Design and Testing of a Locking System in a Girder at NSRRC

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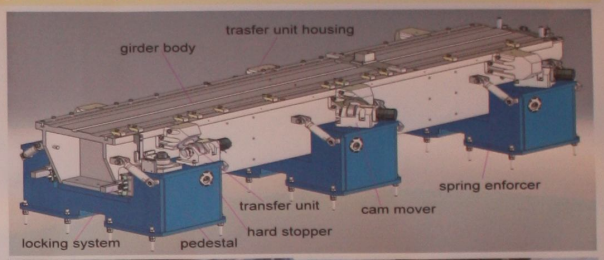
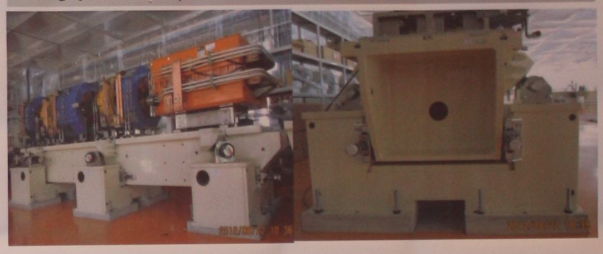
Abstract

In Taiwan Photon Source (TPS) project at National Synchrotron Radiation Research Center (NSRRC), the girder system is designed to precisely adjust displacement and rotating angles for electron beam stability. The adjustable structure has the characteristic of lower stiffness and leads the lower natural frequency of a girder. This paper represents the designed motor-driver circuit of the locking system and the testing result of the locking girder. A locking system is designed to increase natural frequency without the effect of the position and the angle after adjusting a girder. The locking system consists of eighteen wedge mechanisms driven by motors, a motor driver circuits and an industrial computer. Through the testing results, the verification and validation of the designed locking system is effective.

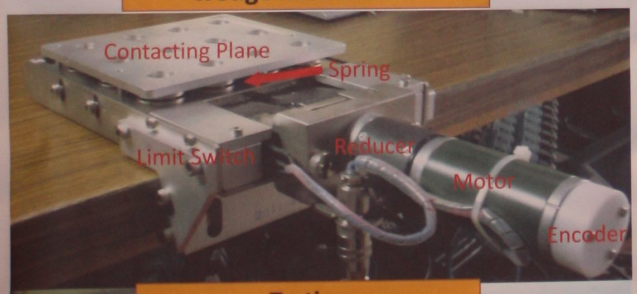
A new 3-GeV synchrotron facility is constructed at National Synchrotron Radiation Research Center (NSRRC). To satisfy with beam dynamics specifications, we demand all magnets on girders having to be located at precise positions and well supported. The girders are designed to provide precise alignment with little manpower and less adjusted time. Each girder is supported with six cam movers on three pedestals to realize 6-axis adjustments, as shown in Fig. 1(a) [1, 2]. To avoid the resonance of girders due to that the lowest structure frequency is close to the ambient lower frequency, we introduce a locking system designed to provide clamp force on the two sides of the girder body and increases the first nature frequency of the girder. The position deviation of the locked girder has to keep in the range of ten micrometers. Each girder is locked by six-wedge mechanisms and the locking-system circuit has twelve motor-driver channels. The locking system includes twelve wedge components, a motor-driver circuit and an industrial computer.

To maintain the stability of electron beam, the magnets on the girder are adjusted to the calculating position and the positioning error is smaller than the specification. To improve the stiffness of girder system, a locking system is designed and applied to clamp the girder and three couples of clamping mechanism are installed on three pedestals, respectively.

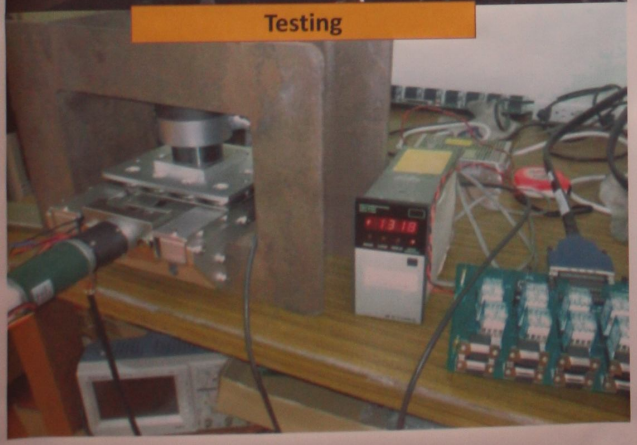




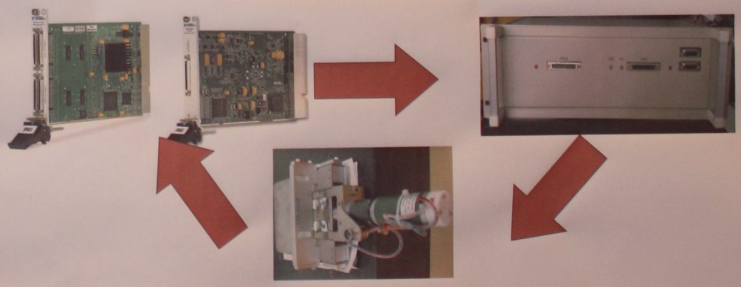
wedge mechanism

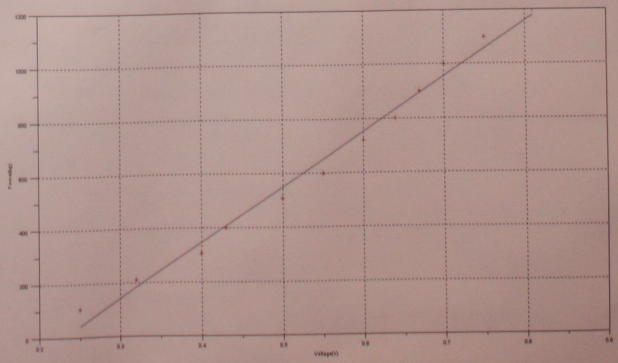


Testing



Locking System





The Deviation of a Locked Girder

Deviation	Transverse	Vertical	Longitudinal
First	-3 μm	8μm	6μm
Second	-9μm	20μm	-17μm

Conclusion

After the girder position error achieves to required precision, a locking system are applied to clamp all girders. The locking system efficiently increases the nature frequency of the girder. Mass production of the locking system is complete, transferred to quality assurance for testing. The automatic girder-locking procedure will be design with these devices.