	4.293	7.982	8.390
Min (μm)	0.001	0.001	1.545	0.847

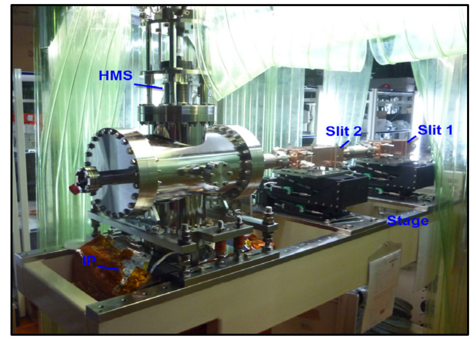

Figure 5: Components mounted on Stand 1327.

Stand Vibration Test

In the study, vibration tests have been carried out before the assembled stand is placed in the storage ring of NSRRC to prevent resonance phenomenon. The synchrotron radiation ambient excitation bandwidth is about 6-30 Hz, so the stand natural frequency should be avoided in this bandwidth.

The 1X, 2X... in Figure 6 mark the location of accelerometers which are distributed evenly in X and Y directions to generate four stimuli each, which are averaged and presented in X and Y direction in Table 3 and 4. Due to limited space, a schematic diagram of the X and Y test results is presented respectively.

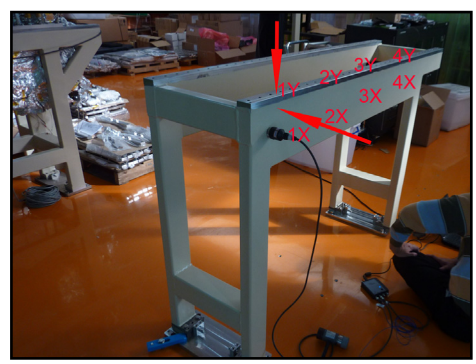

Figure 6: Erection of vibration test of stand 1327.

Table 3: Vibration Test Results of Stand 1327 (X direction)

mode	Natural Frequency(Hz)	Damping ratio (%)
1	16.84	7.95
2	35.88	4.34
3	73.97	1.7

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Table 4: Vibration Test Results of Stand 1327 (X direction)

mode	Natural Frequency(Hz)	Damping ratio (%)
1	16.11	8.97
2	32.95	4.33
3	98.14	3.74

CONCLUSION

This study focuses on the testing related to the mechanical geometry, shape and surface roughness of the front end stands of TPS. We have checked a total of 25 stands and chosen one for static analysis and vibration modal test after installation.

As for the measurement results after manufacture, we have successfully controlled the amount of deformation of the steel strip within 150 μm, but that of some stands longer than 2 meters may exceed the standard. And the amount of deformation of a stand in the static simulation is within an acceptable range of about 8 μm.

The vibration test results will help future installation of stands in the storage ring of TPS. Considering the synchrotron radiation ambient excitation bandwidth of about 6-30 Hz range, the first mode of the stand natural frequency will appear in the excitation bandwidth before the components are mounted, and then exceed it after mounting the components according to our expectation.

These results will help during the construction of the front end base to some extent and are expected to be able to provide some assistance to successful operation of TPS.

REFERENCES

[1] Sie Ci-Jin, Instructions for Power Inspects, General Integration Technology Co., Ltd., 2013.

[2] Chen Jie, Operating Manual for Electronic Automatic Collimators , U.D. Measure-tech Co., Ltd., 2013