THE 2ND CIB W78+W74 SEMINAR
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CLASSIFICATION OF INFORMATION IN THE CONSTRUCTION PROCESS - AN ISO PROJECT

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As you may know I am in my work engaged in developing and introducing tools for an improved infomation flow in the construction process. An important part of that is to act as a bridge between research and the practitioners who design, produce, operate and maintain our buildings and facilities. I will therefore not necessarily present new research results but far more try to give you a quick impression of my perception in what direction use of Information Technology is going in the construction industry. After that I will concentrate on classification of information in the construction process, the needs, solutions and possibilities of practical implementation.

As I see it we have two new areas where Information Technology starts or will in a relatively short time start to be very important in the construction process
+ electronic trade
+ digital building models

For both areas four necessary components may be distinguished
+ hardware
+ software
+ data banks
    o general data banks
    o project data banks
+ EDI Electronic Data Interchange

I have no comments to the first two.

General data banks such as product data banks and standard specification data banks have to work on commercial market conditions.

So will also EDI services offered e g by computer suppliers and VANS suppliers. For EDI to work standardization is necessary. Adaptation of the EDIFACT[1] standard to the needs of the construction industry takes place within EDIFACT Board MD5[2] which comprises EDI communities in Belgium, Denmark, Federal Republic of Germany, Finland, France, Great Britain, Netherlands and Sweden. The EDIFACT Board is a UN[3] organization endorsed by the EC[4] and EFTA[5].

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[1]Electronic Data Interchange For Administration, Commerce and Transport

[2]Message Development Group 5

[3]United Nations

[4]European Communities

[5]European Free Trade Association

I have pointed at some important new areas where IT will contribute to a rationalized and improved construction process and at some components needed for the implementation of the new tools. I have deliberately neglected to mention the "soft factors" which could be summarized as the human factor.

In my work I am constantly faced with this side of the coin. You have to get the new solutions accepted by the intended users or the work may have been wasted. I am here talking about development work of the type discussed in this paper intended for direct implementation in practice, not about basic research where conditions may be somewhat different.

I have given this description to underline the complexity in improving communication in the construction process. Another basic requirement for the implementation of new tools for communication in the construction industry is a well functioning classification system. At the first joint seminar of CIB W78+W74 in Lund, Sweden October 1988 I presented the principles for classification of information in the building process which had been developed by W74. The principles have since then been accepted by ISO/TC59/SC13 as a basis for work with the aim to produce ISO Standards and possibly an ISO Technical Report. The results so far and the status of the work are described in Draft ISO Standard "Classification of information in the construction process" which is appended in full to this paper. The main content of the document will be described during the seminar.

Appendix Draft ISO Standard "Classification of information in the construction process"

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Appendix

ISO/TC 59/SC13

DRAFT ISO STANDARD

CLASSIFICATION OF INFORMATION IN THE CONSTRUCTION PROCESS

Ad hoc group 2 (Henry Karlsson + Tony Allott) August 1990

SB/T 99:90

CLASSIFICATION OF INFORMATION IN THE CONSTRUCTION PROCESS

Contents

1. THE PURPOSE OF THE STANDARD

The primary purpose of the Standard is to provide the basis for an improved information flow in the construction and building use processes and to give guidelines for organizing related general information. The recommendations are aimed both at improving the information flow within particular countries and also from country to country.

There has never been a greater need for effective communication tools. Major factors motivating this statement are:

- Information becomes increasingly important in the construction industry as we move towards an information society. The computer gives possibilities to communicate and use more efficiently the vast amounts of information which are used and created in a project during design, site production, operation and maintenance. Losses of meaning may be minimized and everyone may be provided with the information he needs to fulfill his task. Efficient use of computers, however, requires a 'common language' of well performing classification and coding systems with clearly defined rules for their use

- A 'common language' is required both as a sortation and search tool in databases and for structuring documents in the construction process in a unified way, irrespective of whether the documents are produced and used in a computer-aided way or manually.

- The increase in international trade of construction products, consultancy services and international construction services makes internationally accepted principles for classification and coding systems as well as other tools, e.g. electronic data interchange formats more important than ever.

- The increasing attention being given to management of the use phase of buildings, including operation and maintenance, has increased the need for classification systems which may be used throughout the total construction/building use process, from inception to demolition.

2. THE CONSTRUCTION PROCESS, ITS AGENTS AND DOCUMENTS

2.1 The construction process

The **construction process** is the common term for all activities included in design, production and use of buildings and other facilities (e.g. roads, bridges, dams, mains services). The construction process may be roughly subdivided into **design, production** and **use.**

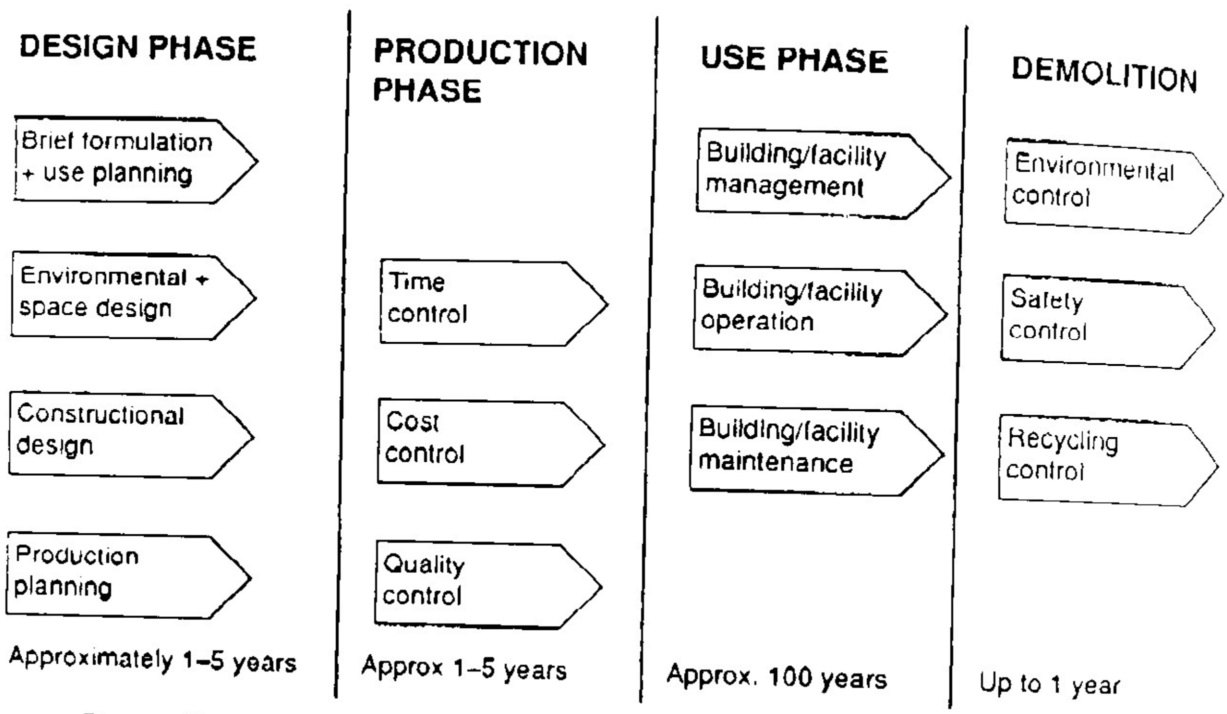

Figure 1 The parts of the (total) construction process

The construction process is long. There are normally at least 50 years between the birth of a project idea and the remodelling or demolition of the typical building or other facility. During this time a massive flow of information takes place. Hundreds of persons from different organisations and with different tasks exchange and store thousands of facts in connection with the planning, production and maintenance activities of the construction process.

It may also be observed that large amounts of economic and physical resources are used during the construction process – **resources** are transformed into **results** by **activities.** Thus both matter/energy and information flows take place

The construction process is described above as for a new building/facility, but it can be considered equally for the alteration or renovation of an existing building/facility. Many buildings undergo major change at least once during their lives, either to make them suitable for a change of use or to upgrade their quality and level of performance. When this happens there is a design phase and a construction phase before the commencement of a new, different use phase for the building. The original building can be thought of as the 'site' for the alteration/renovation project.

2.2 The agents of the construction process

The activities in the construction process are controlled and executed by persons with distinct roles. These persons are usually called the **agents** of the construction process. In every construction project a particular combination of agents participates, having to communicate with each other and with persons less directly involved in the project.

Traditionally, the 'agents' have been thought of as the actual organisations of the construction industry. The changing patterns both of building/facility procurement and of the structure and operations of contracting firms and organizations mean that the concept of agent – he/she who acts in the process – must be redefined. The sum total of all the construction processes, from first idea to the end of the building's/facility's life is regarded as the **(total) construction process**. It consists of three parts (Design, Production, Use) regardless of what kind of organizational pattern is involved. Each part can be broken down into the activities which must be performed to advance the project. With the new definitions the agent is **the one who is responsible for the process.** In classification analysis the process is primary; the task – not the person – is important.

Thus in principle the roles of the agents are not affected by the organizational form for carrying out a particular project (turnkey project, early tendering, traditional tendering with a main contractor, separate trades contracting, management contracting, etc). Similarly, the information needs of the agents are not influenced by the organizational pattern of a particular project, e.g. whether the architect is working for the client or the contractor. The organizational pattern may influence how easy it is to get certain types of information, but that is a quite different consideration.

Here is a listing of the most important agents and a description of their roles in the construction process:

- The future **user** must define his requirements in order that his needs for space and facilities can be determined.
- The **client** expresses his needs in a brief.
- The **architect or engineer** designs the building or other facility and may select its equipment. **Other members of the design team** (structural engineer, mechanical engineer, electrical engineer, quantity surveyor, etc) design the structural system, services and electrical installations, calculate quantities of materials and components, carry out cost calculations.
- The **contractor's estimators** assess the cost of using various types of resources and of managing the construction in order to prepare tenders.

- The **builders and installers** plan how the project is to be constructed, requisition the resources and carry out the site production.
- The **property manager** is responsible for operation and maintenance of the building.
- The **materials and components producers** manufacture and supply, either directly or through dealers and stockists the materials and components as well as the construction plant used in the project.
- The **stockists/suppliers/distributors** (general agents, wholesale and retail stockists) supply and distribute materials and components for the building/facility.
- **Machinery and construction plant lending firms** provide equipment to the site.
- **Authorities** (supra-national, national, regional, local), **information centres** and **standardization bodies** produce and distribute regulations and other information about buildings/facilities and their use.
- **Financing institutes** (banks and other money lending institutes, administrators of state subsidised loans) provide the necessary finance.

2.3 Human interfaces in the construction process

The following often takes place in the construction process:

A person A (**the information sender**) who works on a project is about to transfer his knowledge about something to person B (**the information receiver**) who is working on the same project. The communication is carried out with the help of **signals** via **media,** e.g. drawings, written documents or telephone lines. Person B **must receive the signals and completely understand the information before he has the same knowledge as person A.**

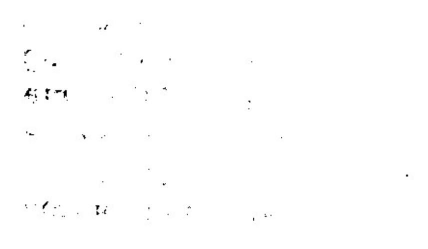

Figure 2 Communication of information

Often there are barriers which inhibit the effective communication of information. In a simplified model of the communication process the barriers are at the so called interface between sender and receiver.

The construction process is rich on information. The information flow is complex because it involves a great number of interfaces. Many of the interface barriers may be overcome by using systematics for information communication such as classification, coding, etc.

Those working within an organization normally use the same systematics for structuring internal information within the organisation, so that the information flow between those working in the same organisation normally does not create major problems. If we widen our scope to a national construction industry we are inevitably confronted with interface problems if measures are not undertaken to create a common systematics within that industry. Generally if the building process is to perform well, the information flow must not be slowed down or stopped at the interfaces between persons, organisations or sectors within the construction industry.

2.4 The documents of the construction process

The documents used in the construction process are the main media for communication between the agents. The interfaces are more easily bridged if the media are of high quality and if common systematics are used for coding, arranging and expressing the contents.

The documents used in the construction process may be divided into three main groups:

- **Project documents,** i.e. documents produced for a certain project.
- **Project related documents** which may be:
  - General documents to which reference is made (in whole or partially) in the project documents.
  - Documents which apply to the project because of laws and regulations.
  - Documents which are for other reasons frequently used in projects, e.g. product documentation, cost guides.
- **General information documents,** i.e. documents not normally referred to in the project documents, and used for knowledge acquisition generally in construction.

The border between project related documents and general information documents is somewhat unclear but it has proved useful to make this distinction. The following examples may be helpful for further clarification:

Examples of project documents:

Briefs
Project specifications
Project drawings
Bills of quantities
Cost calculations
Quotations and orders

Examples of project related documents:

Documents stating requirements for particular types of building/facility.
Regulations, e.g. building regulations, regulations for occupational safety.
National Building and Engineering Specifications.
Codes of practice
Approval certificates
Standard product specifications
Product documentation, trade literature
Cost guides, general schedules of rates

Examples of general information documents:

Handbooks
Research reports

A 'document' has traditionally been understood as a paper document, but to an increasing degree documents may also exist in other forms, e.g. as a display on a screen.

2.5 Data banks

We are moving towards a situation where the information on a certain project is suitably structured and stored in one or more related computerised data libraries, forming a data bank. The project data bank is built up during the design stage, relevant data are extracted for the production stage, further processed during production and finally a data bank containing information on the completed project is there, ready to be used during the use stage.

Project related data banks containing e.g. national building and engineering specifications, standard or manufacturer's specific design details and cost data will be available for inclusion in relevant parts of the project data bank. Outputs from the project data bank may be produced on paper or on a screen. These outputs correspond to the project documents described in section 2.4 and will typically be in the form of project specifications, drawings, etc.

The situation described above requires a far more integrated information flow than when manual routines were used. In the traditional situation the human brain created the interface between different documents and helped to reduce possible uncertainties. The use of computers has thus increased the need for a systematic approach to information communication.

3. THE SYSTEMS APPROACH: BASIC CONCEPTS

3.1 Physical realisation of the project

In section 2.1 the construction process is described in terms of the main activities, i.e.

- Design phase
- Production phase
- Use phase

The construction process can also be thought of in terms of its physical realisation, as shown in figure 3. Matter/energy resources are selected from the market, then transformed by production/construction activities into the result (the building or facility). The whole process is managed by means of planning, control and result assessment against cost, time and quality considerations. This simple model is fundamental to the systems approach to classification.

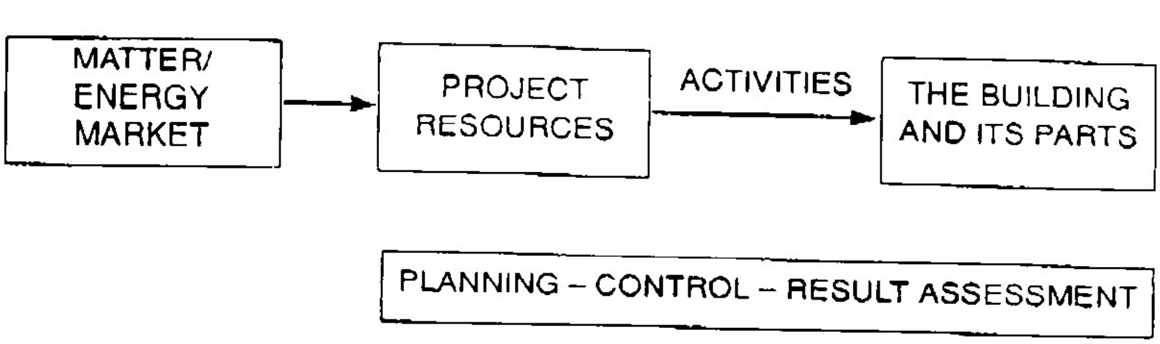

Figure 3 The physical realisation of the building.

3.2 The resources

Matter/energy resources are of three kinds:

- Materials/components which end up as part of the finished building/facility during production or maintenance.
- Tools/machines (with fuel) and other equipment on site, not to be part of the finished building/facility, also equipment used during design and use.
- Human effort, suitably skilled.

Obviously, in the specific project these matter/energy resources are part of the project. In a general construction information system, however, they have to be defined as part of the general 'market' – part of the environment of interest to the construction information system but not part of the construction process.

Information is also a key resource. The designer uses available information from the client, from project related documents and general information documents combined with his own skill to produce information on the desired building/facility. This is used as a resource (input) into the production (construction) system, first by the designer translating his requirements into terms suitable for construction, then by the construction planner in determining the construction programme. This translation of design information is decisively linked to the organization of the production process. it must take contracting and subcontracting into account. Each country and each time has its own habits in this respect. Finally, information on the produced building/facility, including instructions for operation and maintenance, is used as a resource (input) into the use system.

Management of the construction process is also part of the general class of resources. Throughout the process the various agents are concerned with the basic management considerations of time (programming), cost and quality. They make use of disciplines such as communications, management science, finance and the law, which pervade not only the process but also the internal workings of the organisations participating in that process. In addition, the agents make use of many information and management aids and methods, e.g. CAD, cost feedback conventions, other databases. It will thus be seen that management is not a resource per se, but is an implicit part of two other resources, i.e.

- Human effort, particularly the time and skills of management personnel.
- Information, particularly the general and project documents which are centrally concerned with management.

The resources required during the various construction processes can be illustrated as follows:

CONSTRUCTION RESOURCES

PROCESS	PHYSICAL RESOURCES: HUMAN EFFORT	PHYSICAL RESOURCES: TOOLS/ MACHINES	PHYSICAL RESOURCES: PRODUCTS/ MATERIALS	INFORMATION: GENERAL INFORMATION	INFORMATION: PROJECT INFORMATION	RESULT
DESIGN BRIEF	Building owner + users			General user requirements	User requirements	PROJECT BRIEF
DESIGN	Designers			General design information	Project brief	PROJECT DESIGN
CONSTRUCTION PLANNING	Construction planners			General technical information	Project design	CONSTRUCTION SCHEDULES
CONSTRUCTION	Managers, operatives	Plant and tools	Building products	General construction information	Construction schedules	COMPLETED BUILDING
OPERATION, MAINTENANCE	Maintenance engineers, operatives	Tools	Spare parts	General maintenance information	Information on completed building	MAINTAINED BUILDING
DEMOLITION	Managers, operatives	Plant		General demolition information	Information on maintained building	DEMOLISHED BUILDING

Figure 4 Resources for various construction processes

3.3 The building/facility in focus

In any construction project the building/facility and its parts are the focus of interest for all processes:

- In the **design process** the building/facility as such and its parts are studied as models of a desired reality.
- In the **production process** the parts of the building/facility are produced, one after the other.
- In the **property use process** the building/facility is an artifact used by a living system.

The reality of life in the building/facility – the living system for which the building/facility is needed – is the primary consideration during the design process and consequently during the production process too. This is true of the building/facility as a whole and also of its parts, which are of two kinds: the **space systems** and the **systems of physical parts.**

3.4 Space systems

The spaces within buildings should be related directly to the needs of the users. Living systems – for which buildings are made – are not part of 'building'. We have to consider space classification in connection with the classification of users' activities/organizations. In the case of engineering facilities the space system will usually be to accommodate objects rather than people, e.g. roads accommodate vehicles, bridges accommodate vehicles or trains, dams accommodate water, docks accommodate ships.

In the case of building we may distinguish between two levels of spaces, namely individual spaces and 'the sum of spaces' or the **building** as a whole. Both **individual spaces** and **whole buildings** need to be considered from the point of view of the activities taking place within them. Examples of 'spaces' are bedroom, hotel corridor, caretaker's flat, dining area. It will be noted that the concept of 'spaces' is not the same as 'rooms' – a space may be a room, an aggregation of rooms, or part of a room. Examples of 'buildings' are hospitals, churches, office buildings, one family houses.

3.5 Systems of physical parts

The physical parts of the building/facility act together to enclose and service the spaces, and as such can also be considered as systems. We may distinguish between two types of such systems: **elemental parts** and **work section parts**.

Elements are the large physical parts of the building/facility considered from the point of view of the building user. They are closely related to the space systems which they enclose and service in that they are of a functional character. They are 'anonymous' from a detailed design, construction and materials point of view, i.e. they do not presuppose anything about the technical solution to be chosen or the resources to be used. The concept includes elements of the building fabric, external site elements, services elements to provide facilities and climate control.

Examples of elements are:
Foundations
External walls
Upper floors
External doors and windows
Water supply and distribution
Space heating

Fire detection/alarm/control
Road sub-base
Pedestrian pavings
Bridge deck

The elemental parts are the complete physical building/facility divided down according to characteristic locations and functions. The same complete physical building/facility can be divided into parts considered from the point of view of how they were or will be constructed. Such **work sections** are of interest to the contractor and are organisational groupings based on operative and sub-contractor skills. The skills are usually related to certain types of material and the construction of certain types of elements. One type of work section may be included in several elements. Equally, one element will usually include several types of work section. The work sections give the elements their detailed design and material content.

Examples of work sections are:
Excavation and filling
Piling
In situ concrete
Brick/block walling
Stone slab cladding
Mastic asphalt roofing
Raised access floors
Plasterboard dry lining
Drainage below ground
Low temperature hot water heating
Foam fire fighting

As explained above, the work sections are related to certain types of material and the construction of certain types of elements, and in consequence many of them have 'two part' titles, e.g. Stone slab cladding. However, some work sections have titles based entirely on 'materials', e.g. in situ concrete, whilst others have titles based entirely on 'building parts', e.g. Raised access floors. The difference is merely one of emphasis, it being impossible to devise short titles which fully represent the concept. In all cases the work sections are 'types of work' according to their method of construction, involving the use of certain types of resources and related to certain parts of the building.

3.6 Activities

Obviously, the whole construction process consists of activities, from design through production into use. At each stage of the process there are characteristic subactivities, e.g.
- Design: collecting data, synthesising, drawing, cost estimating.
- Production: planning, ordering materials, fixing, finishing.
- Use: regulating, cleaning, repairing, maintaining.

It appears that there is no strong demand for standard classifications of this type and in consequence they are not considered in detail in this Standard.

An alternative approach to the classification of activities is from the point of view of their result. Thus, for example, the RIBA Plan of Work classifies design activities into, e.g.

- Feasibility
- Outline design
- Scheme design
- Detailed design
- Production information
- Tender

Similarly, the activities of the production phase are most commonly classified in terms of the finished result, i.e. the part(s) of the building/facility being constructed. Para 3.5 describes elements and work sections which either separately or together can be used to define and classify the activities of the construction (production) phase for purposes of planning and control. The various locations of the building/facility, e.g. block 2, floor 2, will also be relevant, particularly on larger projects.

Classification of activities in terms of results during the use phase of buildings/ facilities is not considered in this Standard.

3.7 A model of the construction process

The various concepts described in chapter 3 can be assembled in the form of a dynamic model of the construction process – see figure 5. They are displayed in the sequence of the physical realisation of the building, starting with the resources and ending with the completed building. They could equally be displayed in reverse sequence to reflect the generality of the design sequence.

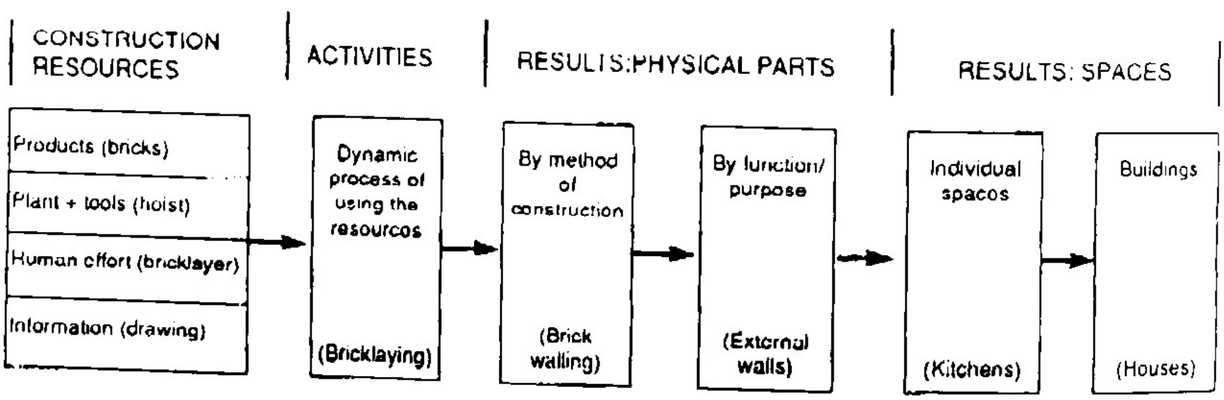

Figure 5 The main concepts within the construction process

In figure 5 the concept of ACTIVITIES is different from the rest. The other concepts are physical in the sense that one can touch or see them as objects or walk into them as spaces. But activities as shown in the diagram are a process – they are not the resources used, nor are they the end product. It is useful to consider the difference between:

- Activities, e.g. bricklaying – this is a dynamic process, at a particular point in time – the actual construction taking place on site.
- Results, e.g. brick walls, external walls – these are static objects, existing at a later point in time. When considered by method of construction, e.g. brick walling, this is a retrospective view.

It will be seen that the main difference between bricklaying and brick walling is one of timescale – in this sense they can be thought of as mirror images of each other. For this reason it is practicable to use a single classification table (work sections) to embrace both concepts. It should, of course, be mentioned that by using a combination of work sections and elements (e.g. brick walling in foundations) one can obtain a finer-grain classification of activities.

3.8 Attributes

At all stages of the construction process there is a concern with quality, suitability and fitness for purpose. The building owner will express preferences and requirements, the designer will wish to select products and design to certain levels of performance, the contractor will be concerned to comply with the specification and also to select practicable and economic methods of construction, and finally the occupiers will form views on the quality of the finished building and its parts.

Physical attributes are the properties of and the requirements which may be specified for either building resources (essentially building products) or results (whole buildings, spaces, elements, work sections). They are becoming increasingly important as more and more emphasis is placed on the quality control and quality assurance aspects of building. It will be seen that attributes stand in a matrix relationship with the physical objects of building as follows:

It should be noted that:

- The importance of the attribute in relation to the 'object' varies considerably. In some cases the attributes may be of great importance, e.g. appearance of facing brickwork, strength of a floor, thermal climate of a space. In other cases the attribute may be unimportant or irrelevant, e.g. strength of loose fill insulation, thermal resistance of foundations, structural strength of a space.
- In a functional sense the various objects are related in a hierarchy, e.g. the thermal attributes of a product will influence the thermal attributes of the relevant work section, which will affect the thermal attributes of the relevant elements, which will contribute to the thermal characteristics of the enclosed spaces.

- At the level of complete buildings the concept of attributes is very broad, and can be thought of as functional subsystems. Thus the fire safety subsystem of a building may involve the flammability, etc. of the various types of work (products fixed in position), the fire resistance, etc. of various elements, the fire detection and alarm system, the sprinkler or other fire fighting system, the spaces which afford means of escape.

	CONSTRUCTION 'OBJECTS'				
ATTRIBUTES	Products	Work Sections	Elements	Spaces	Complete Buildings
Constituent material					
Shape, size					
Weight					
Accuracy					
Appearance					
Strength					
Fire properties					
Moisture content					
Thermal properties					
Light					
Acoustic properties					
Compatability					
Ease of use					
Cost of production					
Cost in use					

Figure 6 Matrix of attributes in relation to construction 'objects'

3.9 Other concepts

So far we have discussed the construction process from the point of view of resources, production activities and completed works. Clearly, the whole construction process co-exists with many other fields of human activity and knowledge and with many other industries. The sciences and humanities at large lie on the boundaries of the construction process and, particularly in the design phase, are heavily pervasive. It is not the purpose of this Standard to deal with the classification of such concepts: the question is raised simply to emphasise that classification of the construction process is part of a much wider continuum of concepts.

4. AN INTERNATIONAL CONSTRUCTION CLASSIFICATION SYSTEM

4.1 Basic requirements

Classification systems are usually difficult and expensive to change, and such change is often unpopular with users. Stability is therefore a necessary feature, and to provide this any classification system should be based on a sound analysis of the basic principles and concepts which it seeks to represent. This is true at any level, but particularly in national and international systems of classification. The analysis of concepts in chapter 3 thus has great relevance.

An international system should meet a number of other basic requirements, including the following:

- The system to be created should be felt as giving freedom, not constraint. It must be felt as an advantage to use the system if it is to attract many users.
- It must be possible to change and add new parts to the system when need arises. This means that the system must be built up in some modular form.
- It must be possible to use only those parts of the system which are needed for a particular purpose.
- Internationally recommended solutions should be natural to apply in a national system. Within the framework of the national system branch/trade applications should be possible. Local applications may be necessary to reflect variations in conditions and needs. Individual, willfully different national, branch/trade or local applications would be counter-productive.

4.2 Classification classes and tablos

A practical classification system will consist of classification tables covering the basic concept areas or 'classes' described in chapter 3. For each of the classes there are three steps to be performed when creating a classification table.

1 Identify all items which belong to the class.
2 Order the items in a suitable way (create a useful structure of the table).
3 Give codes to the items.

There is no standard predetermined division of a class into its items. The items have to be selected so that they are as meaningful for the intended use of the classification table as possible. Neither is there a standard predetermined structure of a table – this needs to be devised so that it is as helpful for the intended use of the table as possible. Obviously there are no standard predetermined codes – here again the practical usefulness decides.

These choices and the historical absence of an international standard mean that existing national classification tables for the same class often vary significantly. For example the CEEC Cost Planning Commission has to cope with five basically different elemental classification tables among the eight participating countries. There is an even greater degree of variance between the work section classification tables of various countries.

In the context of this Standard it is relevant to ask the following question in relation to each classification class:

- What would be the value of an international standard table?
- How practicable would it be to achieve an international standard table?

The answers vary from one classification class to another, and different countries and different types of user may give different answers to the same question. An international system must therefore be structured to permit different degrees of standardisation of tables and to enable the pattern of standardisation to change with time. It is envisaged that some classification tables will be recommended for universal international use, but for most classes it will not be practicable to advocate universal adoption of a single table.

The computer may be used as a translating tool between different tables provided that the same basic items are found in both. Unfortunately, it is usually the case that different tables for the same class contain different basic items so that translation is not a practical possibility for day to day work. The more frequently different tables for the same class have to be used together, the more necessary it is that the differences between them are removed.

4.3 The importance of class definitions

Classification tables can be thought of as modular components which need to fit together without gaps or overlaps. To give maximum flexibility all components must be interchangeable, which means that they must observe the discipline of the module.

In the analogy, the 'space' for the component is the basic concept or class which the classification table represents. The modular lines which define the 'space' are determined by the definition of the class, so that if a classification table:

- goes over the boundaries of its class definition, it will clash with adjoining tables (components), or
- does not include all things which it should, it will fail to fill the space allotted to it.

For this reason the most fundamental and important parts of international classification are the definitions of the basic classification 'spaces'. If the class definitions are universally followed it will, for example, be possible for country A and country B to have a common classification table of e.g. elements, but different classification tables for work sections without experiencing difficulties of 'fit' at the joints.

4.4 The proposed framework

Figure 5 shows the proposed set of classification classes based on the concepts shown in Figure 4. The classes are described in more detail in chapter 5.

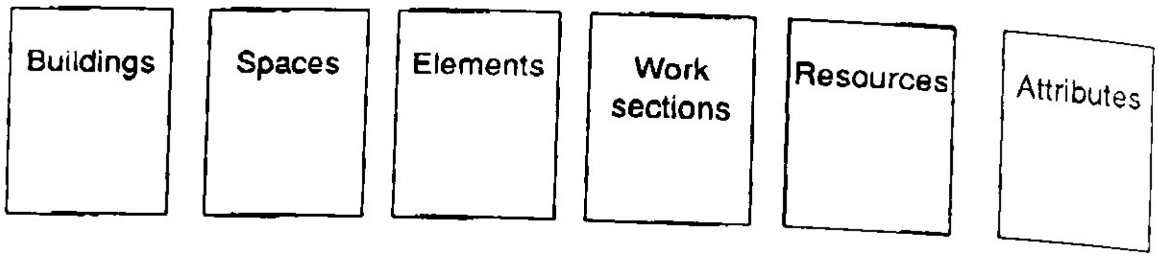

Figure 7 Proposed international classification classes

5 THE CLASSIFICATION CLASSES AND TABLES

5.1 Buildings/Facilities

Definition
Whole buildings or major parts of buildings according to the main activities taking place within them. Engineering facilities according to their principal function.

Examples
Factory
Hospital
School
House
Road
Power station
Water supply network

Uses:
Building regulations
General information on user requirements
Historical data on design
Historical data on costs
Information for property management

International standardisation
A standard table would give significant benefit. However this type of data is mainly historical and on a large scale, which means that change from existing national systems could be difficult. The most widely used existing classification is CI/SfB Table 0 and this may, given some changes, be suitable as an ISO **Recommended Standard Table.** Work is being done on this during 1990.

5.2 Building spaces

Definition
Spaces within buildings/facilities according to the activities taking place within them.

Examples
Office spaces
Health care spaces
Teaching spaces
Recreation spaces
Residential spaces
Road spaces
Electricity generation spaces

Uses
General information on user requirements
Project specifications

International standardisation
A standard table would give some benefit. In practice this table needs to be constructed with a close relationship to the buildings/facilities table in order to permit classification of:

- 'dual' ideas, e.g. office spaces within factories.
- information about e.g. offices in general, regardless of whether building or space.

An **ISO Recommended Standard Table** is therefore envisaged.

5.3 Elements

Definition
The major physical parts of a building/facility, its servicing systems and external works which perform basically the same function(s) as the corresponding parts in most other buildings/facilities (regardless of particular physical form or the materials and methods used in construction).

Examples
Foundations
External walls
Floors
External openings
Ceiling finishes
Space heating
Electricity supply and distribution
Fire detection/alarm/control
Cuttings/Embankments
Pavements
Bridge decks

Uses
Clients brief
Written descriptions of design proposals
Drawing numbering
Layering of data in CAD systems
General information on performance
Product information
Historical data on design
Historical data on costs
Cost planning
Life cycle costing
Bills of quantities

Construction management
Property management

International standardisation
Elements are of interest to clients, architects, engineers, quantity surveyors, construction managers and property managers, and therefore have a great potential for information co-ordination within each country. International agreement on a common table would give significant benefit, particularly for data banks and cost feedback. However, the many and various national classification tables are, in general, well used and would be difficult to change. Perhaps the most realistic and constructive action would be to publish an **ISO Recommended Example Table** which would:

- Illustrate the principle of strict compliance with the class definition.
- Be available as a standard for adoption by countries which do not already have a standard table, or which may wish to change.
- Be available for use as a common protocol for exchange of data between several countries, each of which uses its own special table.

It is believed that few, if any, of the existing national element tables comply fully with the proposed definition, and also that there are significant differences between them. This means that a common protocol for exchange of data would probably be difficult to operate. The motivation for adoption of an international standard table is thereby increased.

5.4 Work sections

Definition
Types of finished work according to their method of construction. They are usually executed by particular types of subcontractor or groups of operatives, involving skill in the use of certain materials, tools and techniques and skill in the construction of certain physical part(s) of buildings. The class is influenced by both inputs (e.g. the materials/products used) and outputs (the parts of the building constructed), and thus represents a dual concept.

Examples
(The term 'work' is implied at the end of each title)
Excavation and filling
Brick/block walling
Structural precast concrete
Stone slab cladding
Mastic asphalt roofing
Curtain walling
Raised access floors
Windows
Ceramic wall/floor tiling
Interlocking brick/block paving

Flexible macadam pavings
Below ground drainage
Low temperature hot water heating
Fire sprinkler installation
Underfloor electric heating
General low voltage lighting and power
Emergency lighting installation
Lift installation

Uses

National building/engineering specifications
Project specifications
Standard methods of measurement
Bills of quantities
Construction management
Layering of data in CAD systems
Product information

International standardisation

Work sections are of great importance because of their use in arranging tender and contract documents, at the interface between design and construction. They are also of great use in production planning and control, helping to define activities which coincide with the responsibilities of the various subcontractors and work gangs. Most countries already have their own well established work section tables, reflecting the present (or sometimes former) pattern of subcontracting. It would not be possible to agree an ISO Standard Table at present. During the next few years contracting practices in Europe will probably converge, so that a Standard Table may then become practicable. At present ISO might publish a list of national work section tables which are judged to comply with the class definition.

5.5 Resources

Definition

The matter/energy resources (manpower, equipment and products) required for the construction of a building, and also other resources such as land, money and information. The matter/energy resources are as follows:

- **Manpower:** the time of organisations, professionals, managers and site operatives, including their respective skills.
- **Equipment:** the use of tools, plant and machines (including required energy) for both office work and construction work, not built into the building.
- **Products:** all materials and components and 'kits of parts' delivered to the site for incorporation into the building, including its services, furniture and equipment.

Uses

Product/specification databases

Merchants stocklists and catalogues
Contractors ordering/requisition schedules
EDI transactions

International standardisation

EDIFACT Board MD5C have recognised the value of a classification which divides building products into useful groups. They propose the development of such a new classification, it being envisaged that it will be developed during 1990–1992 and then implemented rapidly. Studies so far have indicated that grouping could be according to the purpose, shape and constituent material of the products.

Product databases exist or are being developed in most European countries. Ten information houses, each one being the principal such organisation in their respective countries, have come together to form a joint venture, called European Product Information Co-operation (EPIC) to define a common basis for exchange of information on products. This involves the development of a common grouping of products and EDIFACT have accepted, in principle, that they should use the EPIC classification when it becomes available.

This proposal for a European product classification has great significance because of the prospective increase in international trade in building products and the great variety of element/work section classifications at present used for product information. At present there are virtually no product classifications as such, and therefore no major problems of change. The proposed classification would probably be used for structuring of international product databases and would thus form a sort of 'Esperanto' between different countries. Each country could also use its existing element or work section classifications to code products – the advantage of such double coding would be that by means of the computer information on products could be made available in the grouping and sequence required by the user at any particular time.

This new initiative is of such force and potential value that it deserves full support from ISO. Subject to the classification being technically competent, and assuming that there would be no problems with copyright, it is proposed that it be adopted as an **ISO Recommended Standard Table.**

The EDIFACT Board MD5C is also investigating the possibility of making recommendations for article numbering and labelling of products and packages of products using bar codes in addition to alpha-numeric codes. Liaison has been established with the European Article Numbering Association. This initiative also deserves full support from ISO.

For most practical purposes, product classification is the most important aspect of resources. However, the other resources, i.e. manpower, equipment and information, should be given at least outline coverage in the proposed ISO Table.

5.6 Attributes

Definition

Physical properties and characteristics of artifacts of all kinds, including products, types of finished work (work sections), elements and whole buildings/facilities. The same or similar properties/characteristics applied, where relevant, to the spaces within buildings/facilities.

Examples

Constituent material
Shape, size
Weight
Accuracy
Appearance
Strength
Fire properties
Moisture content
Thermal properties
Light
Acoustic properties
Compatibility
Ease of use
Cost of production
Cost in use

Uses

Internal arrangement of technical documents
Structuring of product databases, building cost databases, etc.
Structuring of other classification tables according to primary attributes.

International standardisation

The CIB Master List, 1983 Edition is already widely accepted as a Standard. It was designed as an internal arrangement for documents but not for any other purpose. It is proposed that a classification table should be developed, based on the Master List items 1, 2, 3, 4, 9 and 10, as an **ISO Recommended Standard Table**. Such a task would be relatively straightforward, but it should be done in full consultation with CIB.

6. USE OF THE CLASSIFICATION TABLES

To be written. May include:

- Summary of and reference to related ISO Standards describing the use of various classification tables at different stages in the building process, including class conjunction.
- Rules for use of the tables, both for creating and using information.
- Use of sundry 'ad hoc' classifications for e.g. location within a project, type of drawn information.
- Techniques for optimum computer use of classified data, e.g. resortation, recipe technique, structured menus.
- Controlled use of terminology.
- Controlled use of notation.
- Other?