Elevation Changes of the Storage Ring Magnets

Sakuo MATSUI, Chao ZHANG, Kazuma NAKASHIMA, Hikaru KISHIMOTO, and Masayuki TANAKA
SPring-8, Kamigori, Ako-gun, Hyogo, 678-12, Japan

1.Introduction

Though the storage ring was constructed mostly on the hard rock, in some sections the ground was replaced by artificial hard rock (Fig.1). The total volume of foundation improvement including that for the linac and synchrotron areas was 70000 m^3. Figure 2 shows the cross sectional view. The schedules for the tunnel construction and magnet installation are summarized in Table1. The tunnel was constructed in four phases. After the tunnel construction, the baseplates were made into the floor. Then girders were set on these baseplates.

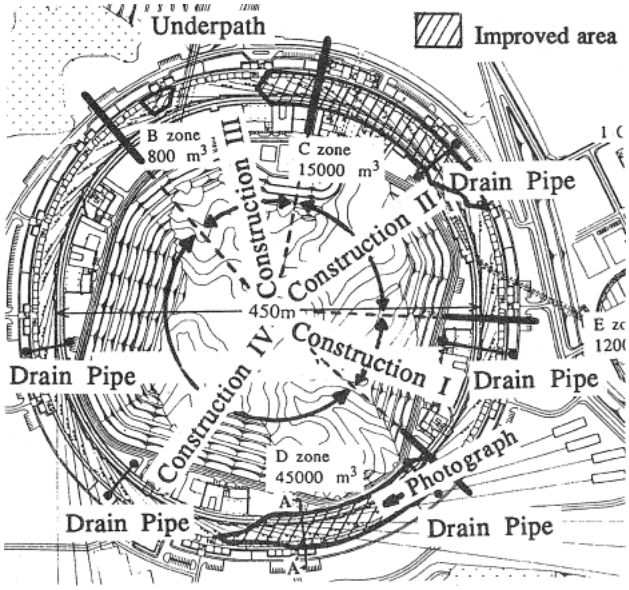


Fig.1. Area of foundation improvement and drain pipe etc.

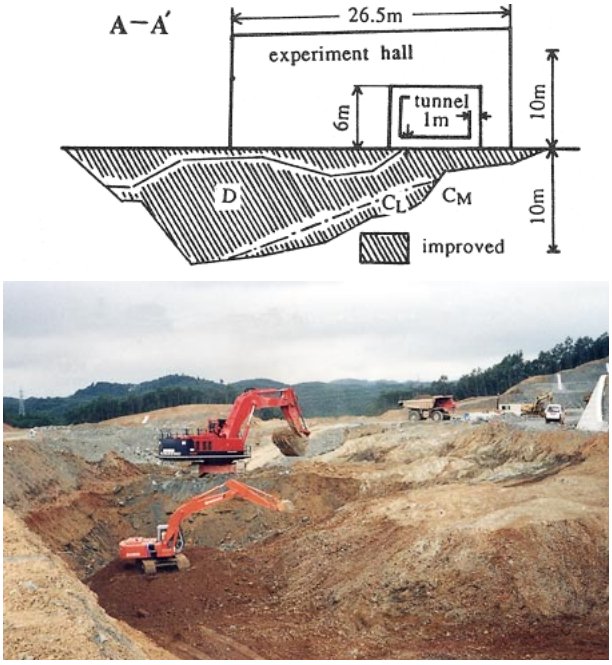
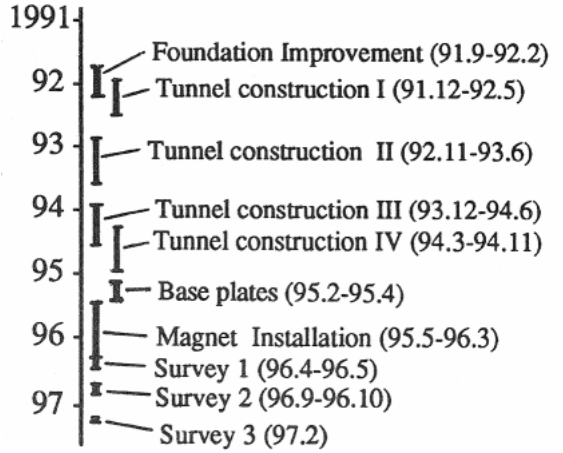


Fig.2. Cross sectional view of the improvement.

Table 1. Schedule of construction and installation.



There is a fiducial plane on the magnet of both ends of the girder. A fixed stage on this plane has a tapered hole. A spherical surface (ø=75) is used for our survey.

2. Apparatus

A Wild N3 level was usually used for the level survey. The target pattern is on the glass plate in the spherical ball. (right photo-graph). Since this method strained the eyes, new instruments were developed. The level difference was determined by measuring the tilt (Fig.3) (Tilt bar method) [1]. Although the stability was not so good, its accuracy was considered to be better than that of N3.

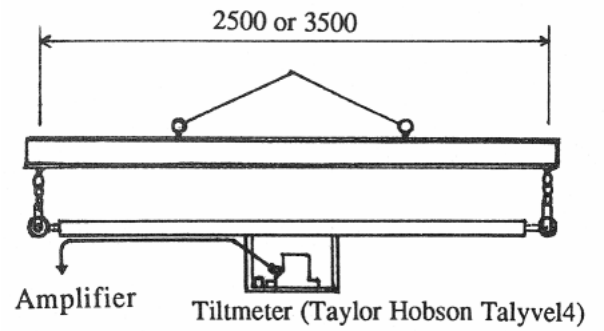


Fig.3. Tilt bar method.

Another method using autolevel NA2 and He-Ne laser is shown in Fig.4. The detector is PSD(Position sensitive device) (Fig.5) (Laser-PSD method). Since the output of this method always fluctuates, it is averaged out using a digital voltmeter. As small a difference as 10 μm can be measured by this method as long as the distance is less than several meters. The pendulum compensator of NA2 was able to decrease the tilt of laser light approximately 20 times.

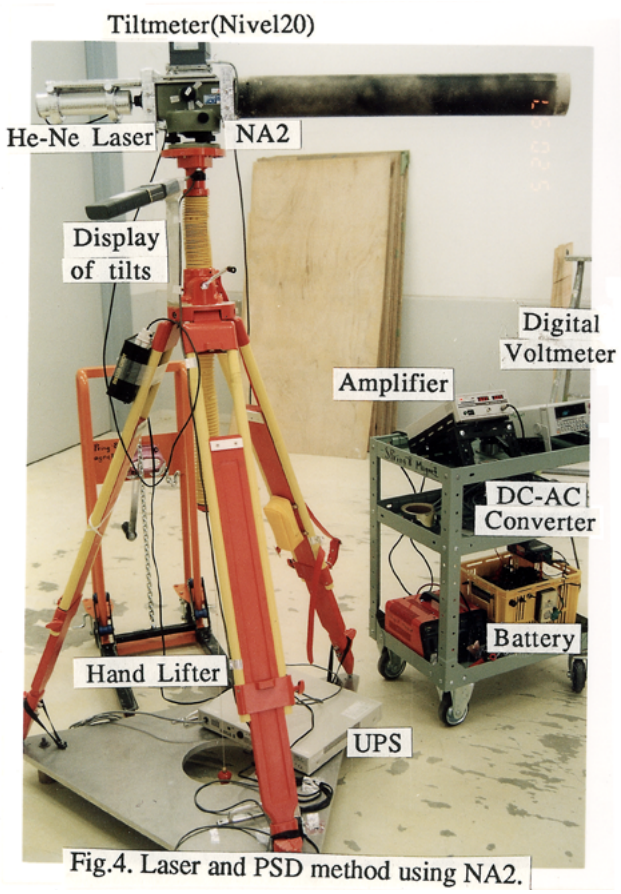


Fig.4. Laser and PSD method using NA2.

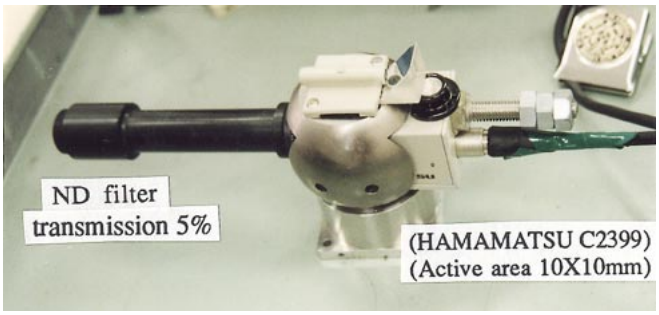
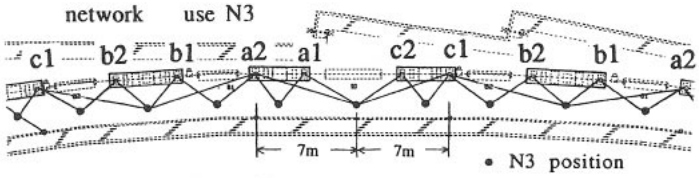


Fig.5. PSD Target.

3. Method and Results

The network is shown below. This ring has 48 cells. Each cell has 3 girders. One girder has 2 survey points.



Magnet levels were surveyed three times(Fig.6). The level difference between two points that are far apart is not reliable. The standard deviation of the relative level between the next girder are also shown.

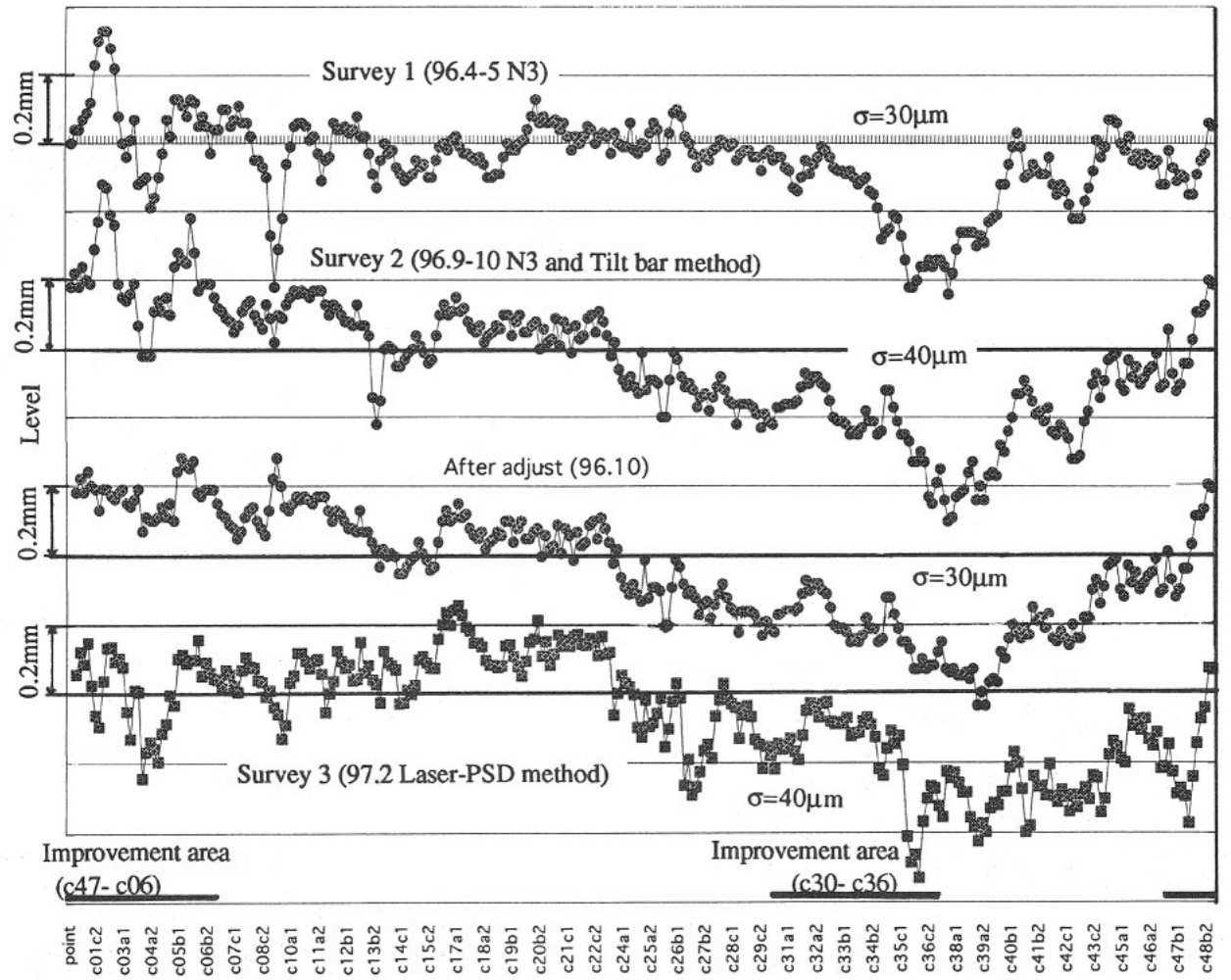


Fig.6. Level survey results

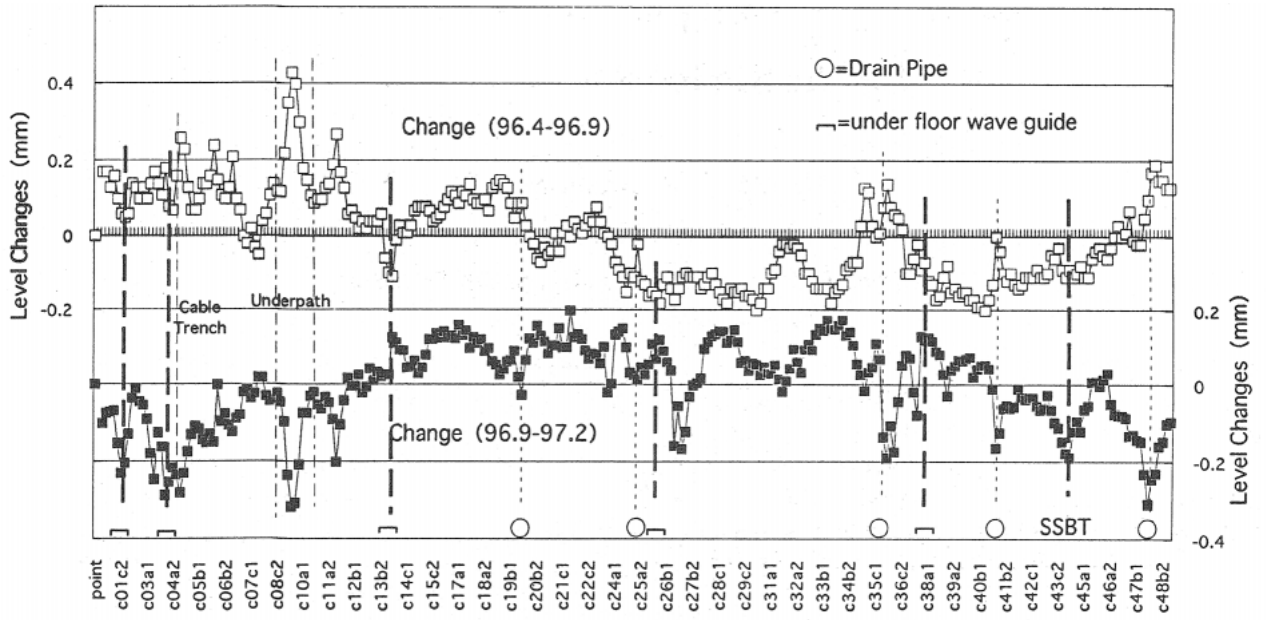


Fig.7. Level changes between two surveys.

After the Survey2, twenty girders were adjusted. Figure 7 shows the changes between the two surveys.

The elevation at the 10 m long underpath for vehicle rose up to a maximum of 0.4 mm during the summer and decreased by 0.4 mm during the winter because of ambient temperature changes. The cross section is shown in Fig.8.

The floor levels over underground drain pipes of 0.9m diameter at five locations changed from ±0.1 to ±0.2 mm in the same way. Since both ends of this pipe were opened in the air(Fig.9), the floor over the pipe section was warmed and cooled.

The floor over the RF wave guide room settled and is now deforming depending on the temperature in that room.

The length of the section over the transport line from synchrotron to the storage ring (SSBT) is about 7 m. The concrete thickness of this floor is 1.4 m. The floor level change of this area was within 0.2mm.

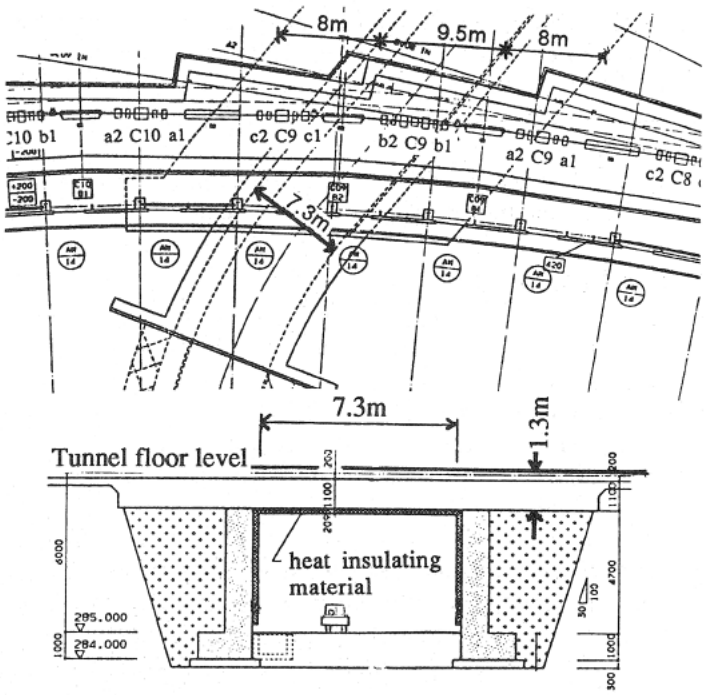


Fig.8. Underpath for vehicle.

4. Concluding Remark

The recent standard deviation of the relative level between the next girder was 40μm.

The levels of floors where there is a space underneath are not stable, but their changes are not so large. The floor level changes in the improved foundation area could not be detected.

It is most important to survey and adjust the girder level under the same temperature, if possible operating temperature.

Reference

[1] Y.Sasaki and S.Matsui, SPring-8 Annual Report 1995, 123(1996).