

17. Summary in English

17.1 Norwegian building standardization *)

A precondition for efficient use of computers in the total building process and also in management and maintenance of the building process is a set of common rules related to processing and presentation of data.

To develop such rules and to give sufficient authority so that they are accepted by the industry requires cooperation from the different parties in the industry.

The Norwegian Council for Building Standardization therefore back in 1966 started on a big program to develop the necessary rules and publish them as Norwegian Standards.

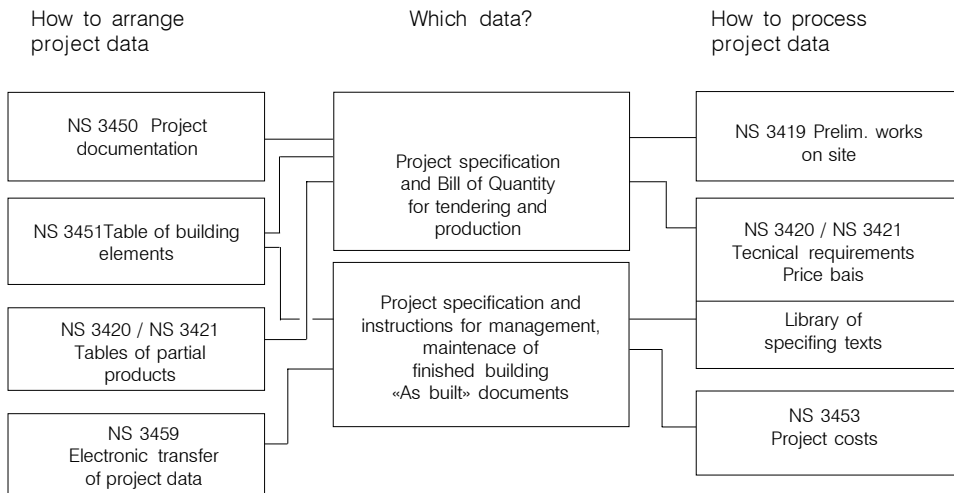


Figure 16.1. System of Norwegian standards for project management

*) Sections 16.1 and 16.2 by Odd Lyng

Today a number of such standards are in force. Together they create a „data infra structure” for the building and civil engineering industry and are the basis for almost all computer programs used in Norway for processing and presentation of project data.

The figure 16.1 indicates the system of standards, their interrelation and how they are used to produce and communicate project data for individual projects. In addition to these standards there are a number of others which are important but not directly connected with the use of computer.

The standards shown in the figure together form a common system that is a basis for much of the design work and management of building projects. Consequently today nearly all data on different individual projects are arranged in a standardized way which makes it easier to communicate and cooperate between different individual systems and firms.

The tables are often combined with tables developed for an individual project, an individual firm or computer program.

Part of the structure are also some rules on the use of the tables and definitions, e.g. definitions and rules related to types of project documents.

17.2 The data

In the same way as the erection of a building is rationalized by the use of prefabricated parts, bricks, windows, boilers etc., the „intellectual erection” of it – design, specification writing etc. – can be rationalized by use of „prefabricated” data packages that can be put together in different ways to make a specification of a building element.

Two standards contain such packages, NS 3420 for construction works, and NS 3421 for installations.

Each of these standards contains a library of short specifying texts – e.g.

Q13.102	STUD WALL FOR CLADDING / BOARDING TOLERANCE CLASS 2.
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Each such text carries an individual code. The code alone can be used when this is convenient. The first part of the code is classifying and refers to technical requirements, price base and methods of

measurement which apply to the specifying text. How this works in connection with the technical specification and bill of quantity is illustrated in the figure below.

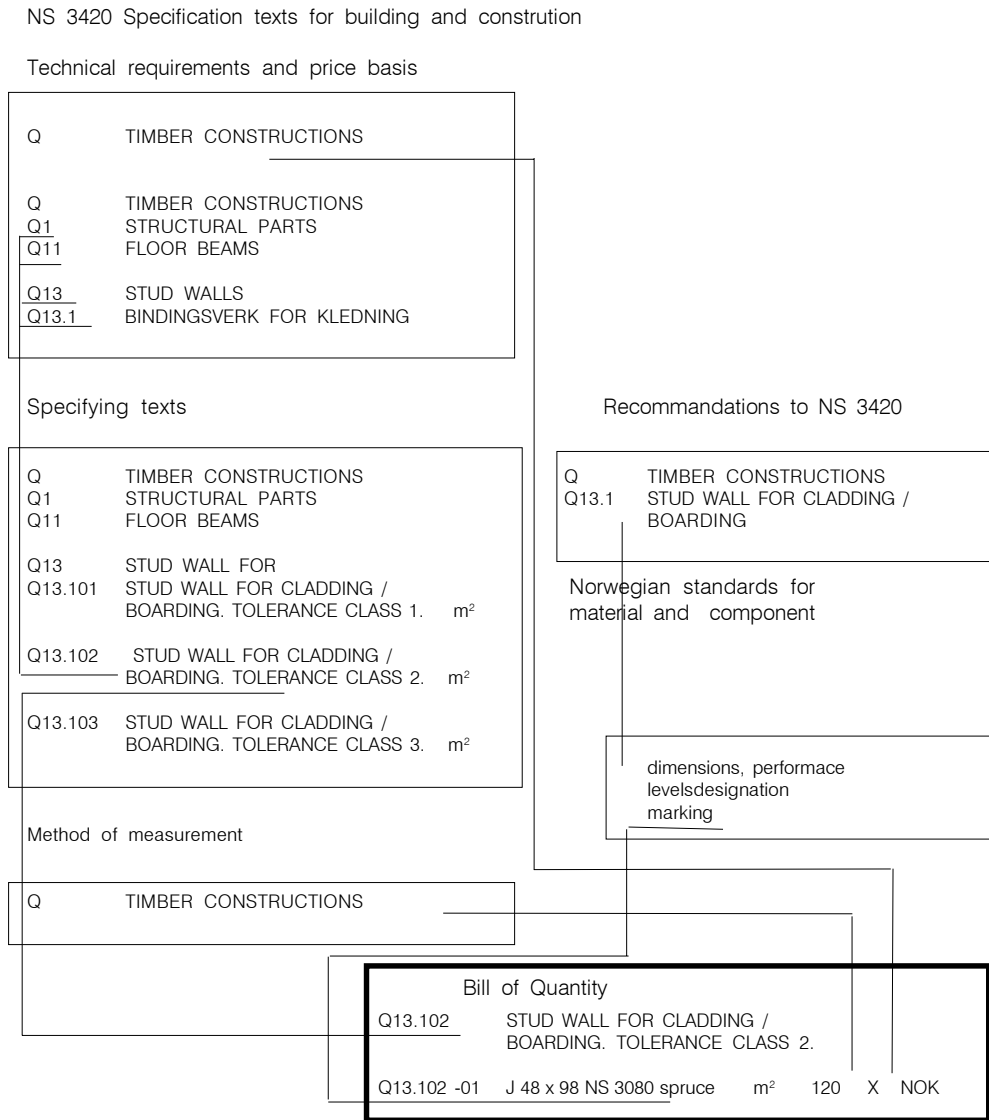


Figure 16.2. Technical specification and bill of quantity

All the 35.000 texts (items) in NS 3420 and the 45.000 texts in NS 3421 are available on computer readable medium.

17.3 What is project management?

Aims, conditions, elements, phases

To manage a project means to complete it according to plans – in relation to quality, time and economy. The management routines are manifested by a continuous comparison between results and plans.

Information concerning plans and achieved results should be recorded and presented in reports related to different phases of the project.

Information must be organized to enable a quick, secure and cheap transfer of data from document to document, from one project phase to another, and more important, between all the partners of the project team.

Today computer programs can be used effectively to build up an information bank for the project and for the production of documents. Well organized project documents are an advantage for both the architect, the consulting engineers and the contractors. The investor covers all expenses related to the project, and will profit from each increase in efficiency within the project team.

Specifications and bills of quantities should form the base of all project documents. This postulate is valuable independent of type of project, the organization of the project team, tendering system as well as political and economic conditions. It is to be expected that soon all specifications and bills of quantities of some magnitude and complexity will be arranged by means of a computer.

A bill of quantities stored on a computer disc should represent a «living» document which can represent the development of the project. This document should serve as a main information source concerning the economy of the project in all phases of planning and construction. The ability of a computer to store large data files in a cheap way will contribute to the enhancement of bill of quantities prepared by architects and consulting engineers. They will be able better to provide the contractors' requirements for knowledge of the quantity details.

After opening the bids the investor can control and compare the offers. Once the contractor is chosen, the results of the contract negotiation can be recorded on the computer disc and a new document – the contract – can be processed. In the case of a contract based on fixed quantities, the contractor will have the opportunity to control all quantity details concerning the project, stored on the disc, before signing the contract. Lists of materials,

manpower, tools etc. can be extracted from the basic data bank established on the computer disc. From the start of construction a copy of the contract file should serve as a base for the invoicing system and as a legal document for recording the alterations and change orders.

A separate file should be used to record the progress of the works. From this file the invoices can be written.

By comparing the progress file against the contract file, economic „status” reports can be produced. The time-consuming work of adjusting the contract according to inflation rates is easily done when both the contract and the progress of the work are accessible on the computer disc.

To the contractor the described method represents a better cash-flow. To the investor it assures a better economic control of the project.

During the construction phase large data sets are collected which may be of great value if utilized to manage the running and maintenance of the building in a rational way. These data can be recorded on the contract file and a new document, „as-built” specifications can be produced.

The described procedures will save a great amount of expensive specialist time, human resources can be better utilized.

17.4 Classification and coding - the „spinal column” of a management system

The accounting system is the key to manage a project. It is the «spinal column» for all the information needed in the project. To be effective this accounting system must reflect both the administrative and the physical structure of the project. Furthermore the accounting system must be based on some scientific principles of classification, coding and logic.

It may be difficult to emphasize sufficiently the necessity of such a structure of an accounting system. The importance of it is still greater when it is seen in relation to modern information technology.

It is indispensable to respect the common rules of classification when structuring the accounting system for the project. It results in flexibility and enables a cheap processing of data. It is strongly recommended to follow these rules when establishing the information structure for a project.

The accounting system must impose fixed rules for the management of information. It must also be able to „grow” according to the progress of the project during all its phases.

It is recommended to divide the accounting system into two independent parts:

- a general part
- a special part.

The general part of the accounting system should consist of the following terms:

- building elements
- partial products
- resources.

This can be illustrated by the figure 16.03 below.

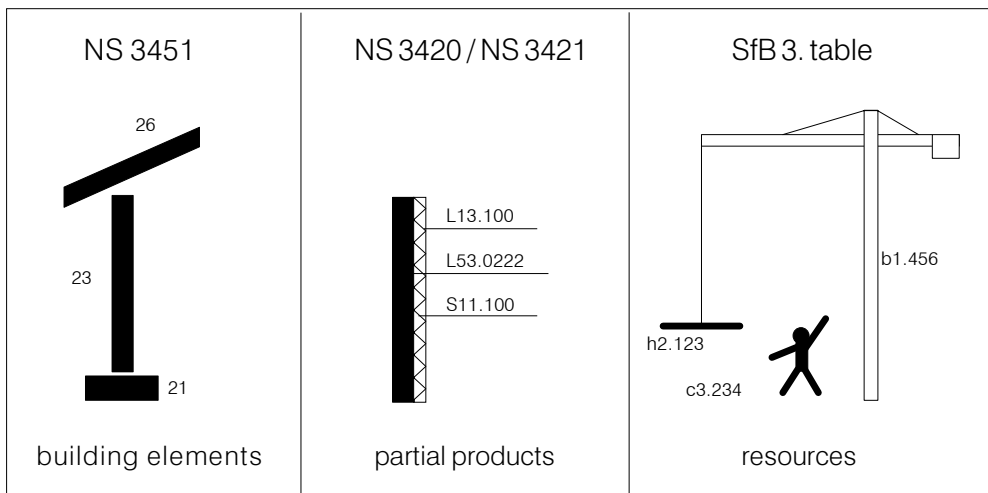


Figure 16.3. Norwegian standards as a facet system for building classification

According to Norwegian practice there are standard documents defining codes and specifications corresponding to the three main groups of the above mentioned terms. For the classification of resources the international SfB-system is recommended.

The special part of the accounting system should reflect both the administrative and the physical structure of the project. When the general codes must be respected with firmness during the entirety of the project, the special part of the code may have a higher degree of freedom. The main task for the special codes are to give „addresses” to physical and administrative parts of the project and to control bodies connected to them.

Examples of such codes are:

- investor number
- project number
- building element
- part of project - block, storey, room
- trade
- contract number, subcontract number
- document type and number - invoice, change order
- date, vendor number
- drawing etc.

Both the general part of the accounting system and the special part should be arranged in independent facets. It is recommended to introduce the principle of logical sum (not arithmetical sum) when it is possible. It should be mentioned that the total of codes within an accounting system should be kept as limited as possible.

Each redundant part of information in the total system increases the project cost. When establishing the accounting system one should analyse the logic of the terms chosen and avoid „over-defining“.

17.5 Specifications, Norwegian standards and individual catalogues

The basis of an integrated management system should be the specifications and the bill of quantity. This document should be the basis for all planning and control functions included in the project. The bill of quantity should be based on the project accounting code, specifications, material take-off and a price bank.

Specifications should be coded by means of a general code. National standards may be used for this purpose. This is the case in Norway where the building industry since 1975 has been applying the Norwegian standards NS 3420 / NS 3421 „Standard specifications for building, civil works and technical installations“. These standards supply the main items, about 80.000 in all, for partial products, in the form of structured and codified libraries.

The standard specifications are limited to cover quality requirements and measuring rules. Architects and engineers designing the project have full freedom to add adequate information to define a particular solution. Such additional texts can be collected in com-

pany standard catalogues which may be used from project to project. Additionally one may need a set of texts which are connected to time and location. These may only be applicable for a given project. For that reason these texts do not belong in company catalogues, but in a separate project catalogue.

The following example illustrates the relationship between texts collected from the three catalogue types:

National standard

L53.122 CONCRETE WALL. TOLERANCE
CLASS 2. NORMAL CONTROL.

Company catalogue

L53.122 -01 Concrete quality C 25.

Project catalogue

L53.122 -86 Front wall facing Henrik Ibsen Street.
Location of construction joints to be
arranged with the architect.

Both company catalogues and project catalogues should have the same code structure as the national standards. It eases the use of all three types of catalogues when setting up the bill of quantity for the project.

Norwegian Building Standardizing Council (NBR) has copyright on national standards. The standards are sold on diskettes. Users are recommended not to make any alterations within the standard specification file, except when corrections are distributed by NBR.

In the specification the user is writing, he will need both standard texts and separate supplementary texts. Standard texts which are supported to form an introduction to his own texts can be entered automatically. In extreme cases, this procedure may reduce the number of code entries by 50 %, for the texts that are to be included in the final specifications.

Measuring unit, unit price and unit weight may be attached to each specification code. This information can be entered automatically in the quantity file and can be used to establish budgets and cost estimates.

17.6 Material take-off, element method

The knowledge of quantities belonging to a project is the main and only way in which one can secure rational planning and control of the project.

Taking care of detailed data will result in profit both to the planners and the contractors. It must be of interest to the investor to have at hand a bill of quantity, which can directly be used as a base for economic control of his project.

It has always been a problem to keep price banks up to date. Computer techniques solve this problem today and give the opportunity to build up relevant budgets and estimates.

The bill of quantity based on the mentioned basic elements answers the questions: what, how much, at what price, where, by whom and when.

17.7 Tender procedures

Tender documents established according to modern rules will consist of:

- a bill of quantity and specifications in form of a book
- a complete copy of BQ on EDP medium
- a set of drawings

The contractor receiving such tender documents will be able to calculate the tender prices using a computer.

This calculation is recommended to have in principle the following run:

- one picks the basic cost for labour, materials and tools from a catalogue and links them to each item in the bill of quantity
- one decides the supplementary factors to cover general expenses as well as the profit for the company
- the programme calculates the basic prices and the final prices to be presented for the client
- the program sets up key figures and information concerning the consumption of manpower according to the main parts of the project
- the program produces the final print-out of the submission document for the investor

The contractor will return to the client the tender document in book form, completed with prices, as well as a diskette consisting of a copy of the same.

Tendering procedures based on a BQ system should be directly connected to further planning routines as:

- attaching activity codes to bill of quantity and specifications
- attaching delivery codes to materials
- establishing a manpower bank
- establishing a relationship between the activities
- drafting a time schedule
- fixing a delivery plan for the materials

The terms mentioned are well known among all specialists working in the area of planning building projects and civil works. A new aspect of this old problem is the fact that an integrated BQ computer system will enable the planners to reuse the basic data, collected within the original bill of quantity, during the whole project time. Each new document will in reality represent a derivative or an improvement of the basic data.

In the future consultants will more frequently be able to offer the bidder a BQ on an EDP medium - documents which can be truly said „to be alive”.

The bidder will in return be able to save time and money by performing his calculations for the tender documents with the aid of computer program – and can return a priced BQ to the client - - both as a printout and on an EDP-medium (diskette).

The client can perform the necessary tender comparisons more quickly with the aid of a computer program, and choose the winning bid.

17.8 Establishing contracts. Alterations and change of orders

Before a contract is written it is usually necessary to change some of the items in the BQ. This can be done very simply if it has already been established on disk.

All possible changes in the project, being either qualities, quantities or methods of work – which are introduced during contract negotiations – should be registered on the original tender documents on disk. From this medium one can now produce a contract agreement, and make this the foundation for all the administrative procedures during the building process.

17.9. Project management, building accounts. Managing changes

Before starting the contract works, it is important that all involved parties agree to a common procedure. For instance:

- all changes ordered by the client are collected in change orders
- change orders are accounted as specified in the table of accounts
- each item is given a symbol for type of transaction (to settle addition for inflation)
- change orders are not being disbursed until they are registered on the EDP-medium
- change orders are registered as soon as possible, and a printout of these are made available to contractors, subcontractors and the project manager
- change orders are being disbursed once a month together with items from the main contract

If it is necessary to replace an item from the original contract with a new item from a change order, this should be submitted with a reference to the main contract. The expression „item removed” should not be used.

The rules defined above are of great importance for the successful implementation of the total task.

With a strong dual discipline between the client and the contractors, it is possible to maintain a complete record of all the supplements for writing out invoices and the actual total obligations, i.e. original contract and change orders.

This solution will cover the need of basic information both for the client and the contractor. The client can now quite easily achieve a complete economic control of the works. By registration of progress he can produce invoices and status reports. Alterations, changes of order and additional reimbursement works will be registered continuously on the contract disk, and be the basis for a complete control of the economy of the project.

Information of progress can be expressed as quantities of activities as defined in the contract items, being performed in a given period (month or 4 weeks), which and be the base for settling accounts. As these are registered, one can immediately print out a supplement to the invoice. This supplement has the form of an extraction of the contract.

At the same time status reports can be produced. These reports may have different layouts, depending on their use. They will all show how much is performed compared to what is ordered through the main contract and the change orders. Special editions form the base for calculation of inflation.

As soon as parts of the works as defined in the main contract or the change orders are completed, a report should list them as closed activities. On the basis of these, one has a partial settlement showing a balance between contracted and completed. These reports are of great interest since many projects contain great uncertainties concerning item quantities.

17.10. Final settlement.

As built document. Maintenance

The previous described procedure for production of invoices will give a base for simplifying the production of a final settlement. This document is being produced continuously on disk. As soon as the last invoice is accepted and possible corrections are reported, the final settlement can be produced. At the same time the client can be handed an as built document in the same way as a shipbuilder receives such a document from the shipyard when handed a new ship.

An as built document will include a complete specification of the building or works, with regard to specification texts, measures, magnitudes, quantities and prices. Such a document may serve as a base for the planning of an organized maintenance.

17.11. Bill of quantity from CAD

Traditionally the specifications and bill of quantity has been established manually, either by the aid of a computer program or simply by pen and paper and a pocket calculator. Today powerful 3-D cad-program have the ability to perform quantity calculations, and furthermore it is also possible to input these calculations to advanced integrated management systems and produce a bill of quantity automatically.