ELEVATION CHANGES OF THE SPring-8 STORAGE RING

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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.

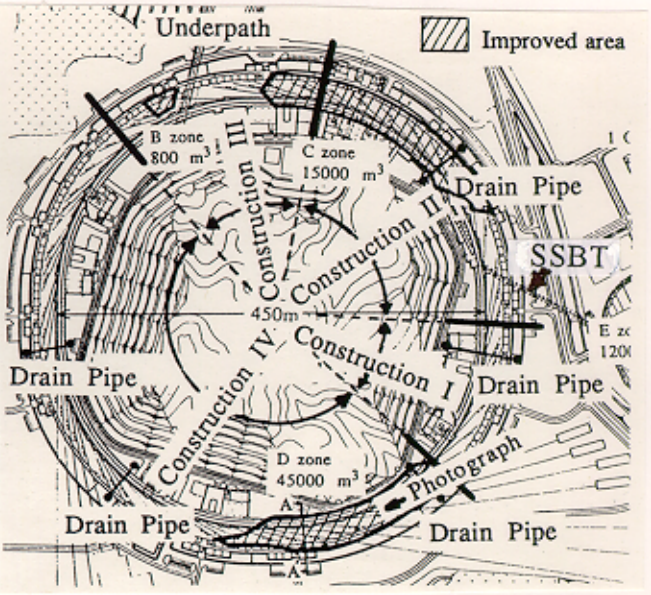
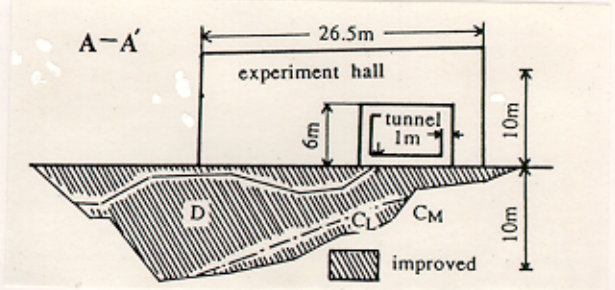


Fig.1. Construction phases, area of foundation improvement, an underpath and drain pipes etc.

Table 1. Schedule of construction and installation.

1991	Foundation Improvement (91.9-92.2)
92	Tunnel construction I (91.12-92.5)
93	Tunnel construction II (92.11-93.6)
94	Tunnel construction III (93.12-94.6)
	Tunnel construction IV (94.3-94.11)
95	Base plates (95.2-95.4)
96	Magnet Installation (95.5-96.3)
	Survey 1 (96.4-96.5)
97	Survey 2 (96.9-96.10)
	Survey 3 (97.2)
	Survey 4(97.7)



There is a fiducial plane on the magnet of both ends of the girder. A fixed stage on this plane has a tapered hole. The level was measured by putting the target on this hole. The bottom shape of the target is spherical surface (ø=75).

Fig.2. Cross sectional view of the improvement.

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. (Fig.3). N3 was used during Survey 1.

Since this method strained the eyes, the level difference was determined by measuring the tilt (Fig.4) (Tilt bar method) [1]. Although the stability was not so good, its accuracy was considered to be better than that of N3. This method and N3 were used during Survey 2.

Another method using autolevel NA2 and He-Ne laser is shown in Fig.5. The detector is PSD(Position sensitive device) (Fig.6). 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. This method was used during Survey 3 ~ 4 .

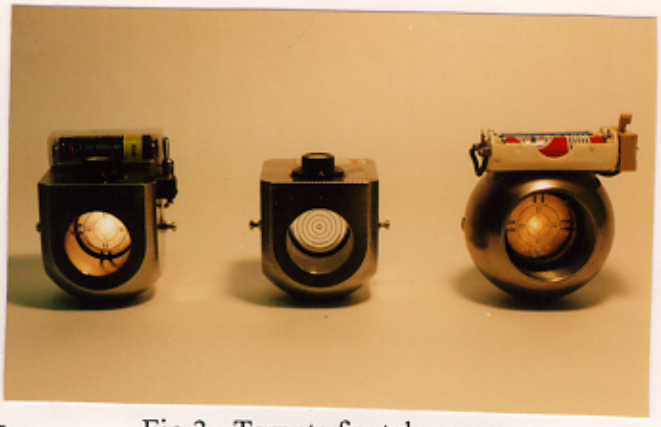


Fig.3. Targets for telescope.

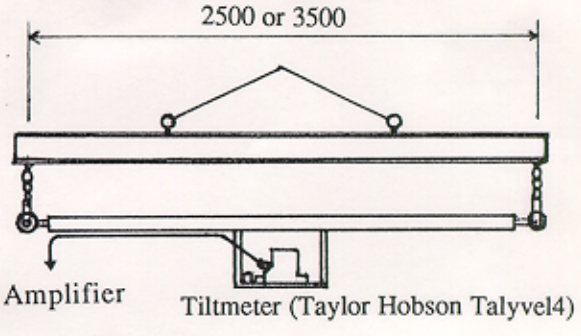


Fig.4 . Tilt bar method.

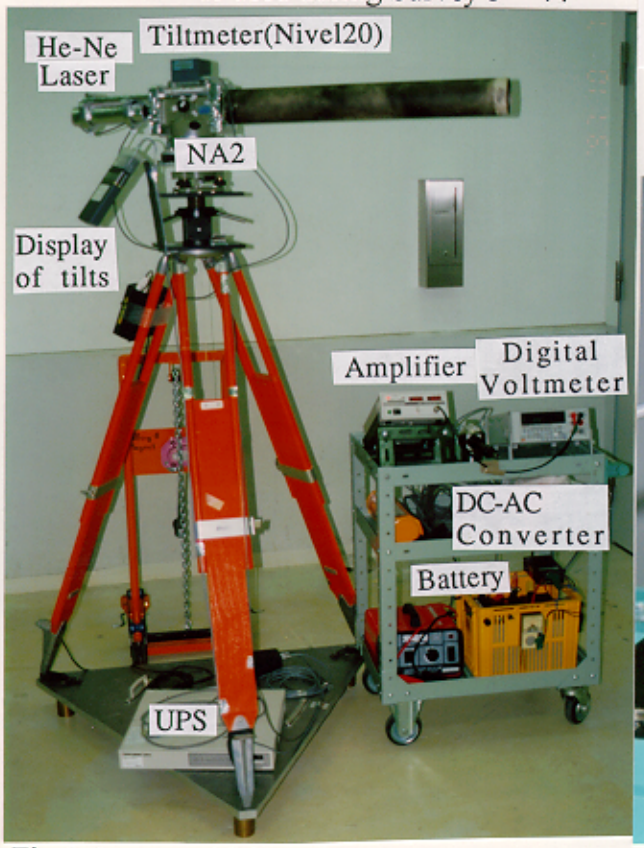


Fig.5. Laser and PSD method using NA2.

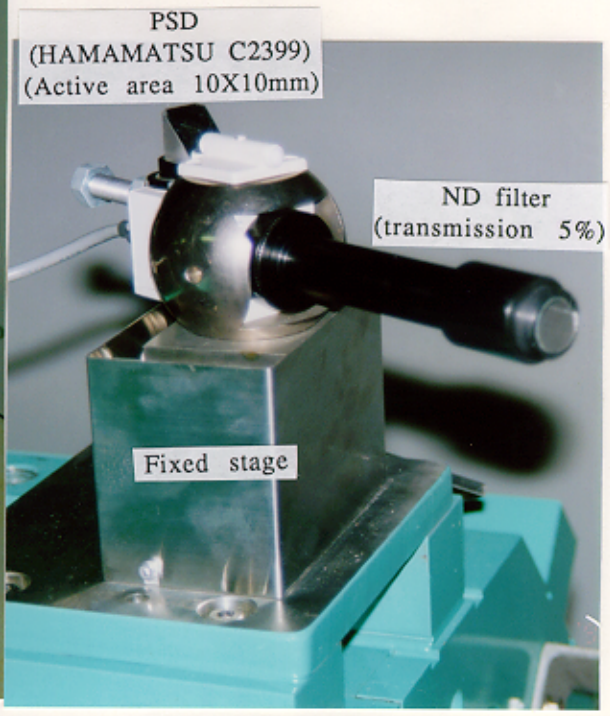


Fig.6. PSD Target.

3. METHOD AND RESULTS

The network is shown in Fig.7. This ring has 48 cells. Each cell has 3 girders. One girder has 2 survey points.

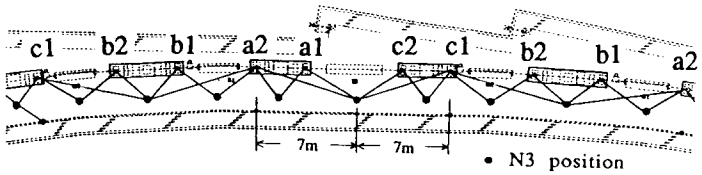


Fig.7. Survey network.

Magnet levels were surveyed four times. After the Survey2, twenty girders were adjusted. Fig. 8 shows the changes between the two surveys and the last level. The level difference between far apart two points is not reliable.

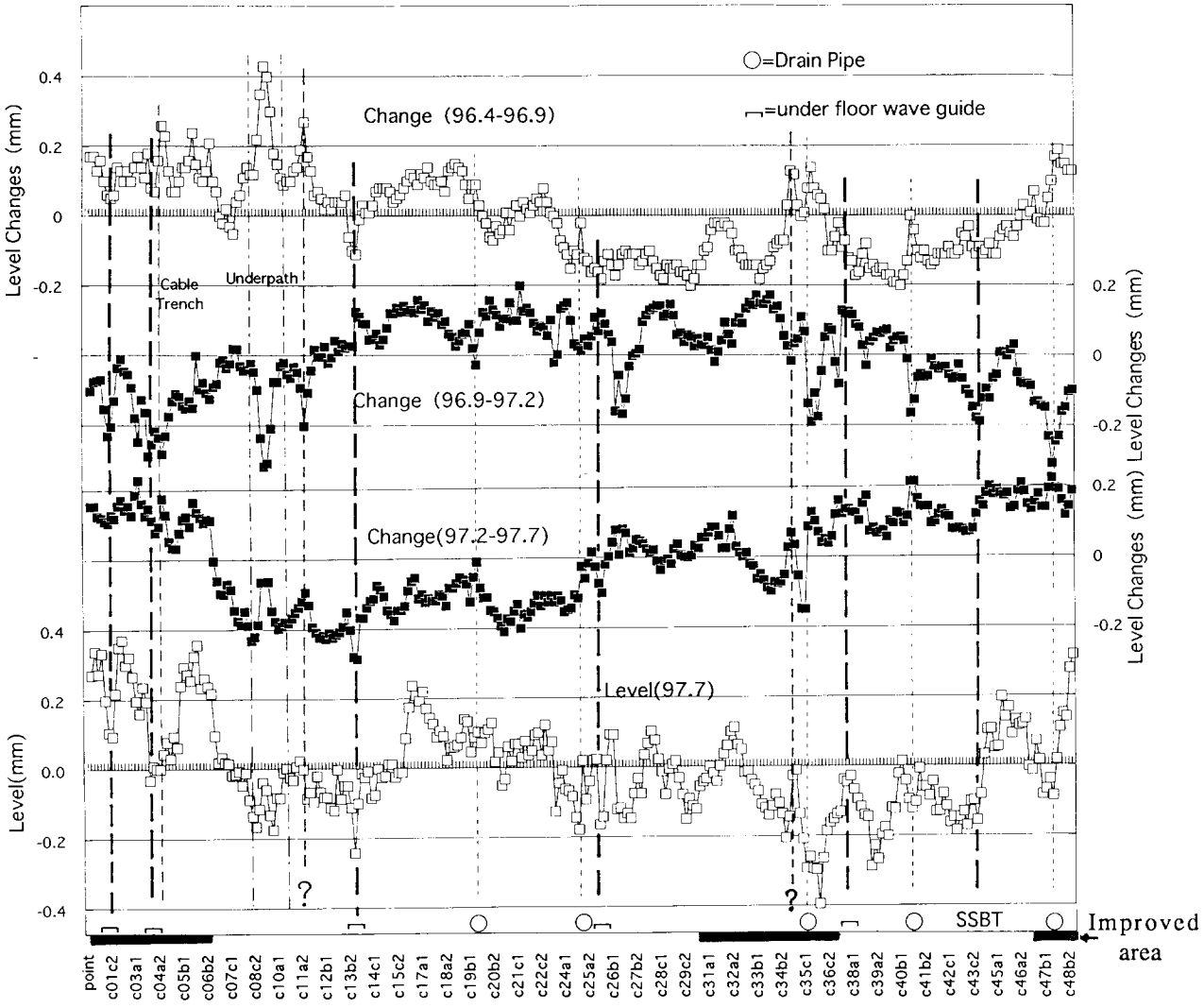


Fig. 8. Level changes and the last level.

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.9. The surface temperature at the side wall changed as shown in Fig.10.

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.11), the floor over the pipe section was warmed and cooled. The depth from tunnel floor level to the top of the pipe is about 1.3m.

There are other two points which show seasonal changes as shown ? mark in the figure. The change reason is unknown.

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.

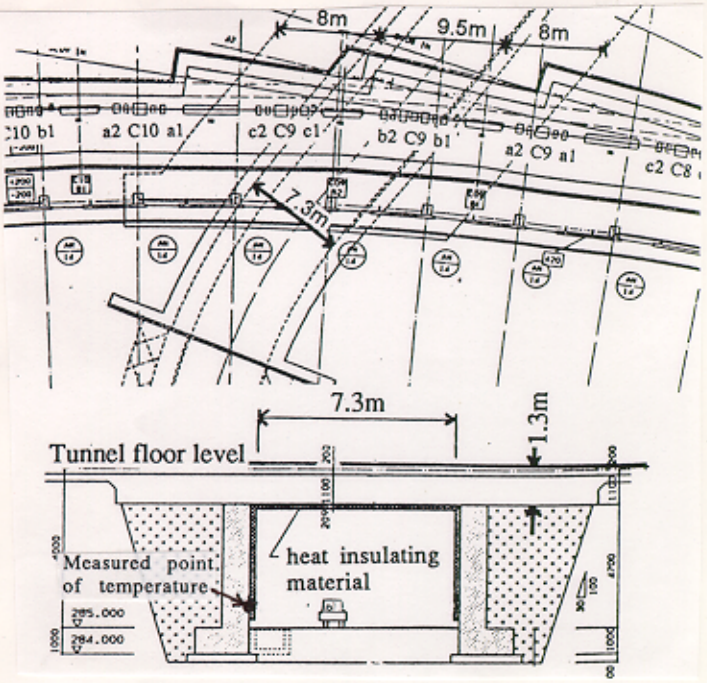


Fig.9. Underpath for vehicle.

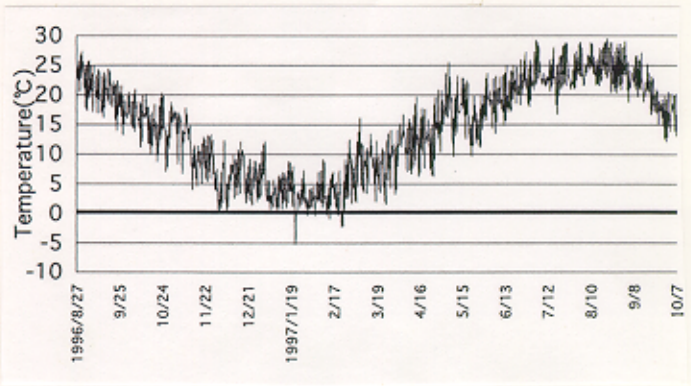


Fig.10. Temperature at the side wall of underpath.

4. CONCLUDING REMARK

The recent standard deviation of the relative level between the next girder was 63μm.

It is not desirable that there is some space under the floor.

The obvious floor level changes in the improved foundation area (about 30%) cannot be detected now.

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

Fig.11. Drain pipe before tunnel floor construction.

5. REFERENCE

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