

## Construction Support System for Management and Inspection Using Digital Image Analysis and Network System

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Commission V, Working Group 2

**KEY WORDS:** Photogrammetry system, Network, Database

### ABSTRACT

We report to here because we developed the system that to use the data of the picture which the photograph was taken in the construction site to inspect and to use a network can make to measure an inspection object by being remote. In this system, we forward picture data to the database server by the network that used the Internet, and we share it with the orderer among the constructor. Also, with that we compute in the analysis to the picture data which the photograph took an inspection object by already developing "the photograph analysis system of 2 dimensions", it is possible to measure on the screen of the computer. We place this system with the element system for the construction CALS to have attempted to efficient-ize a management job and also to have had a purpose of sharing in real time of the data about the construction.

### 1. INTRODUCTION

These days, including the spread of the Internet, the technique of the advanced information communication is introduced about the construction business, too, and in the part, coming to practical use is accomplished. Also, the environment for the network introduction by the

business, too, is ready rapidly. The decline of the price of the equipment about the computer, the peripheral and the LAN as the factor, and then, the appearance of the OS of the network correspondence and so on are given. We are carrying forward the studies and development of some element systems for the origin of such a background, "the rationalization of the construction

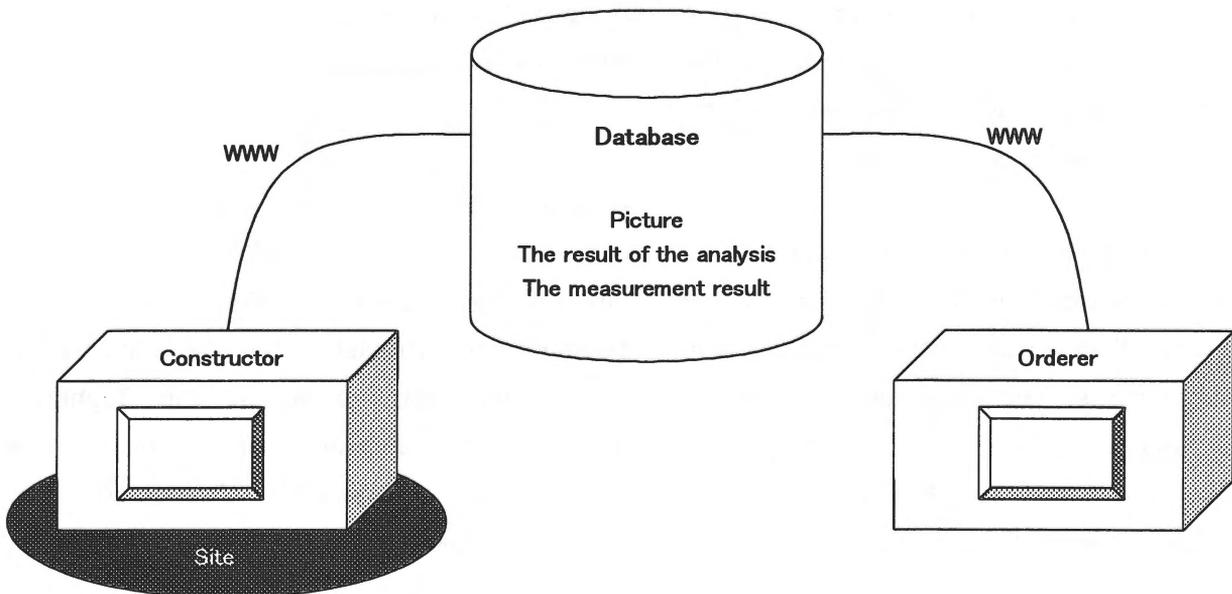


Figure 1 The composition of the system

management", "the securing of quality by the advanced quality control technique". Above all, construction management about the earthwork is classified into the process control, the result form management, the quality control, the cost control. In it, the result form management, the quality control are important work to secure a process and a quality standard, too. Also, there are many points that are common to the supervision and the inspection what the orderer implements in the item of the construction management. In such meaning, it is possible to say that the rationalization of the management job of the constructor connects with the rationalization of the supervision and the inspection on the orderer, too. This time, we report because we forwarded the picture which the photograph was taken by the digital camera in the site through the Internet and built the system where to measure by being remote using the data is made.

## 2.OVERVIEW OF THE SYSTEM

### 2.1 Overview of the System

In this system, we are using "the photograph analysis software of 2 dimensions" which we are developing already. In this system, we analyze the picture which the photograph was taken in the construction site by "the photograph analysis software of 2 dimensions" and we register for the database server through the Internet after that. The supervisor downloads the picture data and the data that is necessary for the measurement from the database server. Then, by "the photograph analysis software of 2 dimensions", they open the data file. Based on the picture that is reflected on the screen of the computer, we measure by this software to inspect.

### 2.2 Work Procedure of the System

The work procedure of this system is shown below.

- 1) We install a control point on the plane that is dealt with for the inspection in the construction site. The control point is the point that is necessary for the analysis computation. As for each control point, the 2-dimension coordinate value must be beforehand found. Doing four minimum control points must be established for the analysis with once.
- 2) Always, for the control point to seem, we the photograph take a measurement object by the digital camera.
- 3) We take in the picture data that the photograph was taken at the computer and we preserve data.
- 4) By "the photograph analysis software of 2 dimensions", we open a picture file.
- 5) On the picture that was displayed in the screen of the computer, we specify a position with control point. At this time, we input by the coordinate value with each control point.

6) We compute in the analysis.

7) We forward the data of the picture and the result of the analysis computation to the database server through the Internet and we register data.

8) The supervisor measures an inspection object using "the photograph analysis software of 2 dimensions" based on the data that he downloads picture data at the inspection part from the database server.

9) The supervisor measures by tracing the part to want to measure on the picture data of the measurement object that is reflected on the screen of the computer. At this time, we can measure a distance among two and length and area around the surrounded part. We check an inspection item by this measurement.

10) We preserve these measurement results as the data.

11) If necessary, the data that did a sketch on the picture can be output as the plan. Also, because this sketch data can be output as the data of the CAD, too, the drawing can be made with the plotter, too.

12) Finally, the data of the forwarded picture, the result and the measurement result of the analysis computation are preserved in the database and the constructor, the supervisor can be referred to.

### 2.3. Characteristic and Function

By using "the photograph analysis software of 2 dimensions" in this system, the inspection object can be measured from the remote location. Also, by accumulating these data to the database using the network, each relation person can be freely referred to. In addition to this, we refer to the construction management criteria from the Internet, we examine a measurement result and the management table can be made.

## 3. APPLICATION CASE

By using this system, the photograph we take the arrangement situation of the reinforcing rod and show a measuring case.

### 3.1 Establishment of the Control point



Photo 1 Establishment of the control point

First, we install a control point on the plane that is dealt with for the inspection. This time, we installed the square frame that measures a size beforehand on the inspection object surface and we used the four corners of this frame as the control point. (Photo 1)

### 3.2 Photography of the Inspection Part

For all control points to seem, the photograph we took a measurement object by the digital camera. As for the digital camera that was used this time, the resolution is



Photo 2 Photography situation

the digital camera of 890,000 picture elements. (Photo 2)

### 3.3 Analysis of the Picture Data

We took in the picture data that the photograph was taken by the digital camera at the computer at the site office. After this, we computed in the analysis by "the photograph analysis software of 2 dimensions". First, we



Figure 2 Analysis of the picture data

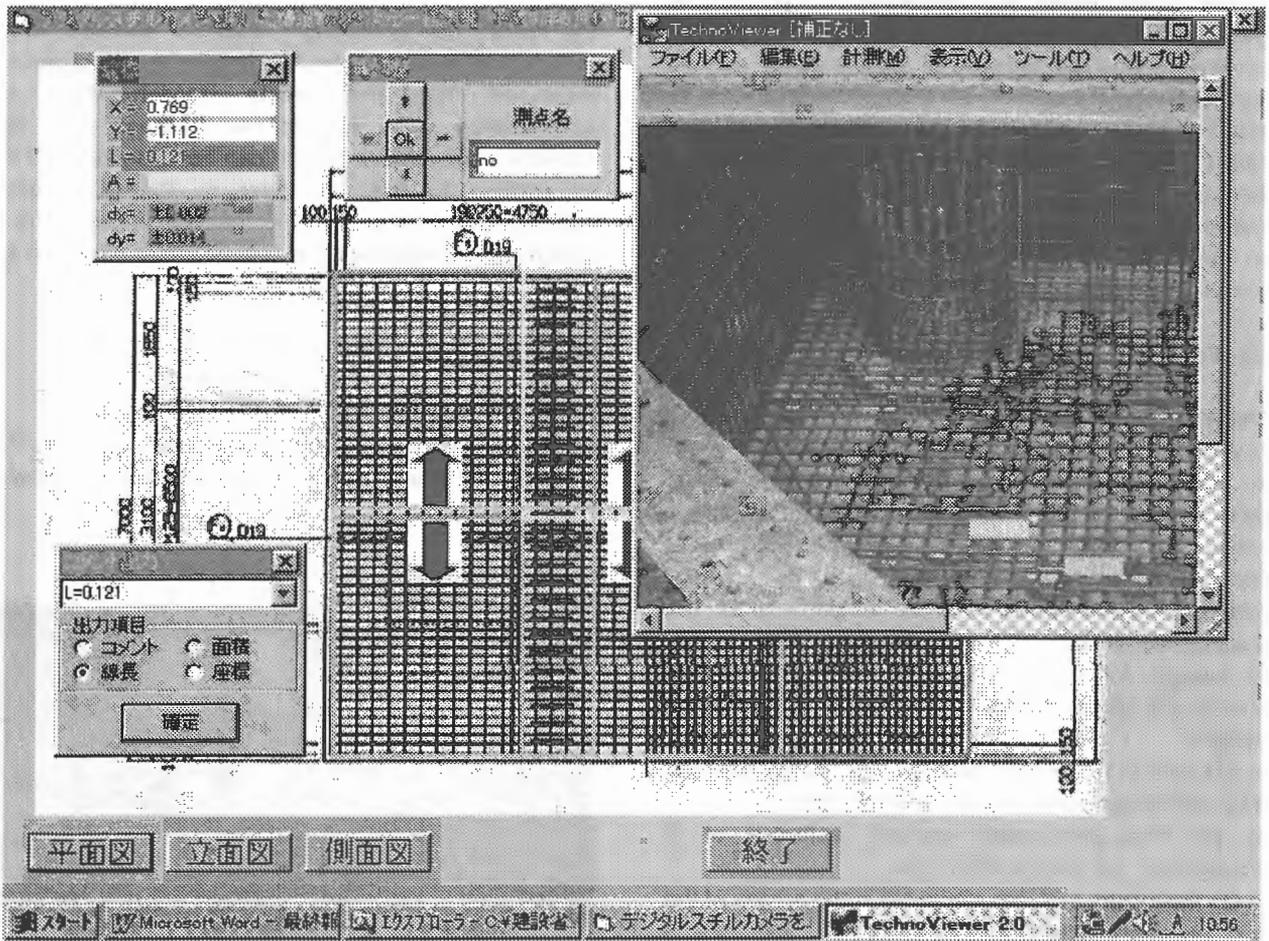


Figure 3 Inspection on the computer screen

display picture data on the screen of the computer, and we click and we specify a position with the control point that was installed on the plane to measure. Next, we input a coordinate value with control point. This time, because one was using the square frame of 71.8 cm as the control point, we inputted (0,0), (0.718,0), (0.718, 0.718), (0,0.718) in order. After ending this work, we execute analysis computation. Next, we connected a computer at the site office to the database server using the Internet. Then, we registered the picture data that ended analysis computation after registering a basic item and the data of the analysis result on the database server.(Figure 2)

### **3.4 Inspection on the Computer Screen**

When opening the starting file of the system for the inspection, a drawing like figure 3 is displayed. When clicking the part that implements an inspection on this drawing, "the photograph analysis software of 2 dimensions" displays a picture at the part. The interval can be measured with clicking the interval of the reinforcing rods on this picture and specifying a measurement part. Because a measurement result is separately preserved as the measurement data, once again, when inspecting the same part, the inspection result in the past can be referred to.

## **4. PROBLEM OF THE SYSTEM**

### **4.1 The Picture Photography in the Construction Site**

As the problem of this system, the following point is given. The fundamental problem of this system is a fact of "it isn't possible to measure when the picture photography isn't possible". This time, there was a place that can not take a photograph in the site that inspected in the interval of the installation of the reinforcing rod, too. It is the following point that is made the reason. First, in the relation of the space in the construction site, it hasn't been possible to secure a photography point. Then, because a measurement object had been concealed by the existence of the obstacle, we are that the picture could not the photograph be taken.

### **4.2 Picture Data Transfer by the Use of the Network**

To make the style that can inspect at the part of the mind, the whole area of the inspection object must the photograph be taken. Therefore, the number of the picture to take the photograph has increased. In the present situation, the form of the picture data to be using is a compressed format, the JPEG, and the telephone

circuit is using an ISDN but must spend very a lot of time on this work when the number of the picture data to forward has increased.

## **5. CONCLUSION**

This system is the system that to use the picture data, sharing picture data in the construction site using the network and the database server that used an Internet can make to do measurement and a sketch for the investigation by being remote. By this system, we think that the efficient-ization of some degree, the management and measurement business and the data became able to be shared in real time. In the future, we are the idea to strengthen the network correspondence function of this system and to attempt the more efficient-ization of the business.