Alignment of Transport Channel of SPring-8 Beamlines

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1. Introduction

For successive construction of beamline transport channels, we investigated a simple alignment method for standard components [1, 2] to reduces a term of construction. We designed alignment tools which can be used for standard components commonly. These tools were designed based on alignment allowance for the components. We tested the method during the construction of beamline BL47XU.

In this report, we show the methods to align transport channel components.

2. Reference line and level for direct beam

Prior to construction of front-ends, two monuments were buried on the floor for each of 61 beamlines showing the direct beam axis [3]. The location of the monuments are schematically shown in Fig. 1. The reference line for component setting was extended from two monuments using a theodolite (Leica WILD T3000).

As well as the monuments for the beam axis, a level monument was mounted on the side of the concrete shield [3] showing a 1400-mm-high level. We marked several level points using a surveyor's level (Nikon AS-2) so that we can see level from surveyor's levels at any positions of the components in an optics hutch. Level error between marks is less than 0.3 mm.

3. Boundary between front-end and transport channel

We defined a boundary between a front-end and a transport channel as follows: L_1 is a distance between the source point and the inside wall of the concrete shield perpendicular to the direct beam axis, and L_2 is a distance between the source point and the boundary (Fig. 1). We used nominal values for L_1 and L_2 and calculate a distance L_3 between the inside wall and the boundary. By measuring L_3 from the inside wall, we marked a point of the boundary.

4. Alignment allowance for beamline trans-port channel

For flanges of beam axis, we use Conflat flanges of 70 mm in diameter for undulator beamlines, and flanges of 114 mm and 152 mm for bending magnet beamlines. Diameter of tubes for these flanges are large enough for typical beam sizes. To let the beam pass through the tubes, an alignment error of ± 1 mm perpendicular to the beam axis is acceptable.

Another limitation of component alignment is how to connect the components using the standard bellows [2]. For usual components, a placement error of ± 1 mm in the beam axis direction is not so serious for optical requirements and it can easily be canceled by the bellows. An error of ± 0.5 mm perpendicular to the beam axis is also acceptable for standard bellows.

5. Alignment tools and alignment method

5.1 Alignment of standard posts using a gauge

We designed a gauge to align the standard post "BL-TC-PST1" [2]. Using the gauge with two plummets, we can align the post in the horizontal direction relative to the reference line and point (Fig. 2). We aligned posts within ± 2 mm in the horizontal direction. Fine adjustment can be made when we mount the component on the post.

5.2 Alignment of standard components using targets for component flanges

Figure 3. shows how to align the component on the post. We designed alignment targets to align the component at the flange positions. The targets are Conflat flanges with hole of 1mm in diameter at a center. Length of the target is 50 mm. We marked the reference point on the floor considering the target length considering a component position and the target length. The targets are attached to both sides of the component flanges. Plummets are suspended from the target holes. In the horizontal direction, we can align the component by setting the plummets to the reference line and point. The component position can be adjusted by six bolts on the top plate of the post. For vertical position, the position can be adjusted by stud bolts of the post using two surveyor's levels which are set to designed levels. When we align the component along an inclined beam axis such as downstream of the vertically deflecting mirror, the surveyor's levels are set considering length of the targets.

Similar method is also used to align the monochromators, mirror chambers and other optics components.

6. Summary

We investigated alignment methods including tools with which we can align components within 1 mm along a beam axis and 0.5 mm perpendicular to it. We tested the method during the construction of beamline

BL47XU and found it can be basically used for transport channel components commonly.

Up to now, transport channels of bending magnet beamlines BL01B1, BL02B1, and BL04B1, and undulator beamlines BL09XU, BL41XU, and BL45XU have been constructed by the similar way.

References

[1] T. Ishikawa, SPring-8 annual report 1995, 38, (1995).

[2] S. Goto et al., this issue.

[3] H. Aoyagi et al., private communication.

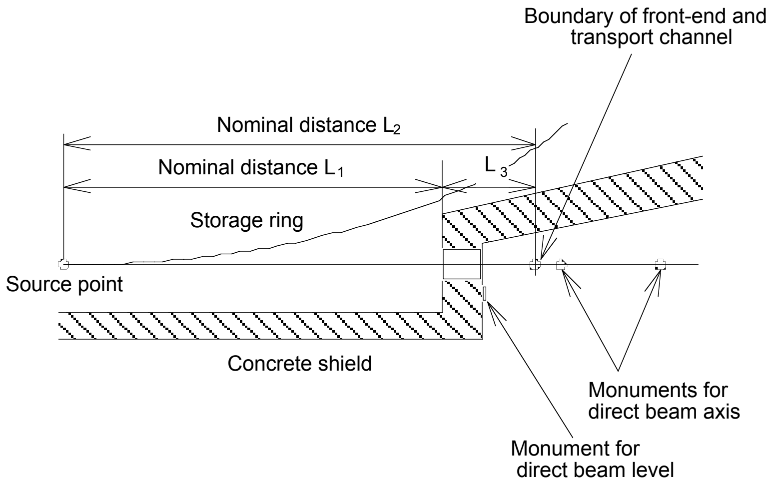

Figure 1. Location of the monuments for direct SR beam and boundary between front-end and transport channel.

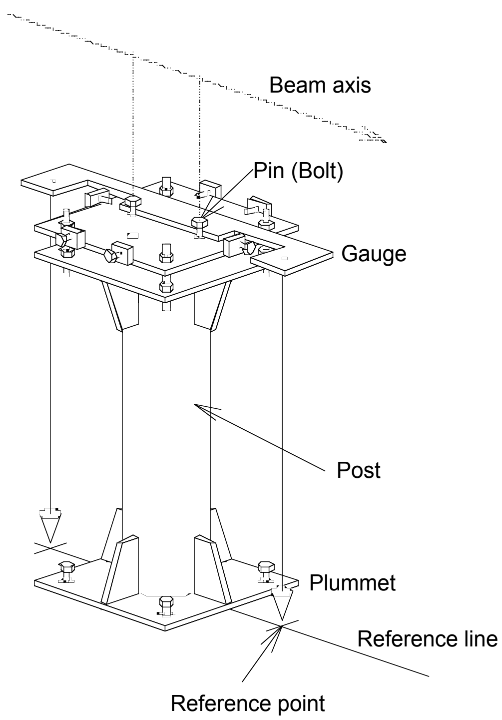

Figure 2. Alignment of the post "BL-TC-PST1" using alignment gauge with plummets.

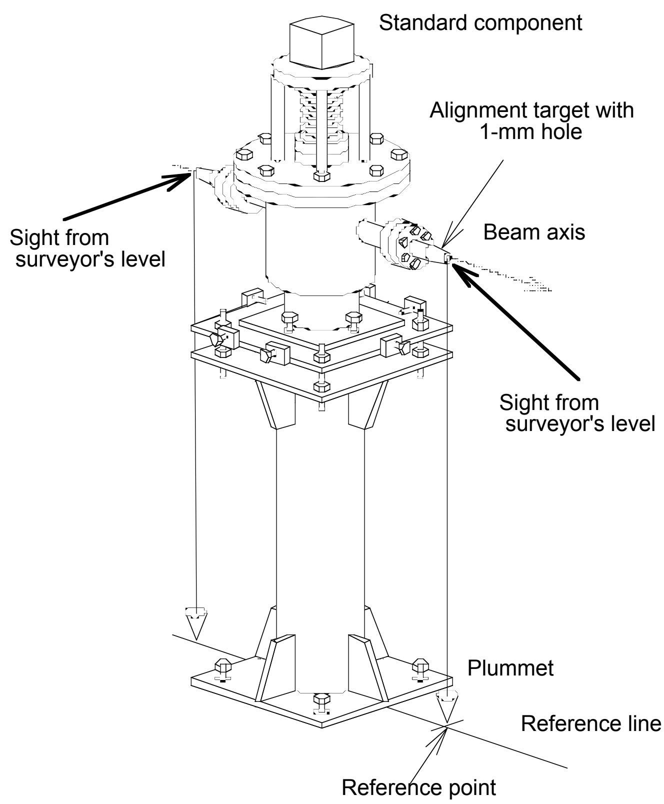

Figure 3. Alignment of the standard component using plummets and surveyor's levels.