ISBN: 978-3-95450-227-1 ISSN: 2673-5490 doi:10.18429/JACoW-IPAC2022-THPOST041

CONSTRUCTION AND MANUFACTURING PROCESS OF SIAM PHOTON SOURCE II STORAGE RING GIRDER PROTOTYPE

S. Srichan†, O. Utke, K. Sittisard, M. Phanak, P. Pruekthaisong, S. Prabngulueam, S. Klinkhieo,
Synchrotron Light Research Institute, Nakhon Ratchasima, Thailand

Abstract

The Siam Photon Source II storage ring is designed with low emittance. This new machine requires a high-performance support system and a precise alignment capability. In order to meet these requirements, we have planned for construction of a half-cell components prototype. In the end of 2021, we completed the first girder prototype. This report will describe construction and manufacturing process.

INTRODUCTION

Siam Photon Source II (SPS-II) accelerator complex is the second synchrotron light source in Thailand. It consists of three main components: a 150 MeV injector linac, a 3 GeV full energy booster synchrotron, and a 3 GeV electron storage ring. The 3 GeV storage ring has a circumference of 321 m and the electron beam emittance of 0.9 nm-rad. The ring consists of 14 Double Triple Bend Achromat (DTBA) cells, resulting in 14 long and 14 short straights.

Since the DTBA cell consists of two mirrored halves only three different girders have to be designed. The beam height was set at 1.2 meters. There are 3 prototypes in different of top plate dimension (Table 1).

Table 1: Girder Top Plate Dimension

Girder1 [mm]	Girder2 [mm]	Girder3 [mm]
750x2750	750x2870	870x2240

GIRDER DESIGN

We developed a magnet girder system which uses wedgemount for precision alignment is based on 3-2-1 alignment method and requires three wedgemounts to control Z-direction, two weggemounts to control Y-direction and one wedgemount for X-direction (Fig. 1). The magnet alignment is based on mechanical tolerances. Therefore, the girder top plate is designed with precision surface with a flatness tolerance of 30 µm. [1]

Design Constraints

The design requirements are:

- The flatness of top plate is 30 µm.
- The allowable deflection is less than 20 µm.
- High vibration stability, design frequency above 35 Hz.

To evaluate the success of design, the first prototype construction has been started.

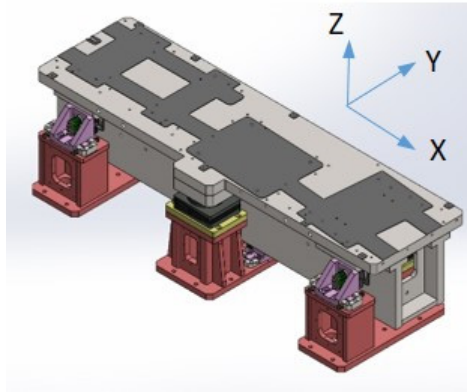

Figure 1: Girder system with three vertical support points.

Material Selection

ASTM A572 Steel Grade 50 was selected for girder construction. Its high strength property compatible with the design. And all of it available in domestic steel industry. The mechanical properties were shown in Table 2 [2].

Table 2: Material Properties

Item	Properties
Hardness, Rockwell B	74
Tensile strength, Ultimate	450 MPa
Tensile strength, Yield	345 MPa
Elongation at Break	18%
Shear Modulus	80.0 GPa

CONSTRUCTION

Because we have less experience for assembling the precision large support system, the girder assembly should be performed by ourselves. We separated the girder construction into two parts. We hired the manufacturing company for the production of some parts. For girder1, the production of girder consists of 2 parts.

Manufacturing Parts

- The top plate dimension 750x2750 mm
- The sub-parts of 3 pedestals.
- Adjustment structure parts.

Commercial Products

Table 3 lists the standard part.

ISBN: 978-3-95450-227-1 ISSN: 2673-5490 doi:10.18429/JACoW-IPAC2022-THPOST041

Table 3: Standard Parts

Part	Function	Manufacturer/Model
Wedgemount	Z-direction	Airloc414-KSKC
Wedgemount	Y-direction	Airloc2130-KSKCV
Wedgemount	X-direction	Airloc2012-KSKCV

The standard parts will be assembled with the manufacturing parts. For the manufacturing parts, there is a process to control the required specifications as will be described.

MANUFACTURING PROCESS

The fabrication of the first girder has been followed this process.

Cutting and Fit-up

The steel material A572 Grade 50 was cut by plasma cutting tool and fit-up for welding.

Welding

The welding was inspected by magnetic testing method to identify the integrity. The welding is according to the Welding Procedure Specification (WPS) to control the quality.

Heat Treatment

Heat treatment is a process of heating and cooling material, using specific predetermined method to obtain design properties. This heat treatment method is to relief stress induce in earlier cold working process.

Fabrication

The most important and critical process of girder fabrication is production of top plate. Figure 2 shows the top plate on the CNC double column machining centre. Because of the tight tolerance, the surface dimension must be controlled.

Figure 2: Top plate machining.

Painting and Surface Protection

A painting type is an epoxy blasting. The wax based solvent called Tectyl was selected to prevent corrosion for precision surface (Fig. 3).

Figure 3: Completed top plate.

Pedestal Assembly

The wedgemount was assembled on the pedestal surface (Fig. 4).

Figure 4: The pedestal assembled with wedgemount.

Precision Surface Inspection

With the restricted tolerance for surface flatness, the geometry inspection was done by portable coordinate measuring machine and the inclinometer instruments. Figure 5 shows the visual inspection for the precision surface.

† supawan@slri.or.th

ISBN: 978-3-95450-227-1 ISSN: 2673-5490 doi:10.18429/JACoW-IPAC2022-THPOST041

Figure 5: High precision surface.

Girder Assembly

The girder assembly procedure is consisting of installation of 3 support pedestals and fix on the floor. Finally, the top plate of girder was sit on the pedestals with the design position (Fig. 6).

Figure 6: Completed girder prototype.

CONCLUSION AND DISCUSSION

There are 3 girder prototypes were planned to constructed. The first girder prototype was successfully done. Regarding the assembly experience, we found that the flatness tolerance is not good enough. It caused decreasing of alignment capability. Next girders, we are planning to perform the geometry control in the line of machining process. It will develop a high-precision manufacturing industry.

ACKNOWLEDGMENTS

The authors would like to acknowledge members of this project, for their hard working especially labour task and good collaboration with MRP Engineering Co.,LTD.

REFERENCES

[1] O. Utke, S. Chaichuay, S. Klinkhieo, S. Pongampai, K. Sittisard, and S. Srichan, "Design of Magnet Girder System for Siam Photon Source II", in *Proc. MEDSI'20*, Chicago, USA, Jul. 2021, pp. 138. doi:10.18429/JACoW-MEDSI2020-TUPA10

[2] https://www.matweb.com/