

Information Sharing System for Structural Steel Experiments under the Distributed Collaboration Environment

Yoshito Itoh¹, Hiroshi Wazaki², and Takahiro Ishiyama³

ABSTRACT: Sharing of experimental data on Internet can assist researchers and engineers to conduct their works. Many studies on structural steel experiment database have been undertaken, but it was difficult to add data constantly, since conventional databases forced the database manager to collect experiment information. This research aims to develop the system which shares the experiment information from wide range of fields. It allows each institution to release the data under the distributed collaboration environment containing a metadata server following the Dublin Core. Accessing only a metadata server, the users are able to retrieve those data stored at the other servers.

KEYWORD: Dublin Core, XML, www, experimental database, steel seismic test

1. INTRODUCTION

In recent years, a lot of scientific information databases on the Internet have been built for sharing of research information [1]. In the structural steel experiment database developed in the past, the administrator of the database had to collect and store the experiment data into a server. The problems on the waste of the time for management and the worry about copyright infringement made continuous addition of data difficult. In order to realize efficient sharing of information resources, the distributed collaboration type system which researchers can release data positively is necessary.

This research aims at developing the database system that promotes a share of structural steel experiment information on strengths of members and results of seismic test. Firstly, the unification standard for searching the experiment data released under the distributed environment is created to deal with experiment information systematically. Secondly, the application system programs are developed using XML, VBscript and Java, which realizes the share of experiment data based on the format and that supports novice researchers and engineers. Thirdly, the metadata information of experiment data, which will be the significant part of distributed collaboration database, is established and installed onto the metadata server.

¹ Center for Integrated Research in Science and Engineering, Nagoya University, Japan, Professor.

² TIS Inc., Japan, Informatics Engineer.

³ Department of Civil Engineering, Nagoya University, Japan, Graduate Student.

2. DESIGN OF SYSTEM

2.1 Distributed collaboration database

The distributed collaboration database system for realizing the share of the experiment data has been developed, in which each researcher releases his/her own experimental data on his/her server. Under the distributed collaboration system, users can refer all of data through accessing to the central metadata server. There are the following advantages in the system. (1) The burden of network and server load is less than those of ordinary databases. (2) The trouble occurred at the server side is avoidable to some extent. (3) The whereabouts of responsibility are clear because of the self-responsibility of researchers. Moreover, the released range of experiment data can be left to discretion of each experiment researcher. (4) When data have changed, each researcher can easily update the data at his/her own server.

2.2 The system architecture

In the system, original experiment data are released and managed by experiment researchers, not by the administrator of the central database server. The role of the system administrator in Nagoya University is not collecting and releasing data, but management of the metadata saved as the properties and the locations etc. of data. This method enables users to deal with the distributed data systematically. To the above roles, the system has the architecture shown in Fig.1. In this research, a central metadata server and Web interface, which supports researchers developed original experiment data, are developed. Metadata applied to the structural steel experiment is created following a standard of the Dublin Core. The details of the Dublin Core are described in next chapter. XML (eXtensible Markup Language) is used to describe the metadata.

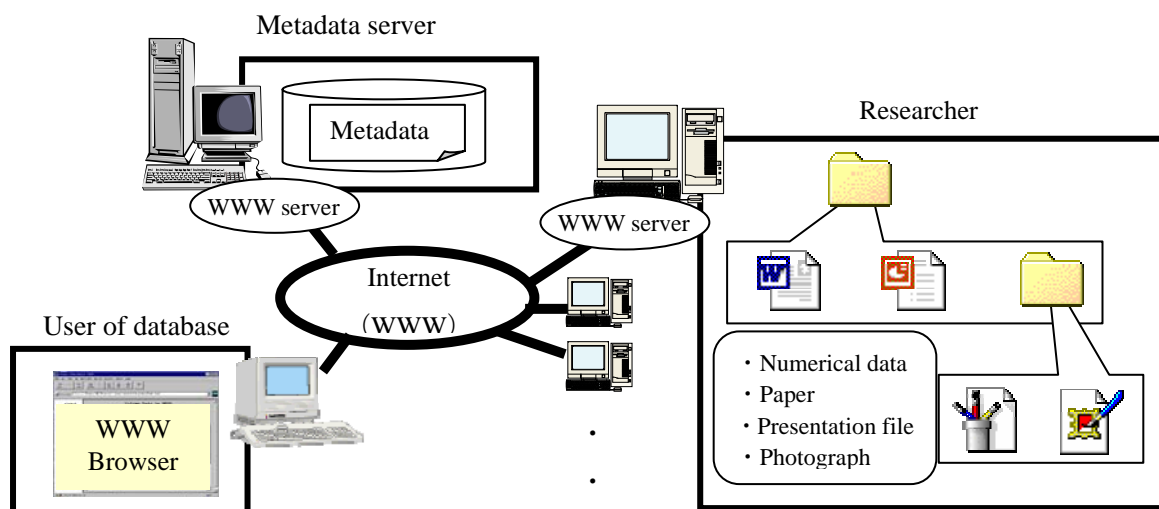


Figure 1. The outline of the system

3 EXPERIMENT INFORMATION METADATA

The Dublin Core (the Dublin Core Metadata Element Set [3]) is advocated by standardization activities of the metadata on WWW, and has been used originally in the field of natural history. The fundamental purpose of the Dublin Core is to make easy to retrieve the information resources on the Web. In the Dublin Core, 15 items of metadata are defined for the improvement of the retrieval efficiency on the Web.

In the system developed in this research, the metadata server which manages the metadata of the experiment data shown in Table 1 plays a main role. Most of items in Table 1 are following a standard of the Dublin Core. Some items are modified and several sub-elements are added for dealing with experiment information. Explanations on each items in Table 1 follow:

- (1) Language: The language that is described the outline of information resources.
- (2) Title: The title of experiment.
- (3) Creator: The person or organization who has responsibility about the contents of information resources. In this research, an attribute, name and E-mail address are added as the sub-elements of this item.
- (4) Publisher: The person who made information resources the present form. In this research, 3 sub-elements are added.
- (5) Contributor: The person or organization in connection with [although it was not an author] the contents of a document. In this research, 3 sub-elements are added.
- (6) Date: The date that can be used in the present form. For example, the year of experiment data released.
- (7) Subject: The topic stated to information resources such as procedures of experiment.
- (8) Specimen: Information about specimen. This item has 3 sub-elements: Name (Name or number of specimen), Type (The model of specimen), and Description (Supplementary explanation).

Table 1. The contents of experiment metadata

Item		Contents
Language		Language for Description
Title		Title of experiment
Creator	Attribute	Affiliation
	Name	Name
	E-mail	E-mail address
Contributor	Attribute	Affiliation
	Name	Name
	E-mail	E-mail address
Publisher	Attribute	Affiliation
	Name	Name
	E-mail	E-mail address
Date		Year of experiment
Subject		The technique of an experiment
Specimen	Name	Name or number of specimen
	Type	The model of specimen
	Description	Supplementary explanation
Relation		Quoted reference
Description		Supplementary explanation
Right		The whereabouts of copyright
Data	Type	The contents of data (Photograph, paper, etc.)
	Format	Format of a file
	URL	URL stored data
Identifier		Registration reference number
Type		(Experiment data)
Source		The source of metadata
Coverage		(Empty)

Specimen item is not original element following the Dublin Core, added newly in the research.

- (9) Relation: Correlation with other information resources.
- (10) Description: Description about the contents of an outline, image data, etc.
- (11) Right: The links to the description about rights, such as copyright description or the description about use conditions.
- (12) Data: Information about experiment results. This item has 3 sub-elements: Type (Contents of data), Format (Format of a file), URL (URL stored data). Data item is not original element following the Dublin Core, added newly in the research. The system of the metadata server stores numerical data in Data item, such as height of column, width of flange plates, yield stress, yield moment, etc.
- (13) Identifier: The number or name for discriminating information resources uniquely.
- (14) Type: information resources like WebPages, dictionaries, and etc. This item is "Experiment data" in this research.
- (15) Source: The number or character string which shows the source of information resources.
- (16) Coverage: The characteristic of the information resources about a geographical place or the time contents. This item is empty, because suitable information doesn't exist in experiment data information. The Dublin Core allows empty in some items.

4 THE OUTLINE OF SYSTEM

4.1 The function of system

The functions prepared in the system are: (1) Search of experiment metadata, (2) Registration and correction of experiment metadata, (3) Perusal of experiment data with figures, (4) Download of experiment data, and (5) User's registration and attestation. Each function of the system in detail is described as follows.

a) User's registration

Researchers firstly have to register their name to install their own experiment metadata to the system. This is for preventing a general user from registering unrelated information. Researchers can get the password for login through registering personal information.

b) Registration, modification, and addition of metadata

Logging in to the system attains the registration of experiment metadata. In the system, the numerical data of experiments can be registered from Web. The original experiment data have been collected and maintained at the researcher sides. The numerical data registered here is used as one key in the case of searching of data. When the registered contents need to be modified, the researchers can revise and add the contents.

c) Searching of experiment information

Two kinds of searching method of experiment data are prepared. One is the simple search which

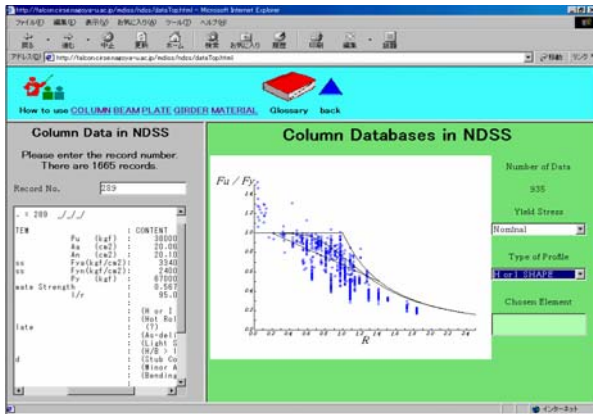


Figure 2. Experiment data
(Strength of steel columns)

can be quickly performed from a top page, and another is the detailed search. In the simple searching, required information can be searched with a single keyword. In detailed search, it can be searched with plural keywords and items more than those of simple searching are prepared. After searching, perusing and downloading the experiment results are possible with tracing links.

d) The usage of system

Since the system is WWW-base, only Web browser is needed to use the system. Netscape Navigator over 3.0 version of Netscape Communications or Internet Explorer over 3.0 version of Microsoft is available and anyone can use the system from

<http://neptune.cirse.nagoya-u.ac.jp/xdiss/english/index.html>

Since the system is linked to MDISS(A database of load carrying capacity experiments in Nagoya University [2]), users can get the data on these experiments. The example of a display is shown in Fig.2. Additionally, the metadata of a seismic experiment have been transferred into XML and inputted into the database. The example of a numerical data display of specimen data and experiment results is shown in Fig.3.

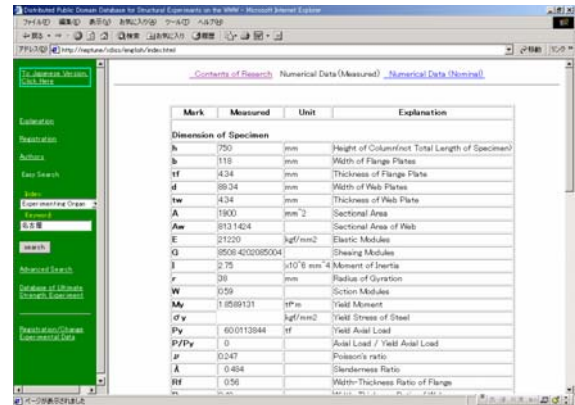


Figure 3. Detailed numerical data

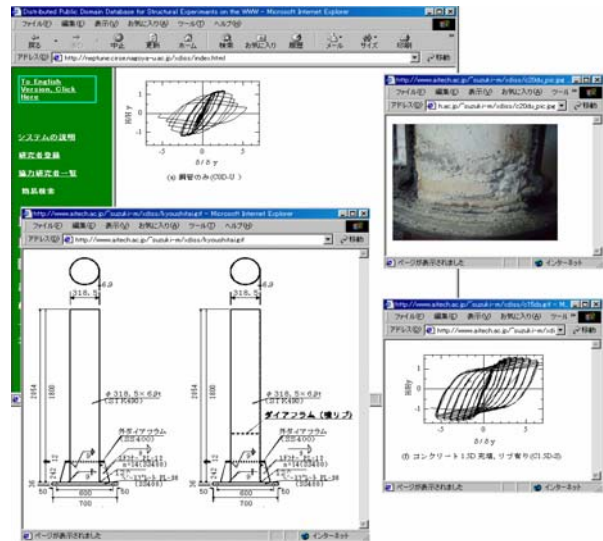


Figure 4. External installation data
(Seismic test data of piers)

Table 2. Stored experiment data

(a) Load carrying capacity test

Form of specimen	Number of specimen
Column	166
Beam	544
Plate	739
Total	1449

(b) Seismic test (Steel pier)

Kind of experiment	Number of specimen
Cyclic test	293(7)
Hybrid test	145
Total	438(7)

4.2 Distributed collaboration database server

This database is designed as a distributed collaboration database which researchers can install original experiment data in their own servers. In order to check the performance of the distributed database and metadata, it was necessary to prepare data installed in the servers in an external network out of Nagoya University. The metadata about seismic experiment of the concrete-filled steel pier in the server of Aichi Institute of Technology was registered into the database server of Nagoya University. Using the system, it was confirmed that the distributed data were retrieved appropriately. Fig.4 shows the data retrieved from the server in Aichi Institute of Technology. The numbers of items that are stored in the system are shown in Table 2. The number in a parenthesis shows the number of registered data in the network outside Nagoya University.

5 CONCLUSIONS

In this research, the distributed collaboration database system has been developed, which aimed at the share of structural steel experiment information. The conclusions of this research are obtained as follows.

- (1) The distributed collaboration system releasing the structural steel experimental data has been developed.
- (2) The Dublin Core, the standard of metadata, is applied in the system to deal with the structural steel experiment data. XML is used for description of metadata of the structural experiment results.
- (3) The good performance and advantage of the distributed collaboration database were confirmed, using the registered experiment metadata in the external network out of Nagoya University.

The followings are future issues required.

- (1) The system should be revised by enriching GUI (Graphical User Interface) to make operation of the system easier for novice researchers and engineers who are not so skill in information technology.
- (2) A function that graphically shows the statistics of the all registered data should be enabled.

REFERENCES

- [1] The Human Gene Mutation Database at the Institute of Medical Genetics in Cardiff <http://archive.uwcm.ac.uk/uwcm/mg/hgmd0.html>.
- [2] Hiroshi Wazaki, and Yoshito Itoh, "Multimedia Database Using Java on Internet for Steel Structures", Light-Weight Steel and Aluminum Structures ICSAS'99, 1999, pp.377-384.
- [3] The Dublin Core Metadata Initiative, <http://purl.oclc.org/dc/>.