DEVELOPMENT OF THE CAFM SYSTEM FOR LIFE CYCLE MANAGEMENT

SADAYUKI SHIMODA, KAZUHISA IKI*, NAOYA KUMADAKI*,
and YUSUKE TAKEGAWA*
Department of Civil Engineering and Architecture
Yatsushiro National College of Technology
Hirayama-shinmachi 2627,Yatsushiro City, Kumamoto, Japan 866-8501
**Department of Architecture and Civil Engineering*
Faculty of Engineering, Kumamoto University
Kurokami 2-39-1,Kumamoto City, Japan 860-8555

Abstract. The purpose of this research is to develop the CAFM system that supports the cost management related to the building maintenance. Furthermore, we examine the possible implementation of CAFM as the supporting tools of medium-long term planning and fiscal year planning of the Facility Management. The function of the building-maintenance-system-oriented-Life-Cycle Cost (LCC)-supporting CAFM system is the feasibility of reference with the relating information database, which are later used for comparative analysis. The following is a detailed explanation of its functions:1) Outlined data display function of the building parts and materials. 2) 3-dimensional CAD models management. 3) LCC display function of building parts and materials. 4) Search function. This system supports the development of an efficient maintenance planning, and an efficient undertaking of the maintenance program. The concrete effects are as follow, (1) Cost-efficient building maintenance planning. (2) Building value increased by appropriate budget planning of maintenance. (3) Processing load and time are shortened. (4) Human mistakes are decreased.

1. Background and purpose of study

The present Japanese society is facing the era of the low growth after the ending of her bubble economy and building is once again considered as an valuable asset. To prolong the longevity of this valuable asset, the development of the CAFM system for Life Cycle Management (LCM) proposed in this paper, is becoming necessary. The use of computer makes possible the effective selection of relevant information from the voluminous data for the exact judgement by the relevant manager.

CAFM system is composed of a number of application tools which supports the Facility Management (FM), based on a digitized database. Considering the above social needs, we proposed a CAFM system to support the maintenance-related-cost-management of buildings. In this paper, we had also examined the possible implementation of CAFM as a supportive tool for the medium-long term planning and the fiscal year planning of the above mentioned

building management and maintenance. This research is based the network-oriented CAFM functions we developed last year.

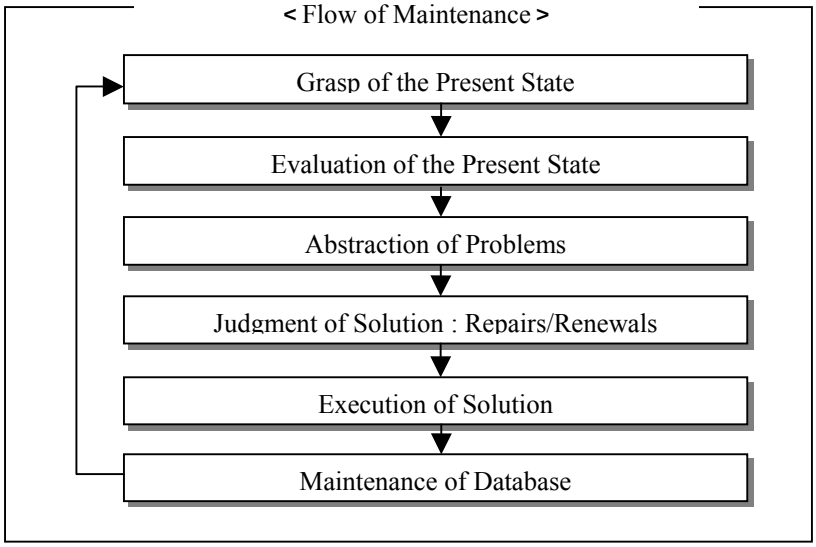


Figure 1. Operation-stage-maintenance Cycle

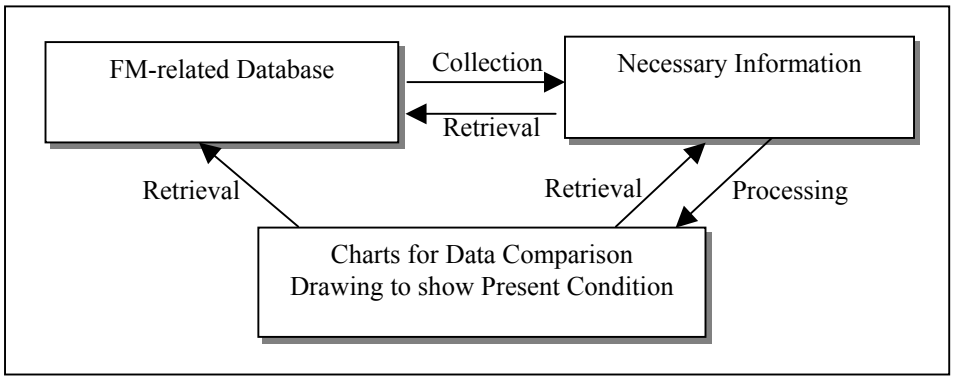


Figure 2. Maintenance Process

2. Fundamental thought of the CAFM system for LCM

2.1. FUNCTIONS REQUIRED

The operation-stage-maintenance cycle is shown in Figure 1. The maintenance

process established in this research is shown in Figure 2. Firstly, relevant information are to be collected and calculated for later grasp and evaluation of present state. Processing and editing work such as comparison and co-relating of data obtained, the calculation of evaluation standards, and the production of respective tables and charts, etc are then to be undertaken. Edited data are to be analyzed with the raw information and the relating information collected. The above procedures (collection, processing and editing of the information) are to be repeated until a final problem factor is obtained.

The above cycle of grasp and evaluation of present state, processing and editing of information, etc., is of great importance during the operation stage. It should be repeated smoothly for the later drafting of medium-long term planning and fiscal year planning.

Functions that support building cost management and maintenance are required in the CAFM system mentioned above. It is important to enable the possible reference of relating database for later comparative analysis.

The following is a detailed explanation of its functions.

1) Display Function of Summarized Data of Building Parts and Materials

Relevant data of every single building parts and materials are needed for their respective maintenance. Furthermore, functions enabling data display without the need of time-consuming file-opening are necessary.

2) Use of 3-D CAD models

Since 3-D CAD model can cope with the voluminous, and in the same time informational data of every single building parts and materials, it is adopted for this system. 3-D CAD model enables the visual expression of parts (not possible in 2-D models) used for visual confirmation of building parts and materials (such as material of the ceiling and piping etc.) before judgment of applicable solution for the repairs and renewals.

3) LCC display function of the building parts and materials

To reduce LCC, cost of every single building parts and materials are under consideration. As a result software supporting alternative drafting of a medium-long term planning is indispensable. In addition, for the grasp and comparison of life cycle of building parts and materials, exporting function to spreadsheet software is necessary.

4) Search Function

Search function that enables easy reference of relevant data is important for the confirmation of the medium-long term planning and fiscal year planning.

The following is the items in concern.

1) Large Division : Structure, Building Exterior, Equipment & Devices, …etc.
2) Medium Division : Roof Furnishings, Structure, Indoor Floorings, ...etc.
3) Building Parts and Material Used: Furnishings, Equipment & Devices, …etc.
4) Latest Renewal Fiscal Year
5) Latest Repair Fiscal Year
6) Day of Proposed Renewals
7) Day of Proposed Repairs

2.2. CALCULATION METHOD OF LCC

LC Evaluation, used for cost evaluation of LC planning stage, is used for prediction of economic efficiency of buildings. In this CAFM system, economic efficiency for every single parts and materials are evaluated. Present Value Method is used for calculations of repairs and renewals expenses.

The calculation method is as follows.

① Calculation Method of Repair Costs

<The constants> Data use for detailed calculation
<The variable> Quantity (such as area, length, the number), Price Variation Rate, Calculation Interest Rate, Repair period

Present Value of Repair Costs = Data use for detailed calculation×Quantity

Repair Costs of Present Value =

Present Value of Repair Costs×Periodic Present Value Factor

② Calculation Method of the Renewal Expense

<The constants> Data use for detailed calculation
<The variable> Quantity (such as area, length, the number), Price Variation Rate, Calculation Interest Rate, Renewal Period

Present Value of the Renewal Costs= Data use for detailed calculation×Quantity

Renewal Costs of Present Value =

Present Value of Renewal Costs×Periodic Present Value Factor

2.3. SYSTEM OPERATION EXAMPLE

2.3.1. System Constitution

The system we developed is composed of the following applications.

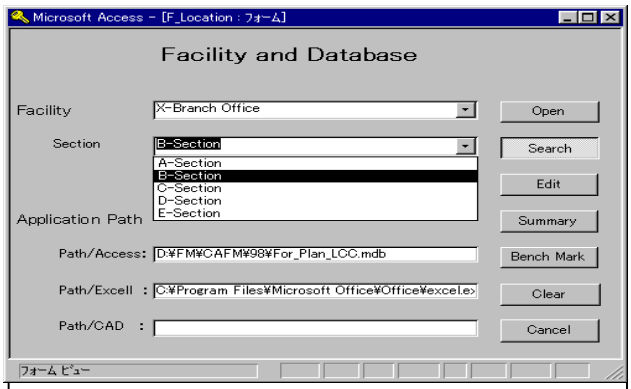
Operating system: Microsoft WindowsNT Version4.0
CAD: AutoCAD Release13J for Windows
Database Management System: Microsoft Access97 for Windows
Spreadsheet: Microsoft Excel97 for Windows

GUI: Visual Basic for Application

2.3.2. CAFM System Operation Procedure

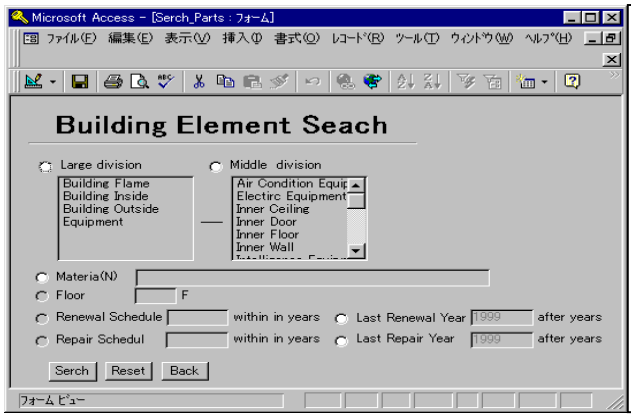
The following is an operation example.

To confirm the present state, we start with searching the parts and materials. Then we locate them on a 3-D CAD Model. The same procedure is used also in the maintenance of building parts and materials. Expensed for repairs and renewals are

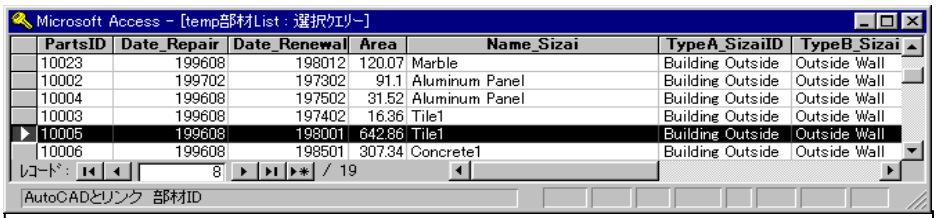


① Click when the required database is selected.

② The CAFM system starts. Click the "Parts/ Materials" button and the search function starts.



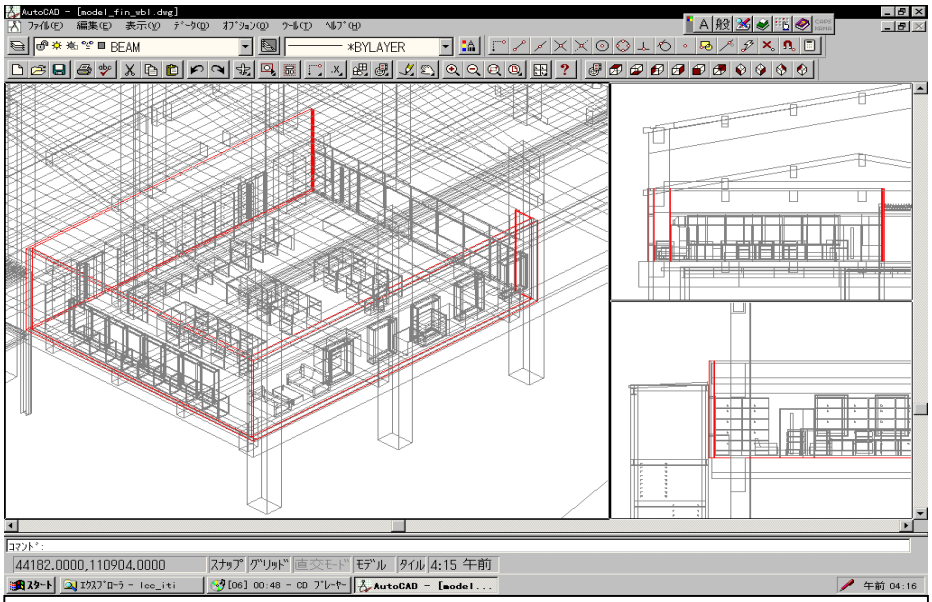
③ In put Data under consideration.



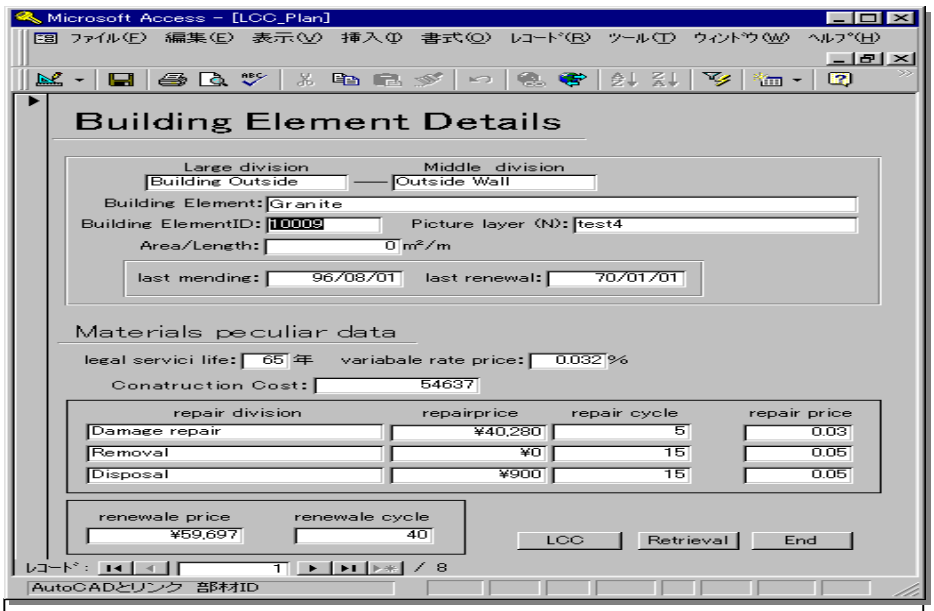
④ Record of building parts and materials that meets the required conditions is labeled.

calculated for drafting and preparation of a building maintenance plan. The above procedures are shown in Figure 3, Figure 4, & Figure 5.

Figure 3. System Operation Example (1)



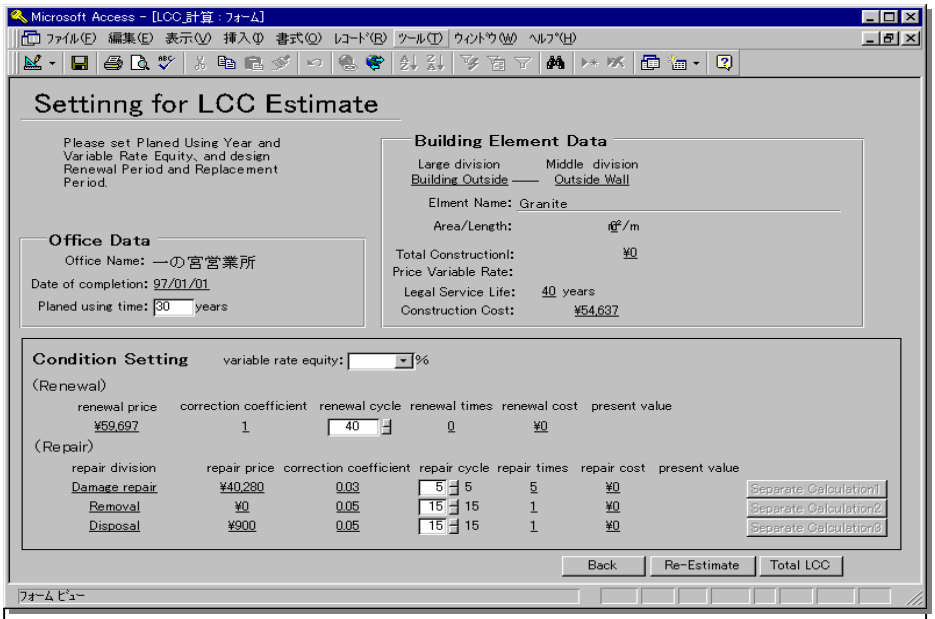
⑤ Location is confirmed with a 3-D CAD model, selected building parts and materials are highlighted. Present state is display on selecting the above building parts and the building parts are labeled



⑥ The detailed data of the object selected are displayed.

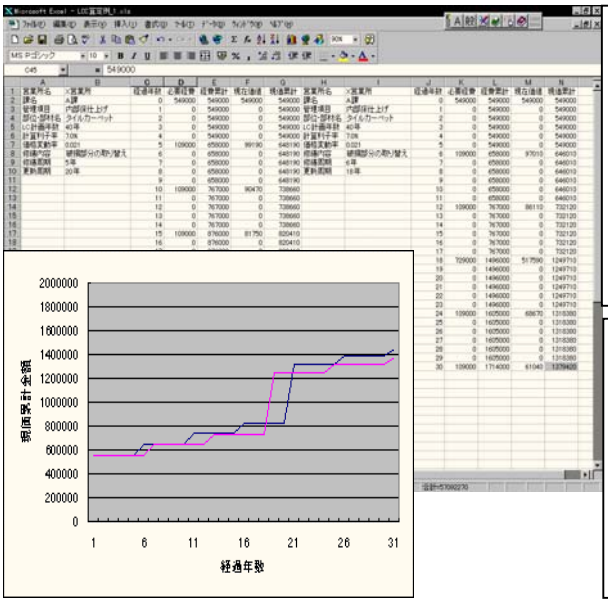
In this case, we try the LCC calculation. Click " LCC ".

Figure 4. System Operation Example (2)



⑦ In LCC calculation, specified values are input and the discrepancy can be observed from the estimation

⑧ Calculation starts on completion of data input, and the results are exported to a spreadsheet software automatically. Same procedures are used for building parts and materials



⑨ Drafting projects are evaluated by comparison of period and interest rate by similar calculation.

⑩ Visual comparison of charts by the mentioned spreadsheet software can be done

Figure 5. System Operation Example (3)

3. Evaluation of the CAFM system

Using this CAFM system, LCC for the building parts and materials is calculated, and comparison examination of projects of repair and renewal become flexible. Furthermore, related building parts and materials can be confirmed easily in 3-D space by the application of 3-D CAD models.

The efficiency of the above CAFM system was is observed feasible and efficient for project preparation of maintenance works.

The followings are the advantages using the above-mentioned CAFM system.

(1) Cost-efficient building maintenance planning
(2) Increase of building value with the appropriate budget planning of maintenance
(3) Time-saving for processing
(4) Decrease of mistake

4. Future Prospect

Primarily, CAFM system is a system to support the overall building lifecycle. However, the above mentioned CAFM is related to the building cost management for maintenance in the preparation stage only. Since running cost is also one of the most important factor in the management of a building, it is necessary to introduce a CAFM system integrated with functions for operating/running stage.

Attention

Explanation of terminology
1) Present Value : Value requested
2) The Periodic Present Value Factor : This value is a cost coefficient to show the present value of the periodic expenses requested.
3) The Calculation Interest Rate : Interest Rate used to show the difference of present value and value at final stage.
4) The price fluctuation rate : Fluctuation predicted for a period of one year.

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