Elevation Changes of the New SUBARU Ring Magnets

Sakuo MATSUI and Chao ZHANG

SPring-8/JASRI

1. Introduction

The New SUBARU storage ring is located in the SPring-8 site. This ring is on the Sayo gravel bed. It consists of conglomerate clay layer. The cross section of the beam tunnel is shown in Fig. 1. The thickness of the floor concrete is 70 cm. However the final concrete (20 cm) was not filled at the cable pit.

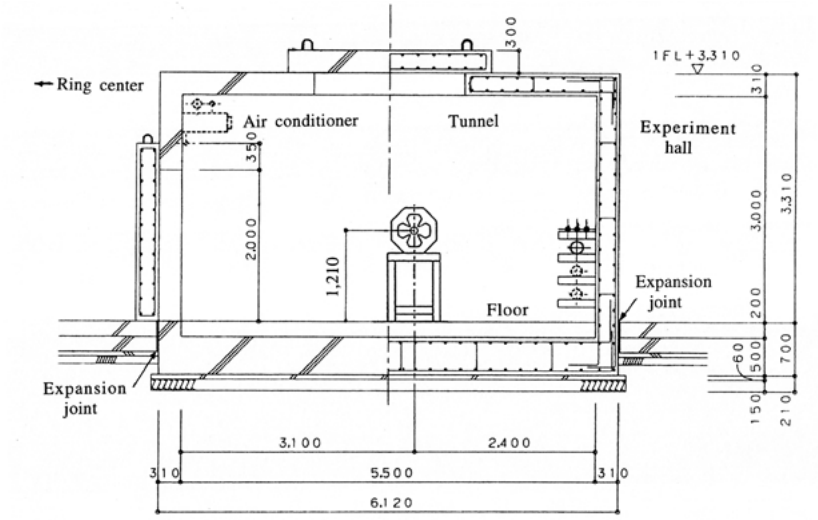

Fig. 1. The cross sectional view of the beam tunnel.

This ring has 6 cells with a circumference of 119 m. One cell has 2 bending magnets (BM) and one invert bending magnet (BI) at the middle and multipole magnets on four girders. The length of one girder is 1~2 m. These girders have no base plates. (Fig. 2)

Two quadrupole and two sextupole magnets are mounted on a normal girder.

There are three fiducial planes on a bending magnet. Each plane has one tapered hole. Multipole magnets has one fiducial plane which has two tapered holes. Spherical target (ø=75) is used for our alignment and survey.

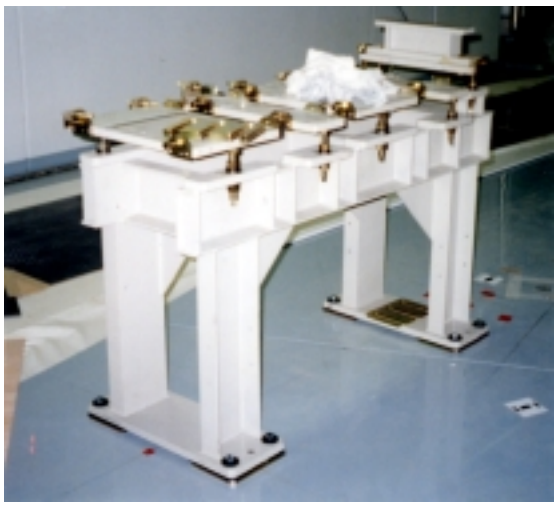

Fig. 2. Normal girder on the floor.

2. Alignment of Vacuum Chamber

2.1 Magnet Divide and Restoration

The vacuum chamber is installed after magnet divide. The upper half of the magnet was put on the lower half magnet and the chamber. Figure 3 shows the cross section of chamber and magnet poles. Moreover the chamber is enclosed with three heat insurance sheets. If the error of chamber production and alignment is large, the chamber contacts to magnet pole, and upper half-magnet shifts. The gap was checked by passing the nylon string between the chamber and magnet pole. Some magnets bit the chamber. Also the tilts of the fiducial planes changed after restoration. According to the survey after restoration, the shift of several sextupole magnets was less than 0.4mm.

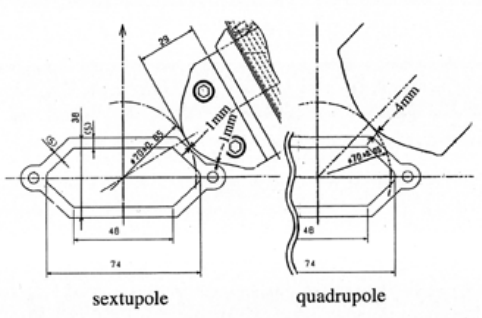

Fig. 3. Cross section of chamber and magnet poles.

2.2 Baking

Since vacuum chamber was close to the magnet pole, many sextupole magnets inclined when chamber expanded. The tiltmeter on the fiducial plane showed the maximum tilt of 1mrad. The influence on the qudrupole magnet was smaller than that of sextupole. It is noted that the tilts did not seem to return to the initial ones after baking.

Since the tie bolts between the pump and chamber were loosed before baking, the pump weight inclined all BI magnets longitudinally about 0.1 mrad.

3. Elevation Changes

The levels of bending magnets were surveyed at September 1998 (half year later after first alignment) and January 1999. Fig. 4 shows the network using a Wild N3. The levels were calculated by least square method. This figure also shows many pits for cable and water duct. Figure 5 shows the example of cross section of bending, multipole magnets and pit, and Fig. 6 the pit around BM10.

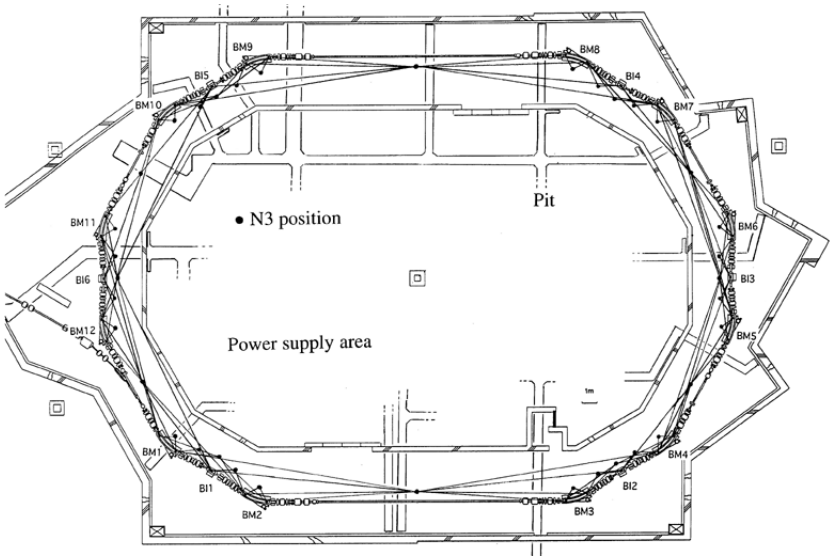

Fig. 4. Network for the level survey.

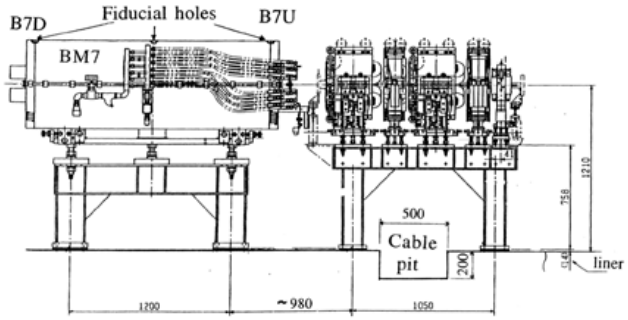

Fig. 5. Cross section of magnets and pit around BM7.

Fig. 6. Pit around BM10.

The levels of the bending magnets are shown in Fig. 7. This figure shows also pit position. The weight of bending magnet is 5 t. The weight of girder on which multipoles mounted is 1 to 1.5 t. It seems that the one leg of bending magnet near pit subsided.

The floor concrete was completed at August 1997, the bending magnets were placed on the floor at November 1998. Four liners (26 cm x 16 cm) are used for every girder to adjust height.

Four months later the alignment was carried out at March 1998. However the floor was not stable. In particularly, the elevation change of BM2 and BM7 were large. One side sank 0.2 mm down during six months. Multipole magnets were aligned at April 1998. The levels and displacements of multipole magnets were also surveyed with a laser tracker. (Fig. 8) The reference positions of this survey were on the bending magnets, which levels were already known. The horizontal large displacements are due to the survey error.

The magnets on five girders enclosed with ellipse in Fig. 8 were realigned with the laser tracker. (Fig. 9)

According to the subsidence of BM2 and BM7, it is supposed that the downstream girder of BM2 and the upstream girder of BM7 subsided. This is shown in Fig. 8.

Moreover the changes of the levels and tilts suggest that the floor from BM5 to BM7 subsided. The magnet levels in Fig. 9 also exhibit this floor elevation change and the influence of pits.

Fig. 9. Realignment of multipole magnets.

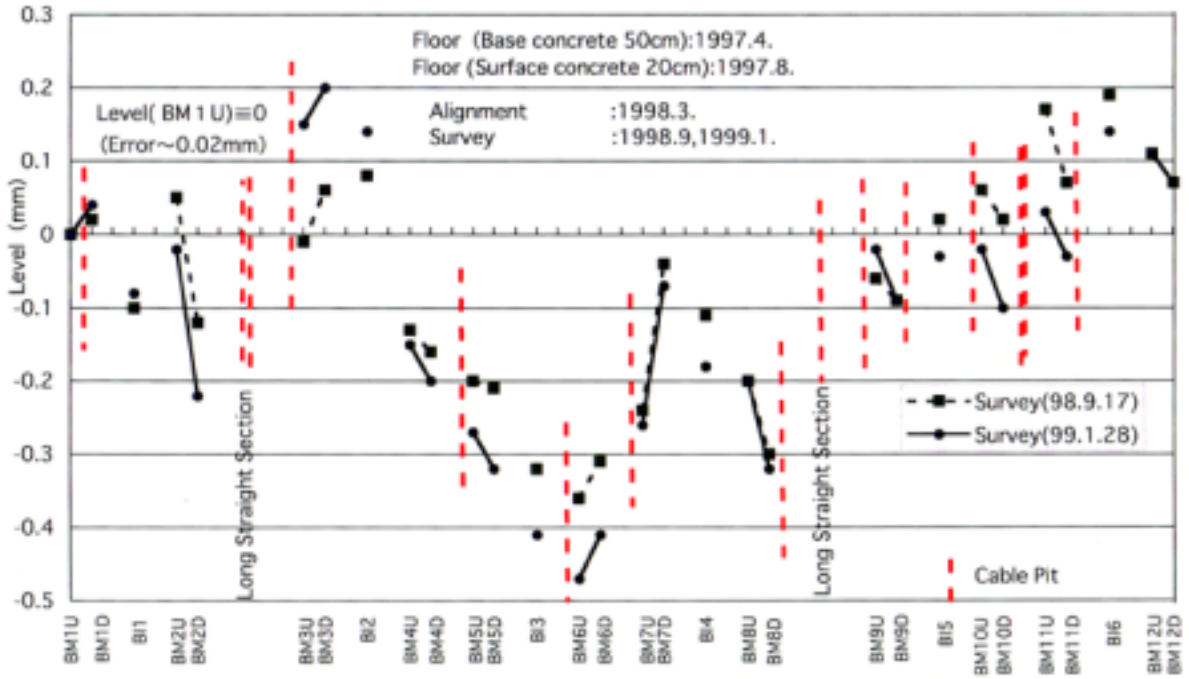

Fig. 7. Levels of bending magnets and pit position.

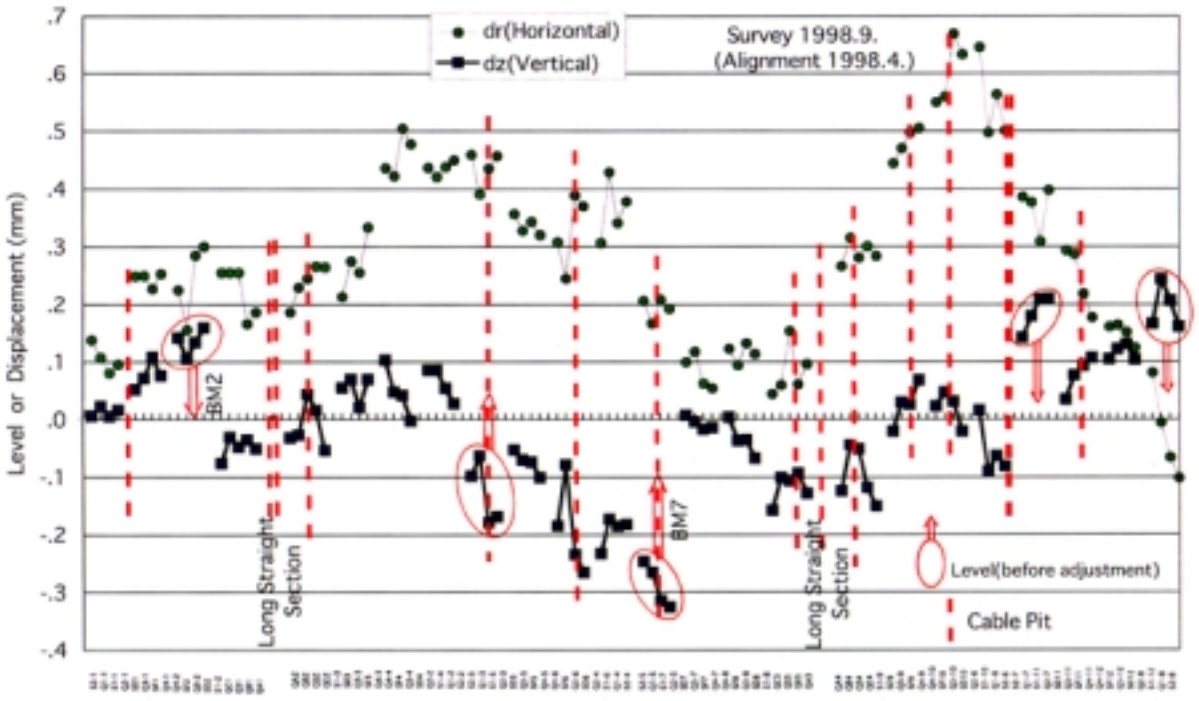

Fig. 8. Levels and horizontal displacements of multipole magnets.

4. Concluding Remark

It is quite necessary to survey the level at several months later after first alignment to check the change.

The cable pit on the floor becomes one of the causes of unstableness. It is noted that the small liner under girder increases the pressure to the concrete.

The alignment of vacuum chamber is also important.