Object Oriented Communication with NICC (Neutral Intelligent CAD Communication)

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ABSTRACT

NICC is a recommendation of the Swedish construction industry for Neutral Intelligent CAD Communication. It will make it possible for different participants in the industry to exchange information in a standardized way, independent of which CAD-system they have chosen. As NICC describes building objects (walls, windows, doors, etc) it makes it possible to transfer uniform and structured information during the whole process. The description of the building objects in NICC is based upon a simplified geometry. NICC can manage GEOMETRY OBJECTS (building objects and spaces), SYSTEMS (logical groupings of geometry objects), CONNECTIONS (between geometry objects) and LOCATIONS. The idea behind NICC is to transfer information about "intelligent" building objects classified after a standard, in Sweden the BSAB-system. Each CAD-system, drawing or model oriented, has to map its own structured data to the minimal meta model of NICC.

Key Words

CAD; communication; building objects; conceptual model; step

INTRODUCTION

NICC is a recommendation of the Swedish construction industry for Neutral Intelligent CAD Communication. A group of 15 architects, consultants and contractors together with 9 application developers are defining this recommendation. The project started in april 1991 and this second phase will be finished in June 1993. It will make it possible for different participants in the industry to exchange information in a standardized way, independent of which CAD system they have chosen. As NICC describes building objects (walls, windows, doors, etc) it makes it possible to transfer uniform and structured information during the whole process. Many ideas behind NICC come from the Swedish MCAD project (Tarandi, 1988), which today has resulted in a product.

NICC is based upon an idea about a MINIMAL META MODEL plus tables that defines different instances of classes under the meta classes. It is

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a simplified and small model onto which other models are mapped. This makes it possible for a large number of companies to accept and understand the model. The assumption is that you can't have a more detailed (complex) model if you want the industry to use it. Other authors have expressed similar thoughts (De Vries, 1991)(Hannus, 1991). In the future it is possible to make it more detailed, if necessary. The minimal meta model of NICC includes a conceptual schema with rules and constraints together with the information base. Today the NICC file is a readable ASCII file, but from june 1993 it will be based upon the STEP specification (ISO) for entities, geometry and physical files (ISO CD 10303-1, 1992). In this paper the STEP related Express G language is used for some of the figures.

Every discipline has its own more or less detailed models that have to interface with NICC's minimal meta model. The thought that one detailed model could fulfil all needs of all disciplines is more or less impossible to implement. An architect is not interested in having a big and complex model about electrical components and their descriptions in his computer.

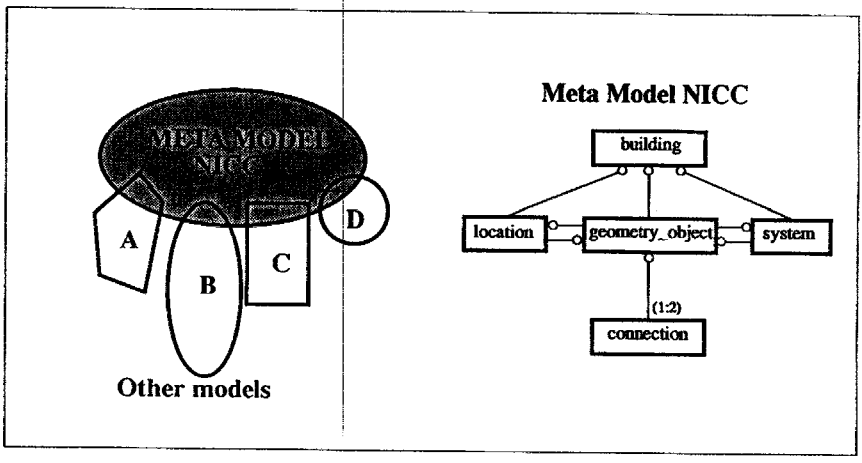

Figure 1. A Common Minimal Meta Model (Express G)

The building is described by GEOMETRY OBJECTS (building objects and spaces), SYSTEMS (logical groupings of geometry objects) and LOCATIONS (volumes with names in the building). The geometry objects can have CONNECTIONS to other geometry objects.

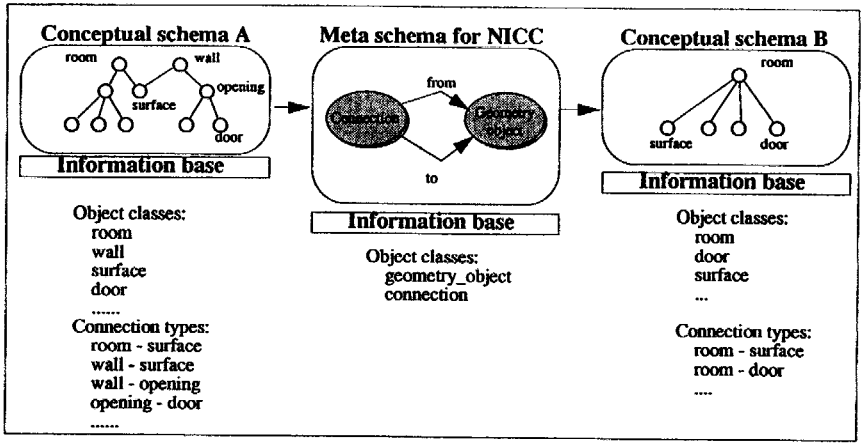

Figure 2. Communication via Mapping to NICC

Two disciplines with different conceptual schemata can communicate via mapping to the minimal meta model of NICC.

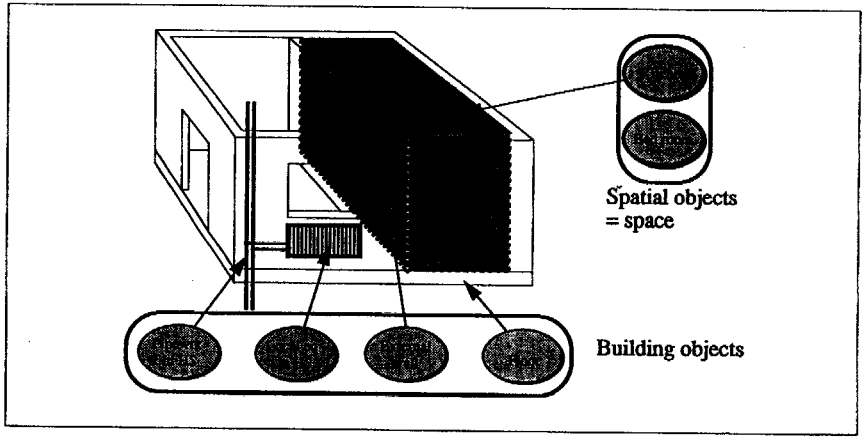

Figure 3. Examples of Geometry Objects

MAIN PARTS OF NICC

Geometry Objects

Geometry object has two subclasses, building object and space. They are the material things like walls, fans, doors and rooms that fill the complete building.

Most of the meta classes have instances that must have a classification code that follow a table defined by NICC. For example the building objects are classified after a standard, in Sweden the BSAB system which is the follower of the Sfb system that is used in many countries (SB Recommendation, 1987).

INTERIOR SURFACES AND ROOM COMPLETION	
372.0	Surfaces on floor and stairs
372.1	-Coating, paint layer
372.2	-Floor and stair base
373.0	Surface on walls
374.0	Surface on ceiling
375.0	Vacancy
376.0	White products
376.1	-Stove

Figure 4. Table Example for Building Objects

The description of the geometry objects is based upon two parts, one "intelligent" and one "descriptive". The intelligent information is defined by the simplified geometry of the geometry object together with attributes. A wall can be defined by its centre line plus HEIGHT and THICKNESS. This information makes it possible to calculate gross and net areas, volumes and length. The descriptive part belongs to the same object and consists of lines, curves, crosshatching, texts etc. If the intelligent definition describes the geometry object completely, then the descriptive graphics are not necessary to send.

The simplified geometry is very important and is defined by the formtype for the current geometry object. The idea is that you must explicitly define what is the direction, height, thickness, left side etc. If you send a true solid 3D volume of a wall, the receiving system has problems with identifying for example the length. Is it the longest projection to the x-y plane?

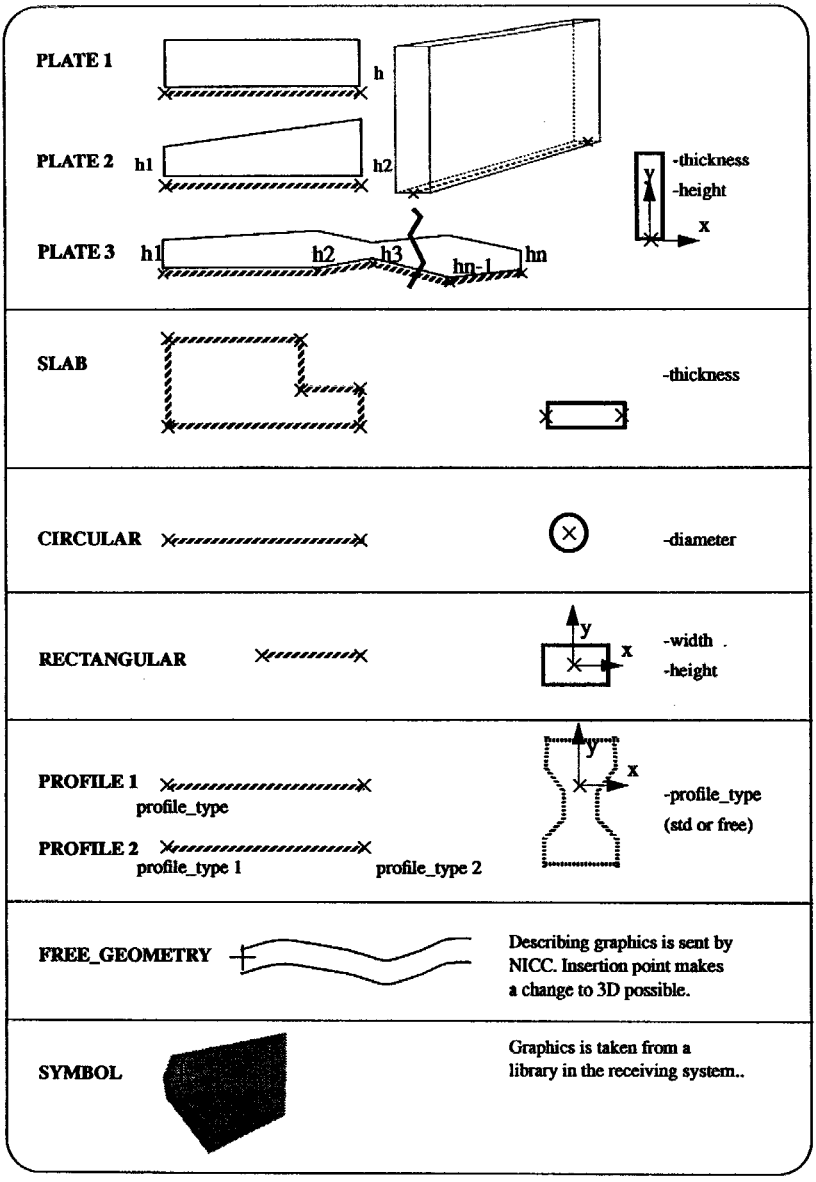

Figure 5. Formtypes

Many classes of building objects are often represented by the formtype SYMBOL. The generic representation with definition point (Dp), zero rotation and mandatory attributes are defined in tables, see Figure 6.

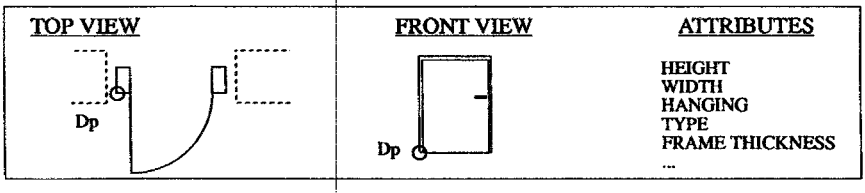

Figure 6. Class of Doors

Building objects can have different sorts of representation and additional information.

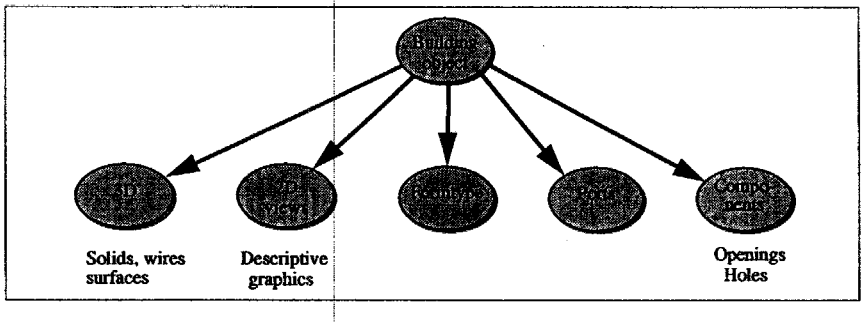

Figure 7. Building Object

Building objects (approx. elements) (Karlsson, 1990) can be divided into building object parts. They represent the smallest division of building objects that have their matching representation in the table for production results (approx. work sections). Building object parts could be erected steel profiles, gypsum boards, insulation board etc. They have the same structure as the building objects, Figure 7.

Connections

Connections are objects that links two geometry objects together. The connection can carry information about type of connection, port identity on the geometry object etc. A port is a predefined connection point on an object.

Systems

Systems are objects with information about function, capacity, name, type and so on. They can consist of other systems (=subsystems) or geometry objects.

Spaces, subclass of geometry object, like rooms can together make up an office system, communication-system, fire zone-system etc.

Building objects, subclass of geometry object, like fans, ducts and ventilators can together form a ventilation-system and columns, beams and slabs can form a structural system.

5 HEATING, REFRIGERATION, WATER SUPPLY AND DRAINAGE SYSTEMS
520.0___ _____ Complex tapwater and drainage systems
521.0___ _____ Tapwater system
521.1___ _____ - Cold water system
521.2___ _____ - Hot water system
521.9___ _____ - Other tapwater system
525.0___ _____ Drainage system
525.1___ _____ - Soil and waste system
525.2___ _____ - Surface water system

Figure 8. Table of System Classification (Svensson, 1991)

It is important that these logical connections between geometry objects are not treated in the same way as explicitly expressed connections. Connections between systems are defined by a connection between two geometry objects, one in each system.

Locations

Locations are objects with names, like floor name, that describes a smaller or larger volume of the building. It can be defined by geometry or just the name. Locations can consist of other locations for hierarchy. They can overlap because of the need for different ways of sorting geometry objects for construction management purposes like planning, cost estimation and material administration. This gives the possibility to give a wall instance both the location Part A of Floor 1 and the location Vertical stair case area 3. Only locations and geometry objects can belong to locations.

DELIVERABLES

The work with NICC is based upon earlier work with the same name finished 1990 (Tarandi, 1992).

That work was focused on the file structure and record format. It used ASCII files.

Today the NICC file is still a readable ASCII file with a file structure and

format defined by the project. From june 1993 there will be a parallel STEP specification (based upon ISO work) for entities, geometry and physical files.

In the summer of 1993 this project will be finished and the result, the conceptual schema and a set of tables, will hopefully be used by application developers and end users. NICC is just the conceptual schema to which each application developer has to make pre and post processors.

NICC IN RELATION TO OTHER CONSTRUCTION CONCEPTS

NICC manages information as RESULTS of activities. Information in the production phase can be described as RESULTS (the erected wall), ACTIVITIES (form work, reinforcement work, concrete work) and RESOURCES (man hours, machine hours and products).

In Figure 9 the information managed by NICC is marked.

In Sweden a project about libraries for products is carried out by a group of designers, contractors and suppliers. As this project follows the NICC recommendation it makes it possible to take information about products into the object part as attributes and graphics.

CONCLUSIONS

The conceptual schema for the construction industry must be very well defined and understandable as there are so many different types of companies taking part. Different words for the same thing and different meaning for the same word makes it necessary to keep the model small with few meta classes!

Simplified geometry is necessary to get a manageable set of information about the geometry objects.

Abstraction and explicitly expressed information makes it easy for the receiving system to use the information automatically in other applications.

Intelligent building objects with mandatory attributes based upon established classification gives the foundations for efficient information management for all participants in the construction process.

This makes it possible to use the information in the process more efficently and in new ways, if the managers in the companies can see and understand the potential in this field. The biggest problem in the future will be to motivate and get the organisations to accept and use the information from product models.

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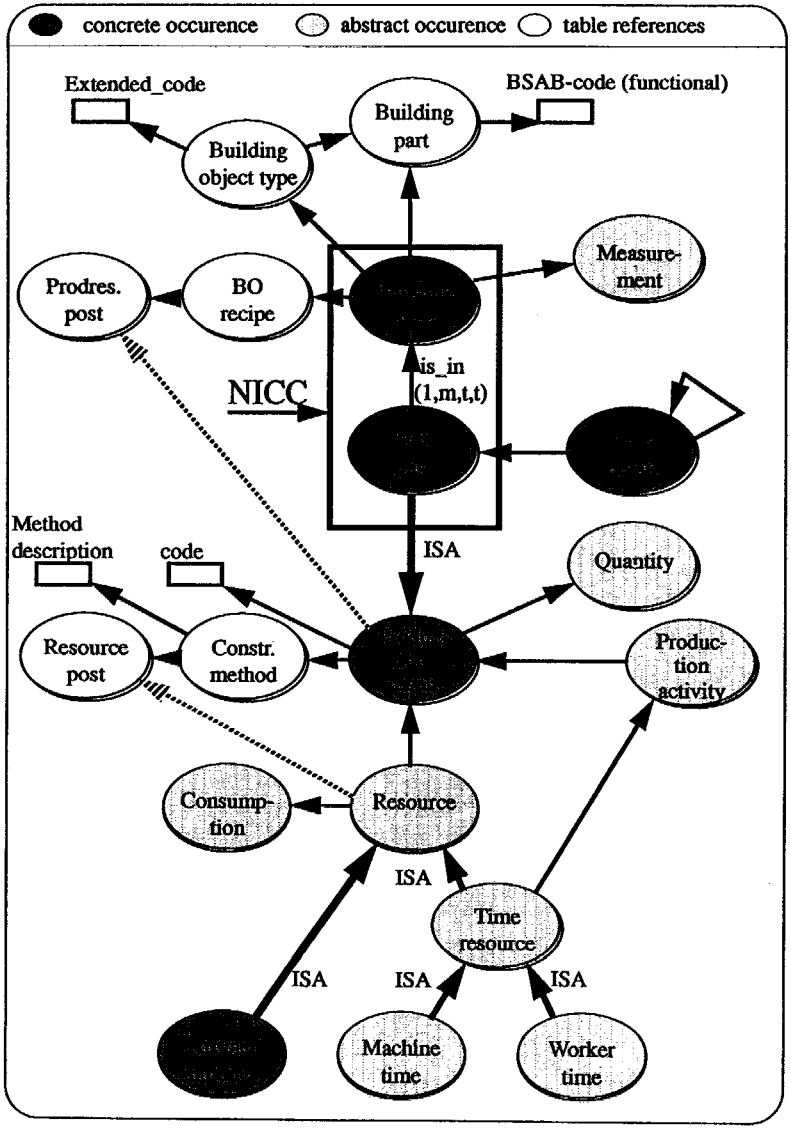

Figure 9. NICC and Surrounding Construction Information

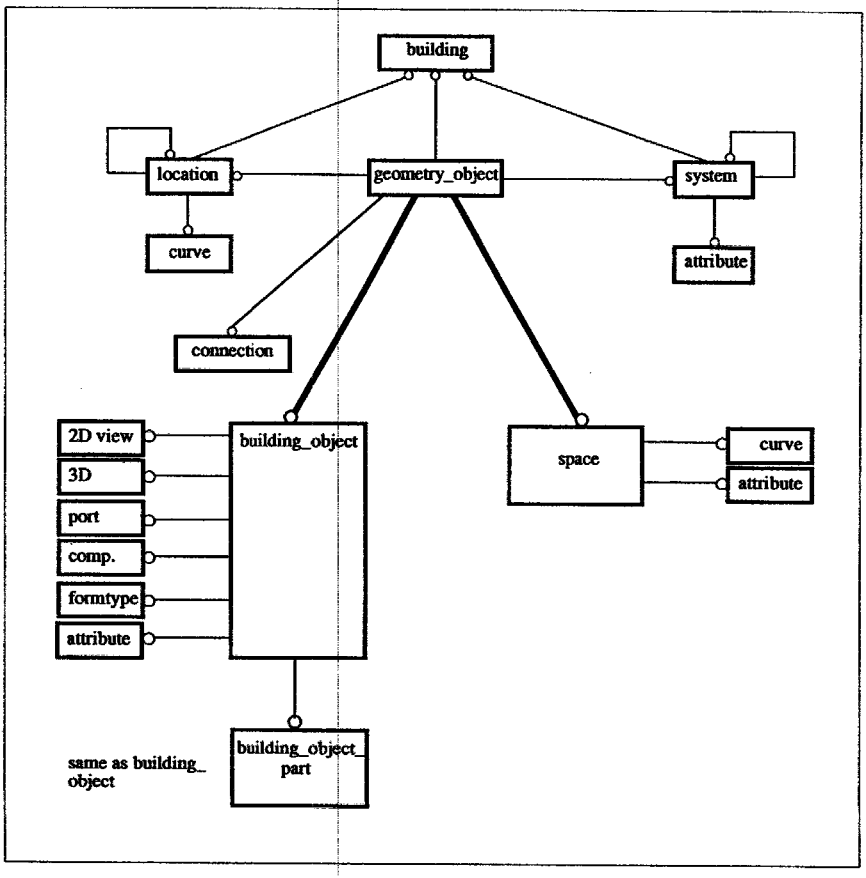

Figure 10. NICC Minimal Meta Model (Express G)

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