

EXAMINATION OF CAD COORDINATED INSTRUCTION SYSTEM FOR MARKING POINTS IN TUNNEL

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ABSTRACT

Various ventilation facilities are installed in a tunnel ceiling side. However, ventilation facilities are not installed only by moving. Therefore, constructor drive screws which were called anchor bolt before the establishment of ventilation facilities into ceiling side of tunnel. And record of marking points to ceiling side are performed before devoting itself with anchor bolt.

However, time and labor were needed by conventional work. Besides, in the same workshop place will be built multiple times by work process. Therefore record of the position of drive anchor bolts in a short time is requested. In this paper, the method to order direct the position to ceiling side of tunnel will be presented.

KEY WORDS

Three dimension, CAD, Marking Point, Measurement, Laser, Tunnel.

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1. INTRODUCTION

By stationary construction such as tunnel ventilation facilities or pump facilities, many large facilities and pipes are installed in the institution inside. In tunnel ventilation facilities included in stationary object, corner vanes are installed to reduce pressure loss of corner parts in tunnel. Furthermore, the plumbing and a cable tray are installed.

These facilities are fixed to a structure with anchor bolts which were embedded to completion structure. As for the embedding work of an anchor bolt, certification and record of embedding position to wall surface are performed. And perforation work to wall surface and embedding work of anchor bolts are performed.

As for the position certification on tunnel ceiling side, positions certification on bed side are performed, and positions on ceiling side are confirmed with pendulum or perpendicularity laser. At last, certification and record of anchor bolt positions are performed last.

Therefore rationalization of complicated work is demanded. Furthermore, marking work in short time is requested by circumstances of other work.

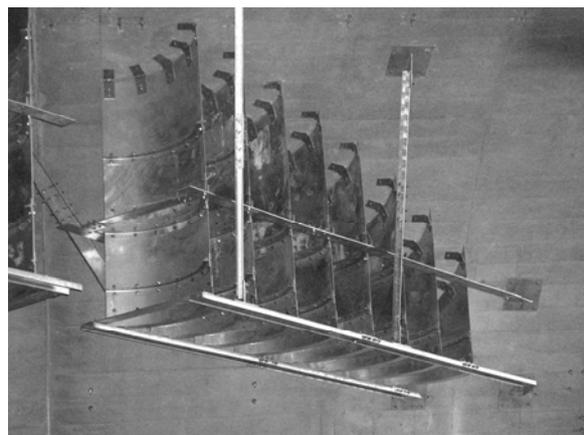
2. CONVENTIONAL RECORD METHOD OF ANCHOR BOLT POSITION AND PROBLEM

Fig.1 shows corner vane fixed state on ceiling side in circular tunnel. Much labor will be needed in conventional record method of anchor bolt position. Because, recording work at bed side was needed. Furthermore, there are a lot of problem. For example, bed side gets wet, or material is put right under a record position, and so on.

For problem of bed side, iron plate is spread to make the situation that bed side does not get wet. On the other hand, about problem of material, the material will be moved by manually. However, they becomes problems that both correspondence needs much time and labor. Therefore, method to instruct marking position of anchor bolt without the problems was examined in this paper.



(a) Whole View of Corner Vane
Fixed Situation



(b) Details of Corner Vane Fixed Situation

Fig.1 Corner Vane Fixed Situation



(c) Marking at Bed Side



(d) Marking at Sail Side

Fig.1 Corner Vane Fixed Situation

3. CAD COORDINATED INSTRUCTION SYSTEM

3.1 SYSTEM COMPOSITION

Method to irradiate point laser to record positions is thought about to solve the problem in foregoing paragraph. In other words, the record position appointed by CAD is instructed by using the motor driven total station which including a laser pointer.

By the way, current position recording is drawn on every wall surface and bed side as two-dimensional CAD information. Therefore, the record are performed in position relation without errors between CAD data and wall surface at structure.

However, instructions of the record positions that used three-dimensional measure are performed in one coordinate system. Therefore distance of walls from bed side to ceiling side is considered as three-dimensional position relations. In other words, when distance from bed side to ceiling is different from CAD information with wall surface at structure, record position of ceiling side will be ordered to wrong place.

Therefore, record position has to revise a difference occurring between CAD information and structure. In this paper, the record position instructions method that considered CAD information and difference of structure was examined.

For plan rationalization of record position instructions work, as well as marking position instructions, rationalization was planned about data making of record position. Therefore, the method to make information of record position with position relations of record position mentioned in CAD drawing was examined.

Details of development system based on described design is introduced in following section.

3.2 Marking Point Data Making

Record position data is made as CAD data with positions of installed machinery, information of structure and so on.

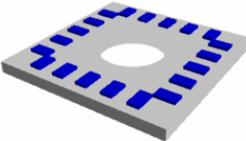
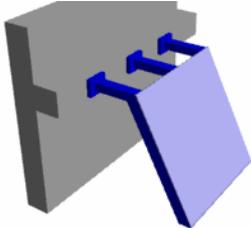
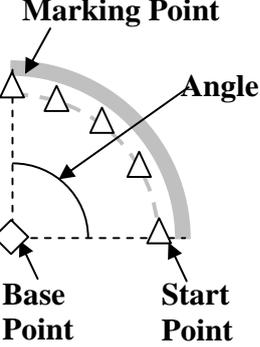
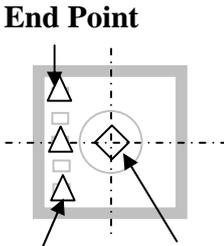
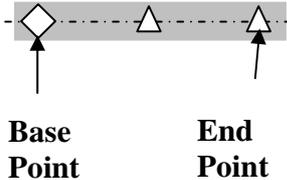
In this research, record positions are stated in CAD drawing as authorized symbol. And, three-dimensional information of the record positions are made with position relations in CAD drawing.

However, the coordinate origin of total station does not accord with the coordinate origin of CAD drawing on CAD drawing. About this problem, the machinery fixed on-site coordinate origin mentions it in a CAD drawing. Furthermore, I keep position relations of a symbol of a position recording the coordinate origin as a standard under control. As a result, a problem of the origin is solved.

When a corner vanes are installed to tunnel ceiling side, Several marking point symbols will be stated on arc. By this work, time and labor to grasp by position relations of record points become a problem.

A mention of a record point symbol is not only a corner vane. There are ventilation facilities to install in bed side, metal fittings for jet fans to install in tunnel ceiling side. To mention a record point symbol in a CAD drawing reasonably, the development system examined patterns of record point symbols to mention record point symbols in CAD drawing by minimum instructions. Table1 shows the sample patterns. Figure2 shows one of patternized record point symbols for cornervane. Mention work of symbols were shortened by 1/4 by patternizing record point.

Tab.1 Sample Patterns

Name Item	Corner Vane	Foundation Base	Board Installation
Shape			
Pattern			

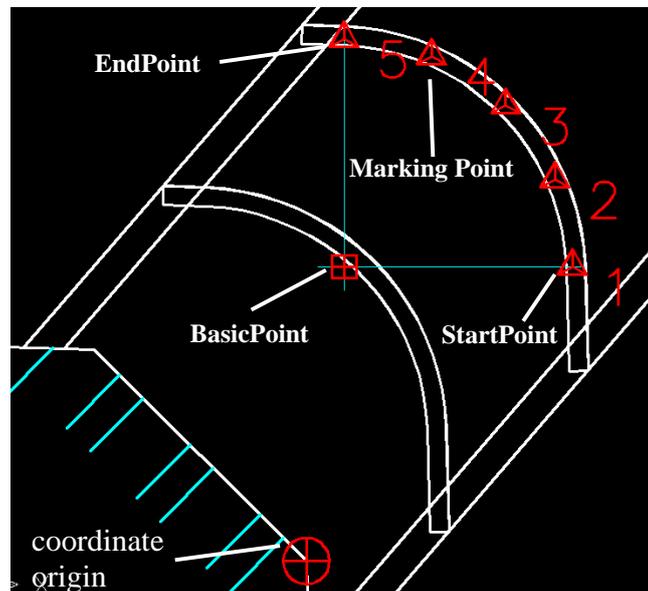


Fig.2 One of Patternized Marking Point Sysmbols for Cornervane

3.3 Instruction Method

When a difference occurs at a CAD drawing and a position of a structure, a revision of instructions position is necessary. In the case for ceiling side, the instructions position will be adjusted in the place where coordinate value on XY plane accords. Figure3 shows revision contents of instructions position.

On the other hand, motor drive total station turns automatically. And, the attention point is measured without measurement target by the total station. Furthermore, the attention point is pointed out with point laser of the total station. In this research, total station were used for instructions of the record point.

Furthermore, revision method of the instructions position that used last measurement result of the record position was examined. Figure4 shows revision method. By this method, calculation method of revision position is changed by the number of measurement points for effective revision.

As for the revision method of record position at figure 3, ceiling side becomes target. When a measurement result does not accord with CAD information by the first measurement, record point data will be adjusted with height of measurement result, and record point will be pointed out by adjusted data(Fig.4(a)).

As the result, the second revision will be performed when XY coordinate value does not accord. In second revision, slant condition of virtual shape will be grasped with two times of measurement results. And z-coordinate value of the place where a Y coordinate value accords with an X coordinate value will be calculated(Fig.4(b)). Afterwards, revision work same as the first will be performed.

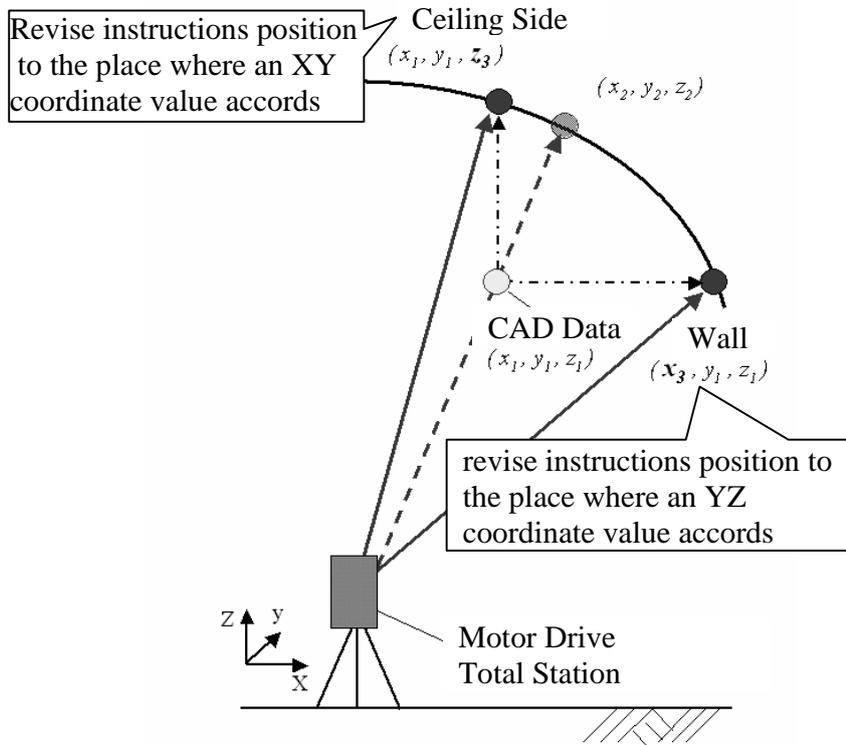
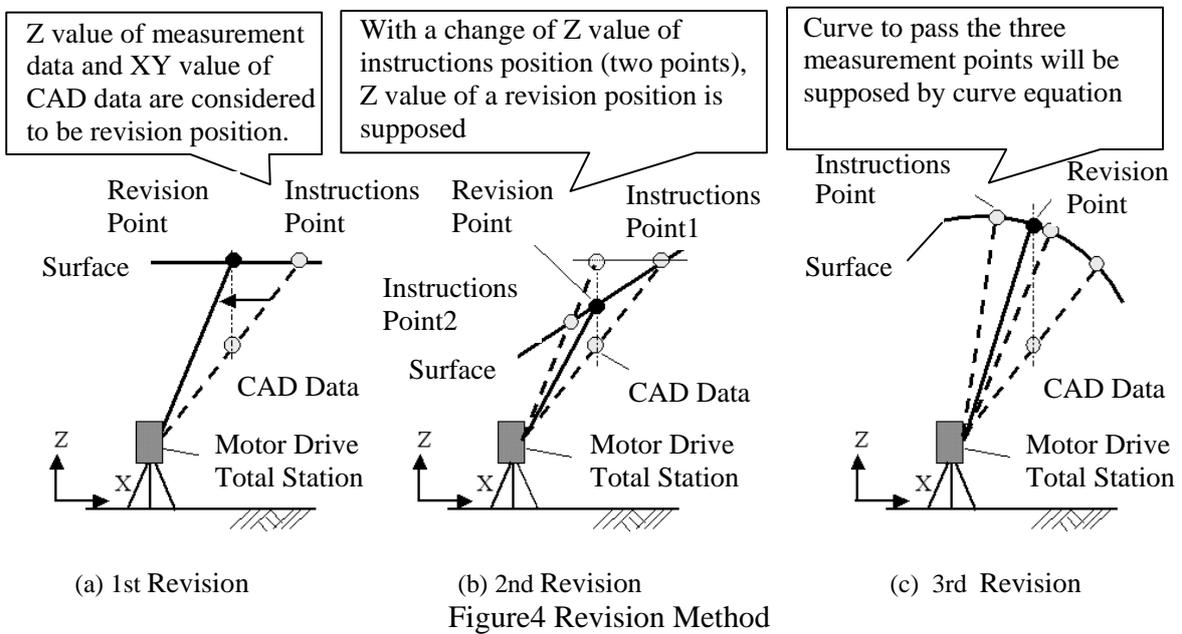


Fig.3 Revision Contents of Instructions Position



Afterwards, when instructions position does not accord, ceiling side will be judged as curved surface. For a revision, the second curve to pass three times of measurement results will be supposed by curve equation(Fig.4(c)). Afterwards, revision work same as the first will be performed.

However, there is the case that instructions position does not accord by a conventional method either. By revision work of afterward, the third revision work is repeated. In addition, by explanation of a conventional revision method, intend for it on a ceiling side. However, in the case of a wall surface, a revision of the instructions position that changed a revision standard is performed. The development system appoints revision standard before instructions.

4. Instruction Result

4.1 Instruction at Plane

By a development system, difference of CAD drawing and structure are considered in revision of the instructions(Fig.5). Therefore, the revision situation when plane height was changed was confirmed. As a result, the revision of instructions position was completed in about 25 seconds. As for one measurement, 10-15 seconds are usually needed. Therefore, revision instructions was judged as normal.

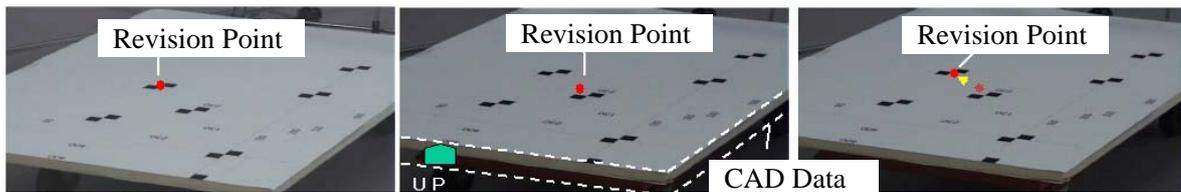


Fig.5 Instructions Situation at Flat Plane

4.2 Instruction at Curved Surface

In development system, revision method will be changed by the measurement times. To confirm the effectiveness, instructions of the record position that assumed ceiling side of a circular tunnel (a model of a radius of 7,000 mm) were performed.

As a result, when the first revision was repeated, more than 3 minutes were needed. On the other hand, instructions of a record position by by development system were completed in about 40 seconds. When radius of model was changed, similar result was confirmed. The effectiveness of a development system was identified by the result.

5. Conclusion

The instructions precision was confirmed by measuring two points distance using staff.

- + Automatically grasp method of record point position in CAD Drawing was established.
- + By patternizing record points at CAD drawing, data making work of record point was shortened to about 1/4.
- + The record point instructions method was established.
- + Revision method of the instructions position that used last measurement result of the record position was established.

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