Common building model for administrative checking system against building design proposals

Tatsuo Terai, Dr of Eng.

Department of Industrial Design, Chiba Institute of Technology, 17-1 Tsudanuma 2-chome Narashino Chiba 275 Japan

Abstract

Japanese local administrative authorities are running a joint project to develop a computer-oriented checking/confirmation system for lawfulness of building design propsals. They aim in the long run to establish a paper-less checking system which enables designers to efficiently utilize their project data derived directly from their own CAD systems. It will take much time to reach the goal, but this could be the first step to establish relating national CAD standards from which we are now kept away caused by specifically complicated characters of our AEC industry.

This paper describes the outline of the system and explains briefly a proposed common building model based on standardized coding system as the results in the first stage of development.

1. Outline of the project and system

A national project called "Development of Advanced Checking System of Building Projects" has been executed by the local administrative authorities since April 1989 aiming at time-, cost- and error reduction, etc. Its ultimate target is to accomplish a paperless checking system against digitalized application data made by differing CAD systems in the building design or briefing process.

The project is devided in two and more phases of development and utilization. In the first phase until March 1992, a very basic System V1, the first version of the advanced checking system, is to be formulated to deal with only the face data of each application proposal as a feasibility test model of the new way of checking practice. System V2 will then be developed in the second phase to be able to cover much larger portion of project information of proposals to reach the final target.

Although being under development, promising to-be international standards like STEP and ISO building coding system based on CI/SfB shall obviously become technological basis for the checking system. But even the basic System V1 ought to be a practical system ready for actual use at some cities just from April 1992, and it cannot wait for complesion of such standards. Therefore it must have its own common building model and coding system similar to STEP and renewal CI/SfB. Results of R&D of STEP and the like will then be formulated to much extent into

System V2. The problem is how the basic technological concepts of such standards could be formulated in the common building model and coding system for System V1.

System V1 consists of the following subsystems (S/S),

for applicants (designers or building owners);

S/S-A : data composing S/S for confirmation of building project

for examiners (building officials);

S/S-B : general management S/S for reception and registration

S/S-C : examination S/S against face data covering project outline

S/S-D : building code/regulation database

S/S-E : management S/S for site information (conceptual study).

Development of S/S-C is a main working item in this project, which requires a common building model based on standardized coding system in problem. S/S-C has major four automatic functions as following;

Function 1 : extraction of items to be checked for confirmation

Function 2 : output of checklists

Function 3 : CAD functions to support examination on the screen

Function 4 : checking of shape and location of buildings.

2. Common building model

In the first phase of practical use of the advanced system, conventional way of application ought to be accepted as it is, and System V1 has accordingly very limitted functions for the time being only to support human task of confirmation. Coverage of automatic checking is also limitted in external form and configuration of buildings. Face data to be dealt with mainly cover a set of information put on the both sides of a cover page of application forms including text data concerning to ownership, responsibility etc. and two drawings; a sketch map of sites and a plot plan of buildings.

The plot plan is conventionally a copy of 2D drawing. In order to introduce CAD-like evaluation as a key point of development, it is devised in this project to convert its form to be of 3D configuration of buildings and site to enable automatic checking against the following 10 items;

- length of roads along the site
- calculation of site area
- calculation of building area
- ratio of building area to site area
- limit of height of each part of buildings against roads
- limit of height of each part of buildings against sites in th neighbour
- limit of height of each part of buildings in the north direction
- limit of height of buildings
- ratio of building volume to site area
- acceptable building types within specific site types for land use.

Conceptual building model like GARM in STEP is not yet feasible for practical use in the complicated and multi-structured building practices in Japan. Common building model tentatively formulated in the project is therefore not a intermediary translator but an envelope model to be able to cope with many major CAD systems currently used in the country. The main specifications of the model are determined as follows;

- number of vertexes of site area : 200 points at the maximum
- type of land use : 4 different areas at the maximum
- type of area for fire-proof : 4 areas at the maximum
- latitude : from 24° to 45° 30' N
- shape of site : line segmentation
- angle : from 0° to 360°
- road with differing width : introduction of hypothetic end line
- building element : 150 elements for one project at the maximum
  100 vertexes of polyhedron at the maximum

3. Revised ACT coding system

A standard coding system is an essential factor to the successful checking system and should be used for full integration of information in common building models and reference databases. In our country, a conceptual framework of a potential standard coding system has been developed as one of the results of a national research project. This basic one called ACT coding system consists of six major coding subsystems: [CONDITION], [METHOD], [SPECIFICATION/PERFORMANCE], [RESOURCE], [ACTIVITY] and [RESULT]. This system is of a sort of modification of so-called CIB coding system concept for physical realization process in which [RESOURCES] are transformed by [ACTIVITIES] into [RESULTS].

In this project, ACT coding system has been revised to be practically used in the common building model proposed. The revised system (Fig. 1) again consists of six major coding subsystems and has a much wider field of application than that of CIB and more intense and deeper classification subtables than those of ACT system.

4. Problems to be solved in coding standardization

In this project, efforts were made to clarify how to formulate the proposed CIB and ACT coding concepts into practical coding sytems. For verification of ACT system, a five-storied office and shopping building project is selected as a study model. 427 terms are picked up from a set of project drawings and coded in ACT system by four building experts independently. The four members' patterns of classification are naturally different to some extent. The major factors of disagreement are as followed;

- the Japanese language has many abbreviations and multiple meanings
- [ATTRIBUTE] and [METHOD] cannot be clearly defined in the classification
- the phase of [ACTIVITY] should be fixed in order to distinguish between [RESOURCE] and [RESULT] because of their "cause and effect" relationship.

[RESOURCE] can be assumed to be [RESULT] from a different point of view. According to the CIB concept, [RESULT] can then also become [RESOURCE]. The suitable way around double coding is to separate materials in genuine [RESOURCE] and genuine [RESULT]. How to devide them is then a significant problem. It may be considered that [RESOURCE] is a common and [RESULT] is a specific part of each building. The problem might also be settled down by combination with building process codes. Currently [RESOURCE]is determined to be abstract entity to be distinguished in the final stage of construction. As for [CONDITION], it is defined to include many kinds of types of conditional factors. Then the concept of [CONDITION] is enlarged. Each type has its [ATTRIBUTE]s, and there remains a possibility to unify [CONDITION] and [ATTRIBUTE]. These problems must be settled later.

C*** CONDITION	M*** METHOD	A*** ATTRIBUTE
C000 General	M000 General	A000 General
C100 Location	M100 Presentation	A100 Locational Att.
C200 Environment	M200 Style	A200 User/Object Att.
C300 Area type	M300 Investigation	A300 Facility Att.
C400 Facility	M400 Planning/Design	A400 Space Att.
C500 Space type	M500 Mechanism	A500 Relational Att.
C600 User/Object type	M600 Manufacturing	A600 Physical Att.
C700 Agent type	M700 Construction	A700 Performance
C800 Constraint	M800 Management	A800 Abstract Factor
C900 Others	M900 Others	A900 Others

S*** RESOURCE	F*** ACTIVITY/FIELD	R*** RESULT
S000 General	F000 General	R000 General
S100 Right	F100 Administration	R100 Project
S200 Man/Organization	F200 R&D	R200 Space
S300 Equipment	F300 Planning/Design	R300 Site works
S400 Material	F400 Cost Control	R400 Temporary works
S500 Money/Fund	F500 Manufacturing	R500 Building
S600 Energy	F600 Distribution	R600 Building Element
S700 Information	F700 Work Section	R700 Services
S800 Negative Resource	F800 Use	R800 Furniture
S900 Others	F900 Others	R900 Others

Fig. 1 The framework of revised ACT coding system

5. Conclusion

Caused by the progress of advanced information technology, importance of data exchange in the construction industry has grown up to much extent even in such a country like Japan, where standardization is usually quite a difficult task to accomplish. Major general contractors and design offices are large enough to develop their own CAD and information systems which are then close to each other.

Although such world-famous standards like CI/SfB or IGES are also well known among the experts in the relevant fields, they fail to get wide popularity in the whole Japanese construction industry. An advanced computer-oriented checking system under development is therefore expected to become a breakthrough to this chaotic situation, for it basically requires some relating national standards or recommendations to accept differing application systems. At any rate, this may be the first attempt to set up a comprehensive standards for CAD and coding systems in Japanese building or construction industry. Ongoing study should be made for practical use. The system is also planned to be revised to get in good harmony with relating ISO works.