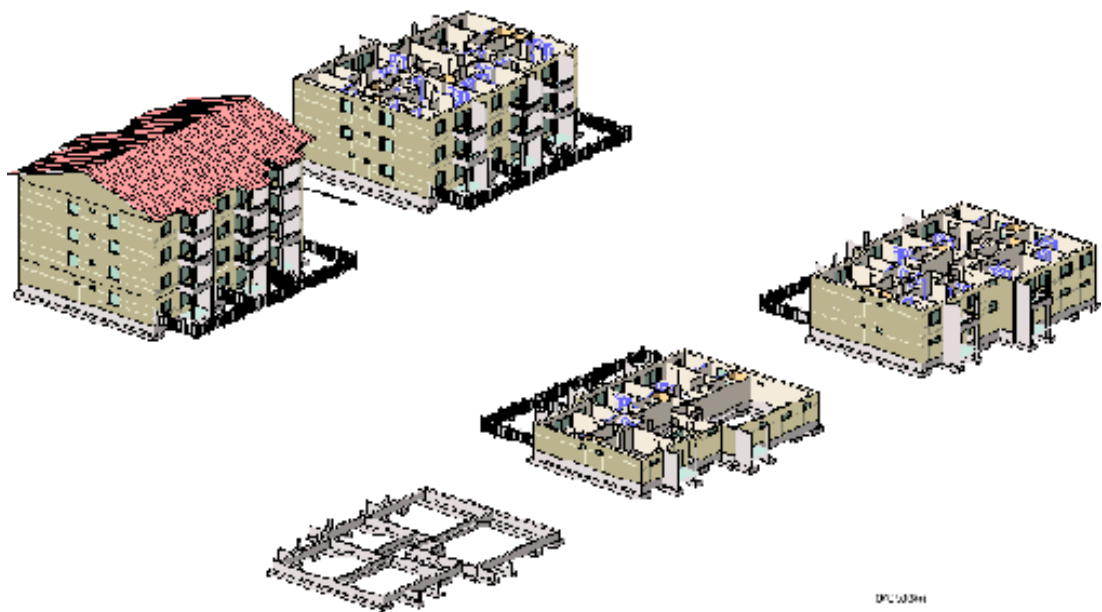


CONSTRUCTION MANAGEMENT

Study Book



Olli Ilveskoski & Seppo Niittymäki

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e-publication

ISBN 978-951-784-721-6 (PDF)

ISSN 1795-424X

HAMKin e-julkaisuja 4/2015

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PUBLISHER

Häme University of Applied Sciences

PO BOX 230

FI-13101 Hämeenlinna, FINLAND

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Hämeenlinna, January 2015

Preface

This publication is a summary of the Construction Management course manuscript. The objective is that as the student gets involved with the Construction Management of Building Projects he/she learns Construction Management topics like Building Process, Production planning, Quantity Take Off, Cost Estimation, Scheduling, Work Safety and Quality Control. Many topics in the field are referred shortly or will be discussed in the future studies.

We thank all the participants and especially TTU Tampere University of Technology and VIA University for their contributions. We want to thank especially our emeritus professor Raimo Salokangas for his inspiring mentoring. The study book has been in use in Construction Management courses in Häme University of Applied Sciences.

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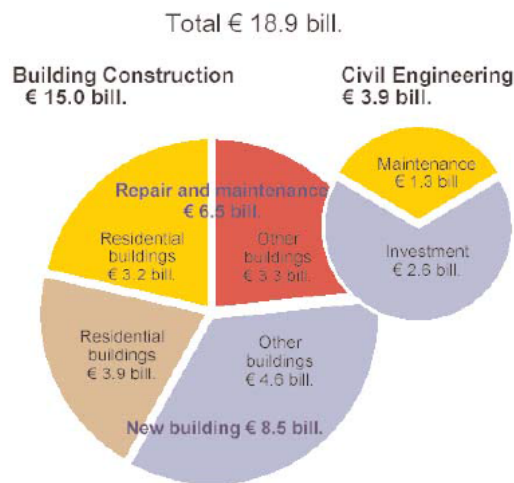
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1 Introduction

1.1 Construction industry in Finland

Finnish construction industry is relatively positive in terms of newly scheduled construction projects, employment and expected profitability. However, the sector has seen huge fluctuations since the beginning of the 1990s. It is difficult to give the precise size of the Finnish construction cluster, because it varies according to the number and types of companies included for a particular project. However the total gross value of construction in 2003 was about €18.9 billion. /25/

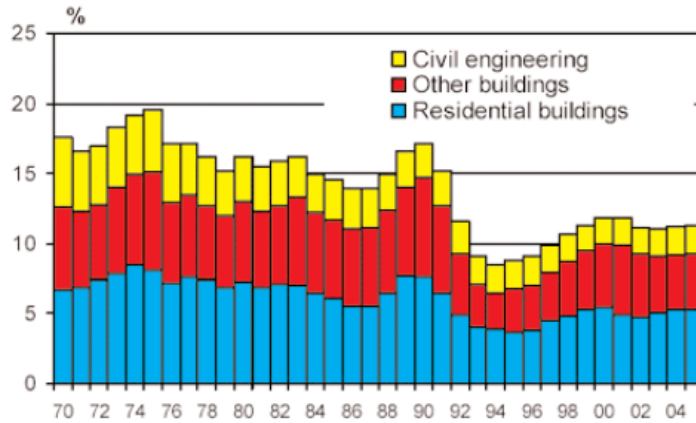


Source: RT, Statistics Finland, VTT, 2004

Fig 1 Construction sector output, €18.9 billion

As the figure shows, 21% of construction revenue comes from civil engineering projects, and 79% from building construction. Within civil engineering 33% of turnover comes from maintenance, while the corresponding proportion for building and construction is 43%. The construction companies must be ready to do repair and maintenance work. They should recognise that customers might not be interested in the current construction project only, but instead in the total package: the construction together with repair and maintenance when the building is in use. This requires that maintenance activities be included in the project plan, either by the company doing the construction or by partners.

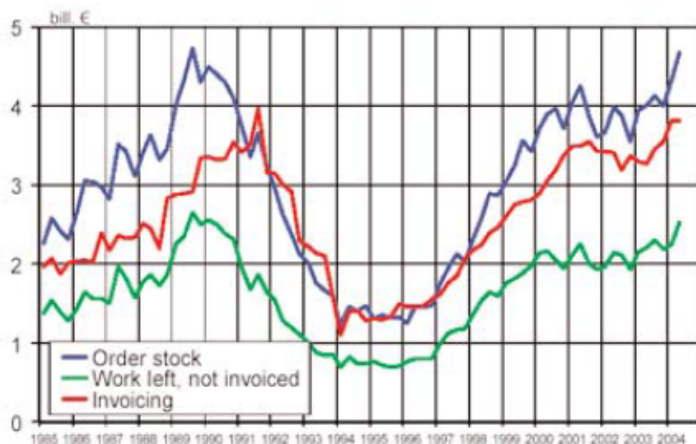
Construction is expensive so it makes sense to measure the health of the sector in terms of construction investment as share of gross domestic product (GDP), as shown in Figure . /25/



Source: RT, Statistics Finland, VTT, 2004

Fig 2 Construction investments as a share of GDP

The Finnish construction industry has historically been very active, peaking in 1975 when almost 20% of the GDP came from construction investments. Until the 1990s an average of 15% of the GDP came from construction. This changed between 1990 and 1994, when it dropped from 15% to 8%. A general slowdown in the economy and the fact that too much capacity was built up during the 1980s. The construction sector has generally recovered from the 1994 recession. It is not yet near the levels of the 1970s or 1980s, but the industry is recovering and it is now relatively stable. However, the industry still has challenges to overcome if it is to maintain stability and certainly if it is to expand. The general economic slowdown at the start of the 1990s also influenced migration patterns, house prices and the demand for new housing. Figure illustrates this slowdown. /25/



Source: RT, Statistics Finland, VTT, 2004

Fig 3 Domestic orders in the construction industry

The construction industry has now recovered from the 1990s recession. However the recession forced people to start discussing the future and strategy of the sector. It was identified e.g. the following challenges:

- Demand for turnkey services is growing and maintenance is becoming part of the construction package.
- Increasing use of partnership-based operational models. The construction industry is characterised by many specialised small and medium-sized companies. Providing customers with a full package requires close collaboration if companies are to present customers with a full picture of costs and services, helping them avoid having to work with several independent contractors. Collaboration can be optimised significantly through data sharing.
- Prequalification of contractors is becoming more common in competitive bidding for contracts. This means that contractors must be able to present an offer that includes data from several partners. This requires fast and smooth access to data.
- Foreign operators will gain a higher profile in the Finnish market. Therefore, Finnish companies must compete on scope rather than on size.
- Growing competition for skilled labour, greater need for training and competition for the brightest students.
- Growth in new construction is slowing and is likely to go into a slight decline towards the end of the decade. This means that construction companies must handle maintenance and repair and be ready to compete internationally.
- As quality and equipment requirements continue to increase, the value rather than the volume of new construction will show a positive trend. This means that the future will bring fewer but bigger projects and that specialised contractors face extinction unless they can operate in a consortium.
- Renovation of real estate and infrastructure will increase greatly in the future.

/25/

1.2 Project stages

Construction management or **construction project management (CPM)** is the overall planning, coordination and control of a project from beginning to completion. CPM is aimed at meeting a client's requirement in order to produce a functionally and financially viable project.

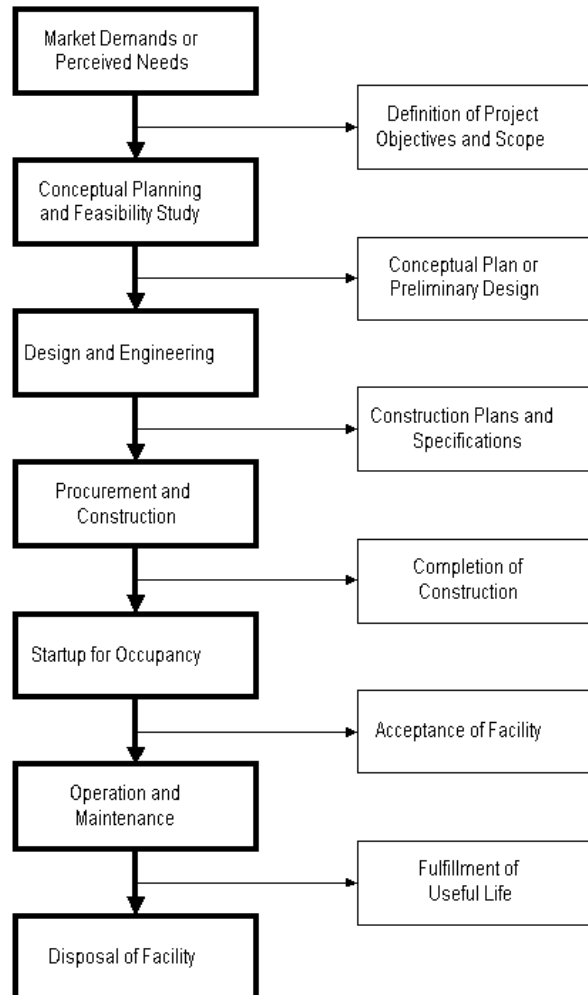


Fig 4 Project Life Cycle of a Constructed Facility /3/

Feasibility Study and Design

The design stage contains a lot of steps: programming and feasibility, schematic design, design development and contract documents. It is the responsibility of the design team to ensure that the design meets all building codes and regulations. It is during the design stage that the bidding process takes place.

- **Programming and feasibility:** The needs, goals, and objectives must be determined for the building. Decisions must be made on the building size, number of rooms, how the space will be used, and who will be using the space. This must all be considered to begin the actual designing of the building.
- **Schematic design:** Schematic designs are sketches used to identify spaces, shapes, and patterns. Materials, sizes, colors, and textures must be considered in the sketches.
- **Design development:** This step requires research and investigation into what materials and equipment will be used as well as their cost.
- **Contract documents:** Contract documents are the final drawings and specifications of the construction project. They are used by contractors to determine their bid while builders use them for the construction process. Contract documents can also be called working drawings. /5/

Bid and Tendering

A bid is given to the owner by construction managers that are willing to complete their construction project. A bid tells the owner how much money they should expect to pay the construction management company in order for them to complete the project.

- **Open bid:** An open bid is used for public projects. Any and all contractors are allowed to submit their bid due to public advertising.
- **Closed bid:** A closed bid is used for private projects. A selection of contractors are sent an invitation for bid so only they can submit a bid for the specified project.

Selection methods

- **Low-bid selection:** This selection focuses on the price of a project. Multiple construction management companies submit a bid to the owner that is the lowest amount they are willing to do the job for. Then the owner usually chooses the company with the lowest bid to complete the job for them.
- **Best-value selection:** This selection focuses on both the price and qualifications of the contractors submitting bids. This means that the owner chooses the contractor with the best price and the best qualifications. The owner decides by using a request for proposal (RFP), which provides the owner with the contractor's exact form of scheduling and budgeting that the contractor expects to use for the project.
- **Qualifications-based selection:** This selection is used when the owner decides to choose the contractor only on the basis of their qualifications. The owner then uses a request for qualifications (RFQ), which provides the owner with the contractor's experience, management plans, project organization, and budget and schedule performance. The owner may also ask for safety records and individual credentials of their members.

Pre-construction

The pre-construction stage begins when the owner gives a notice to proceed to the contractor that they have chosen through the bidding process. A notice to proceed is when the owner gives permission to the contractor to begin their work on the project. The first step is to assign the project team which includes the project manager (PM), contract administrator, superintendent and field engineer.

During the pre-construction stage, a site investigation must take place. A site investigation takes place to discover if any steps need to be implemented on the job site. This is in order to get the site ready before the actual construction begins. This also includes any unforeseen conditions such as historical artifacts or environment problems. A soil test must be done to determine if the soil is in good condition to be built upon. /5/

Procurement

The procurement stage is when labor, materials and equipment needed to complete the project are purchased. This can be done by the general contractor if the company does all their own construction work. If the contractor does not do their own work, they obtain it through subcontractors. Subcontractors are contractors who specialize in one particular aspect of the construction work such as concrete, welding, glass or carpentry. Subcontractors are hired the same way a general contractor would be, which is through the bidding process. Purchase orders are also part of the procurement stage.

- **Purchase orders:** A purchase order is used in various types of businesses. In this case, a purchase order is an agreement between a buyer and seller that the products purchased meet the required specifications for the agreed price. /5/

Construction

The construction stage begins with a pre-construction meeting brought together by the superintendent. The pre-construction meeting is meant to make decisions dealing with work hours, material storage, quality control and site access. The next step is to move everything onto the construction site and set it all up.

At this stage, construction monitoring and supervision is of great importance to ensure that a project is completed on time and on budget, while meeting all relevant regulations and quality standards.

Contractor progress payment schedule

A Contractor progress payment schedule is a schedule of when (according to project milestones or specified dates) contractors and suppliers will be paid for the current progress of installed work. Progress payments are partial payments for work completed during a portion, usually a month, during a construction period. Progress payments are made to general contractors, subcontractors, and suppliers as construction projects progress. Payments are typically made on a monthly basis but could be modified to meet certain milestones. Progress payments are an important part of contract administration for the contractor. Proper preparation of the information necessary for payment processing can help the contractor financially complete the project.

Owner occupancy

Once the owner moves into the building, a warranty period begins. This is to ensure that all materials, equipment and quality meet the expectations of the owner that are included within the contract.

The Project Life Cycle

The project life cycle may be viewed as a process through which a project is implemented from cradle to grave. Owners must recognize that there is no single best approach in organizing project management throughout a project's life cycle. All organizational approaches have advantages and disadvantages, depending on the knowledge of the owner in construction management as well as the type, size and location of the project. It is important for the owner to be aware of the approach which is most appropriate and beneficial for a particular project. In making choices, owners should be concerned with the life cycle costs of constructed facilities rather than simply the initial construction costs. Saving small amounts of money during construction may not be worthwhile if the result is much larger operating costs or not meeting the functional requirements for the new facility satisfactorily. Thus, owners must be very concerned with the quality of the finished product as well as the cost of construction itself. Since facility operation and maintenance is a part of the project life cycle, the owners' expectation to satisfy investment objectives during the project life cycle will require consideration of the cost of operation and maintenance. Therefore, the facility's operating management should also be considered as early as possible, just as the construction process should be kept in mind at the early stages of planning and programming. /3/

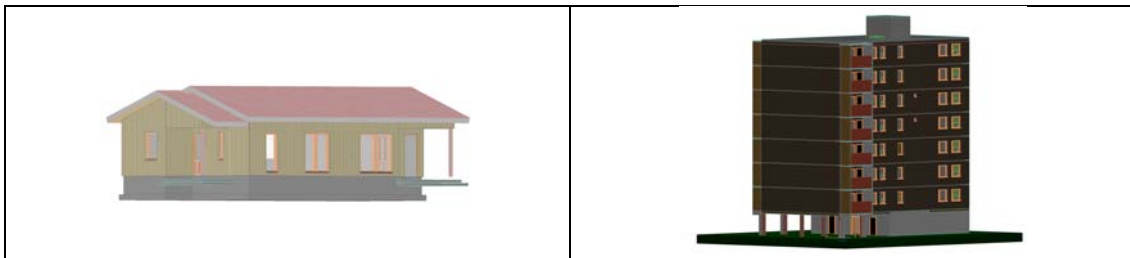


Fig 5 Residential houses

Residential Housing Construction

Residential housing construction includes single-family houses, multi-family dwellings and high-rise apartments. During the development and construction of such projects, the developers or sponsors who are familiar with the construction industry usually serve as surrogate owners and take charge, making necessary contractual agreements for design and construction, and arranging the financing and sale of the completed structures. Residential housing designs are usually performed by architects and engineers and the construction executed by builders who hire subcontractors for the structural, mechanical, electrical and other specialty work. An exception to this pattern is for single-family houses which may be designed by the builders as well. /3/

Institutional and Commercial Building Construction

Institutional and commercial building construction encompasses a great variety of project types and sizes, such as schools and universities, medical clinics and hospitals, recreational facilities and sports stadiums, retail chain stores and large shopping centers, warehouses and light manufacturing plants, and skyscrapers for offices and hotels. The owners of such buildings may or may not be familiar with construction industry practices, but they usually are able to select competent professional consultants and arrange the financing of the constructed facilities themselves. /3/

1.3 Organizing for Project Management

The management of construction projects requires knowledge of modern management as well as an understanding of the design and construction process. Construction projects have a specific set of objectives and constraints such as a required time frame for completion. Project management is the art of directing and coordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, cost, time, quality and participation satisfaction. The owner or facility sponsor holds the key to influence the construction costs of a project because any decision made at the beginning stage of a project life cycle has far greater influence than those made at later stages. /3/

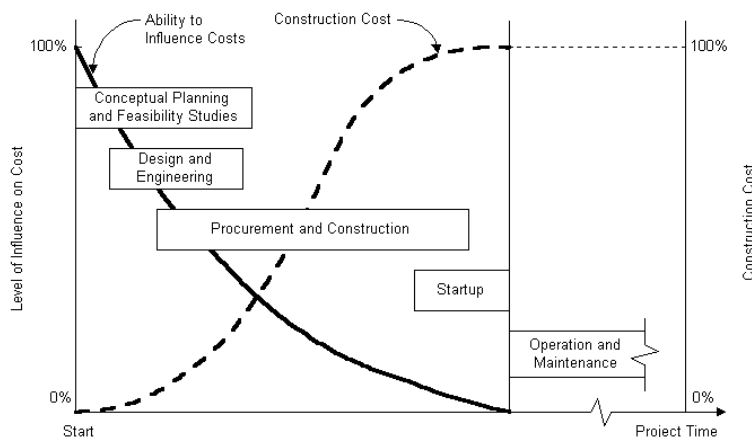


Fig 6 Ability to Influence Construction Cost Over Time /3/

The uncertainty in undertaking a construction project comes from many sources and often involves many participants in the project. Since each participant tries to minimize its own risk, the conflicts among various participants can be detrimental to the project. Only the owner has the power to moderate such conflicts as it alone holds the key to risk assignment through proper contractual relations with other participants. Failure to recognize this responsibility by the owner often leads to undesirable results. /3/

The Design and Construction Process

In the planning of facilities, it is important to recognize the close relationship between design and construction. These processes can best be viewed as an integrated system. Broadly speaking, design is a process of creating the description of a new facility, usually represented by detailed plans and specifications; construction planning is a process of identifying activities and resources required to make the design a physical reality. Hence, construction is the implementation of a design envisioned by architects and engineers. In both design and construction, numerous operational tasks must be performed with a variety of precedence and other relationships among the different tasks. /3/

Contractor's Production Planning System

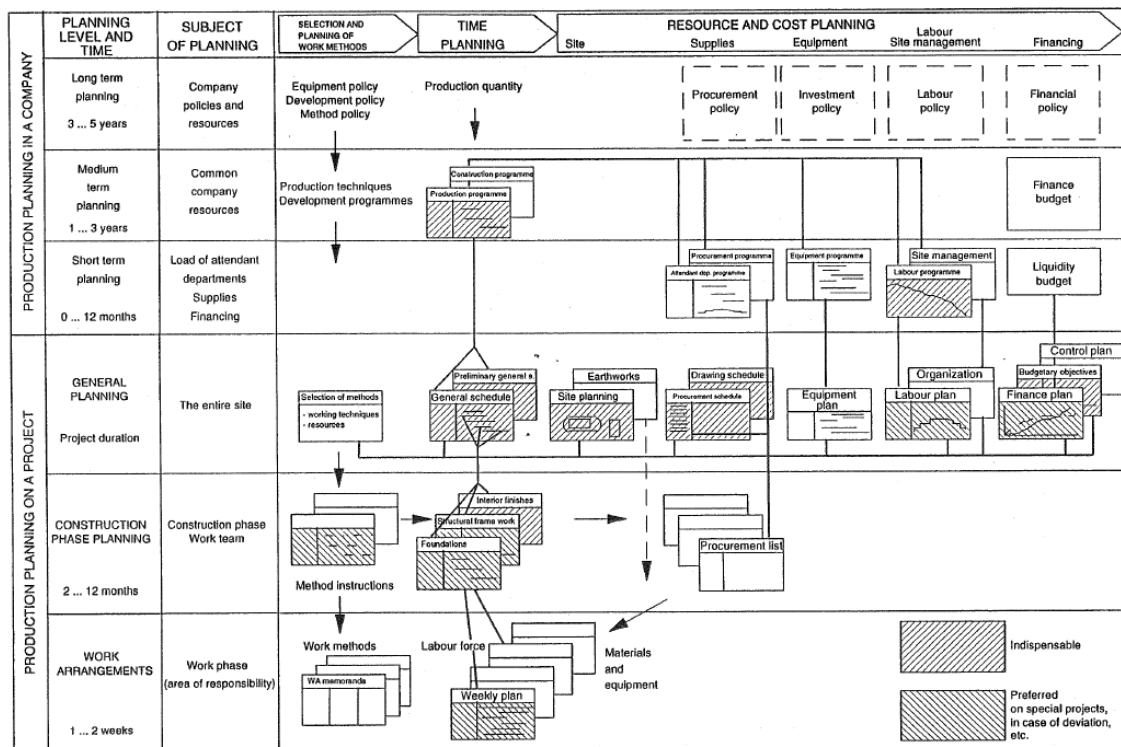


Fig 7 Contractor's production planning system /2/

Production Planning on a construction project aims at most advantageous selection of working and resources as well as time activities. Projects and activities are planned so that an individual project can be completed according to plans and contracts. /2/

The development of a construction plan is very much analogous to the development of a good facility design. The planner must weigh the costs and reliability of different options while at the same time insuring technical feasibility. Construction planning is more difficult in some ways since the building process is dynamic as the site and the physical facility change over time as construction proceeds. On the other hand, construction operations tend to be fairly standard from one project to another, whereas structural or foundation details might differ considerably from one facility to another. From the standpoint of **construction contractors** or the construction divisions of large firms, the planning process for construction projects consists of three stages that take place between the moment in which a planner starts the plan for the construction of a facility to the moment in which the evaluation of the final output of the construction process is finished.

The estimate stage involves the development of a cost and duration estimate for the construction of a facility as part of the proposal of a contractor to an owner. It is the stage in which assumptions of resource commitment to the necessary activities to build the facility are made by a planner. The result of a high estimate would be to lose the job, and the result of a low estimate could be to win the job, but to lose money in the construction process. When changes are done, they should improve the estimate, taking into account not only present effects, but also future outcomes of succeeding activities. It is very seldom the case in which the output of the construction process exactly echoes the estimate offered to the owner.

In **the monitoring and control stage** of the construction process, the construction manager has to keep constant track of both activities' durations and ongoing costs. Constant evaluation is necessary until the construction of the facility is complete. When work is finished in the construction process, and information about it is provided to the planner, the third stage of the planning process can begin.

The evaluation stage is the one in which results of the construction process are matched against the estimate. A planner deals with this uncertainty during the estimate stage. Only when the outcome of the construction process is known is he/she able to evaluate the validity of the estimate. It is in this last stage of the planning process that he or she determines if the assumptions were correct. If they were not or if new constraints emerge, he/she should introduce corresponding adjustments in future planning. /3/

Company level production planning can be divided into three parts on the basis of time spent planning:

- Formulating company policy
- Activity planning for the following 1...3 accounting periods
- Production planning for the on-going accounting period

Company level production planning is aimed at, for instance, advantageous choices of financial, production and personnel policies and the efficient allocation of resources to various projects. /2/

The objective of the production planning on a construction project is advantageous completion of the project within the established time limits according to the plans, contracts, regulations and work quality objectives.

The accuracy of timing of the planning activities divide the production planning in a building construction into four categories:

- Preliminary production planning in the tender phase
- General planning, before construction commences
- Production planning in phases during construction
- Weekly planning during construction

According to the content of the plan, production planning on a construction can be divided into

- time planning, e.g. interior work phase schedule and preparation of the resource plan that is connected with it
- economic and financial planning e.g, preparation of the budgetary objectives
- general production planning e.g. preparation of the the site plan /2/

Production planning is a fundamental and challenging activity in the management and execution of construction projects. It involves the choice of technology, the definition of work tasks, the estimation of the required resources and durations for individual tasks, and the identification of any interactions among the different work tasks. A good construction plan is the basis for developing the budget and the schedule for work. Developing the production plan is a critical task in the management of construction, even if the plan is not written or otherwise formally recorded. In addition to these technical aspects of construction planning, it may also be necessary to make organizational decisions about the relationships between project participants and even which organizations to include in a project. For example, the extent to which sub-contractors will be used on a project is often determined during construction planning /3/

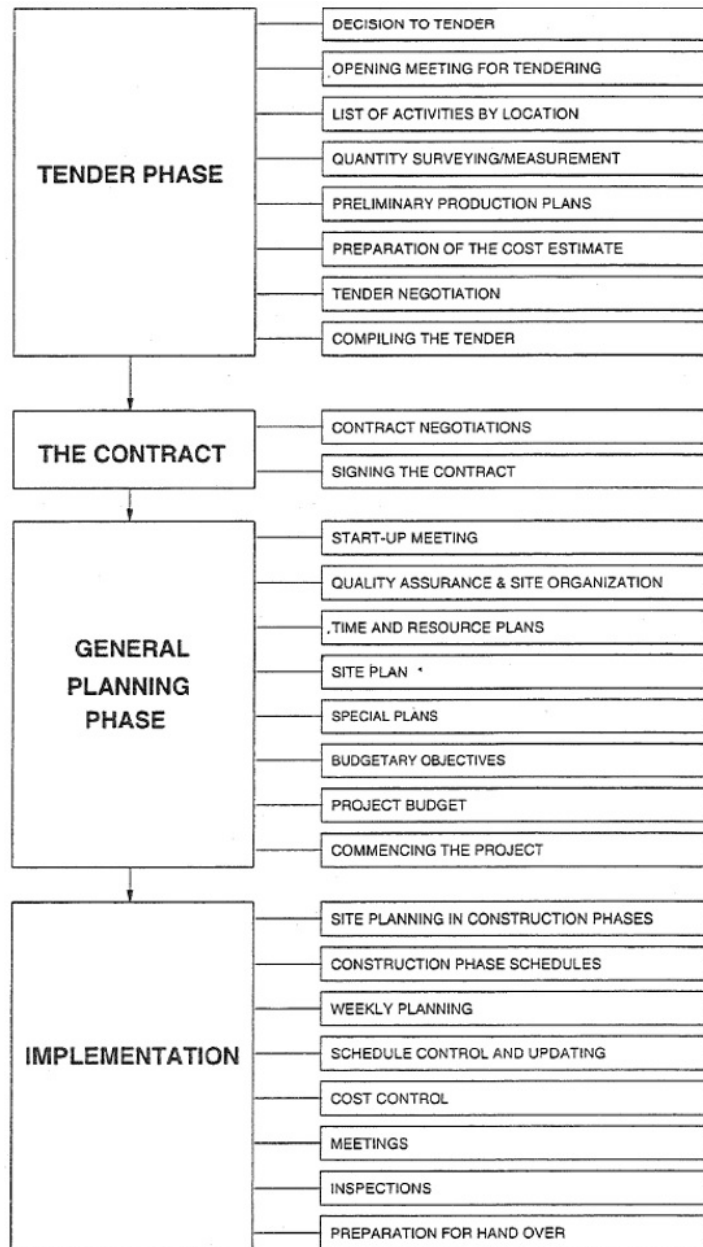


Fig 8 Main phases in production planning /2/

Labor, Material and Equipment Utilization

Good project management in construction must vigorously pursue the efficient utilization of labor, material and equipment. Improvement of labor productivity should be a major and continual concern of those who are responsible for cost control of constructed facilities. Material handling, which includes procurement, inventory, shop fabrication and field servicing, requires special attention for cost reduction. The use of new equipment and innovative methods has made possible wholesale changes in construction technologies in recent decades. Organizations which do not recognize the impact of various innovations and

have not adapted to changing environments have justifiably been forced out of the mainstream of construction activities. /3/

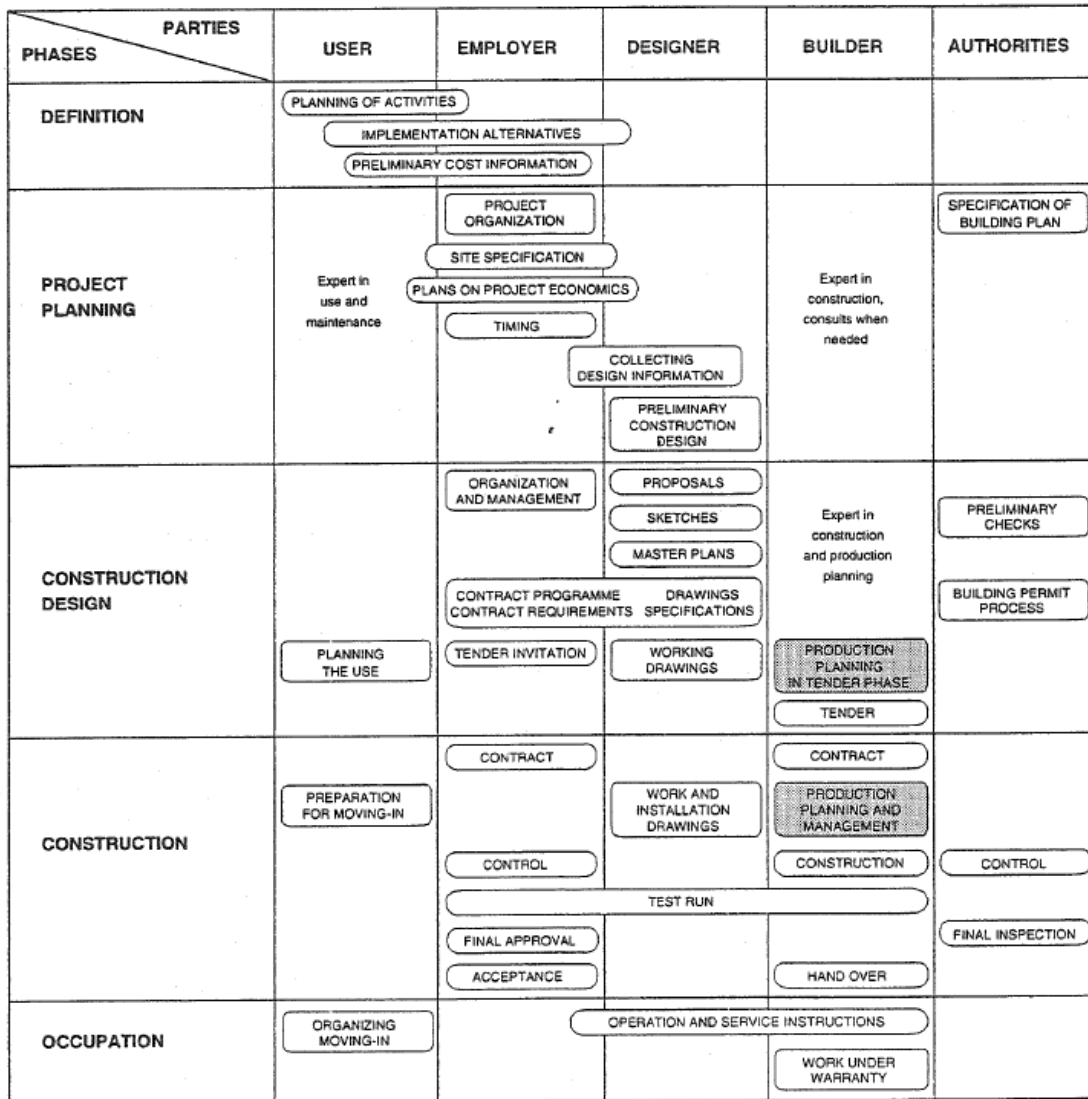


Fig 9 Parties and phases in a construction process /2/

Cost Estimation

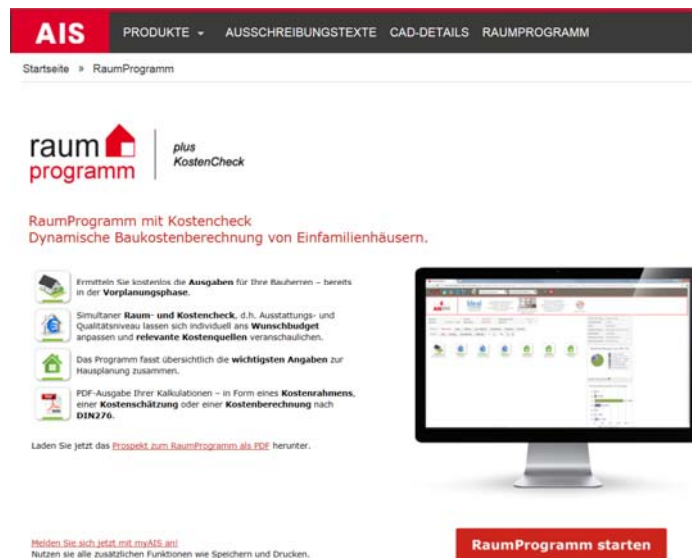


Fig 10 Talopeli German Cost Estimation /21/

Virtually all cost estimation is performed according to one or some combination of the following basic approaches: Empirical cost inference, Unit costs for bill of quantities or Allocation of joint costs. Empirical estimation of cost functions requires statistical techniques which relate the cost of constructing or operating a facility to a few important characteristics or attributes of the system. A unit cost is assigned to each of the facility components or tasks as represented by the bill of quantities. The total cost is the summation of the products of the quantities multiplied by the corresponding unit costs. Allocations of cost from existing accounts may be used to develop a cost function of an operation. The basic idea in this method is that each expenditure item can be assigned to particular characteristics of the operation. /3/

Construction cost estimates may be viewed from different perspectives because of different institutional requirements. In spite of the many **types of cost estimates** used at different stages of a project, cost estimates can best be classified into three major categories according to their functions. A construction cost estimate serves one of the three basic functions: design, bid and control. For establishing the financing of a project, either a design estimate or a bid estimate is used. /3/

Cost Control, Monitoring and Accounting

During the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process. These tools serve the dual purpose of recording the financial transactions that occur as well as giving managers an indication of the progress and problems associated with a project. /3/

Coding Systems

One objective in many construction planning efforts is to define the plan within the constraints of a universal *coding system* for identifying activities. Each activity defined for a project would be identified by a pre-defined code specific to that activity. The use of a common nomenclature or identification system is basically motivated by the desire for better integration of organizational efforts and improved information flow. In particular, coding systems are adopted to provide a numbering system to replace verbal descriptions of items. These codes reduce the length or complexity of the information to be recorded. A common coding system within an organization also aids consistency in definitions and categories between projects and among the various parties involved in a project. Common coding systems also aid in the retrieval of historical records of cost, productivity and duration on particular activities. Finally, electronic data storage and retrieval operations are much more efficient with standard coding systems..

In North America, the most widely used standard coding system for constructed facilities is the MASTERFORMAT system developed by the Construction Specifications Institute (CSI) of the United States and Construction Specifications of Canada. After development of separate systems, this combined system was originally introduced as the Uniform Construction Index (UCI) in 1972 and was subsequently adopted for use by numerous firms, information providers, professional societies and trade organizations. The term MASTERFORMAT was introduced with the 1978 revision of the UCI codes. MASTERFORMAT provides a standard identification code for nearly all the elements associated with building construction.

MASTERFORMAT involves a hierarchical coding system with multiple levels plus keyword text descriptions of each item. In the numerical coding system, the first two digits represent one of the sixteen divisions for work; a seventeenth division is used to code conditions of the contract for a constructor. In the latest version of the MASTERFORMAT, a third digit is added to indicate a subdivision within each division. Each division is further specified by a three digit extension indicating another level of subdivisions.

TABLE 9-6 Major Divisions in the Uniform Construction Index

0 Conditions of the contract	9 Finishes
1 General requirements	10 Specialties
2 Site work	11 Equipment
3 Concrete	12 Furnishings
4 Masonry	13 Special construction
5 Metals	14 Conveying system
6 Wood and plastics	15 Mechanical
7 Thermal and moisture prevention	16 Electrical
8 Doors and windows	

/3/

Fundamental Scheduling Procedures

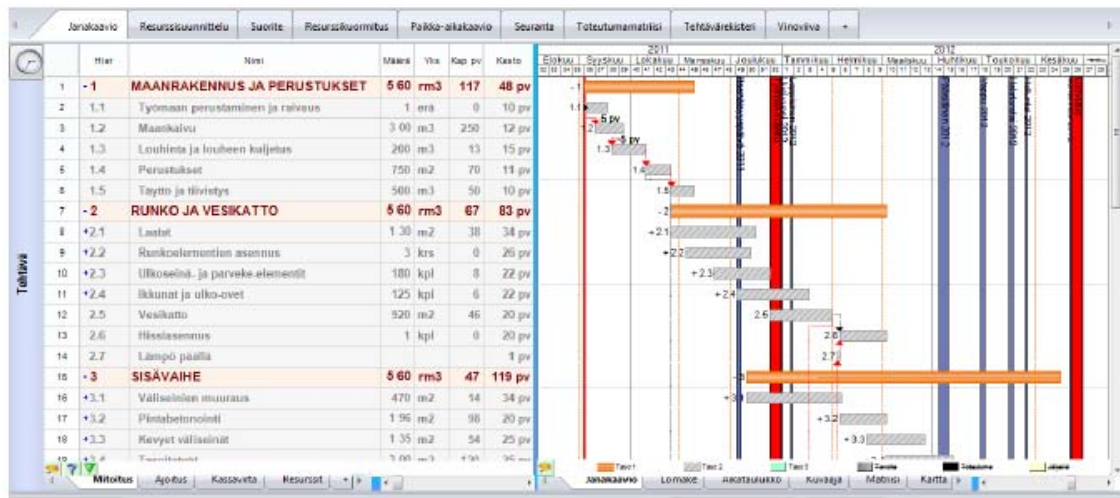


Fig 11 Bar Schedule /22/

In addition to assigning dates to project activities, project scheduling is intended to match the resources of equipment, materials and labor with project work tasks over time. Good scheduling can eliminate problems due to production bottlenecks, facilitate the timely procurement of necessary materials, and otherwise insure the completion of a project as soon as possible. In contrast, poor scheduling can result in considerable waste as laborers and equipment wait for the availability of needed resources or the completion of preceding tasks. Delays in the completion of an entire project due to poor scheduling can also create havoc for owners who are eager to start using the constructed facilities. /3/

Quality Control and Safety During Construction

Quality control and safety represent increasingly important concerns for project managers. Defects or failures in constructed facilities can result in very large costs. Even with minor defects, re-construction may be required and facility operations impaired. Increased costs and delays are the result. In the worst case, failures may cause personal injuries or fatalities. Accidents during the construction process can similarly result in personal injuries and large costs. Indirect costs of insurance, inspection and regulation are increasing rapidly due to these increased direct costs. Good project managers try to ensure that the job is done right the first time and that no major accidents occur on the project.

As with cost control, the most important decisions regarding the quality of a completed facility are made during the design and planning stages rather than during construction. It is during these preliminary stages that component configurations, material specifications and functional performance are decided. Quality control during construction consists largely of insuring **conformance** to these original design and planning decisions. /3/

1.4 The Building Process Guidelines



Fig 12 Land Use and Building Act /4/

The Land Use and Building Act

The legislation concerning Finland's Land Use and Building Act reformed on the whole in the year 2000. The new The Land Use and Building Act (MRL) encourages the citizens and other interest groups to participate in the planning process, the quality of the planning and the building and the principles of the sustainable development. /4/

The Hierarchical Plan System

The planning system of Finland's land use contains three hierarchical levels: regional plan, local master plan and local detailed plan.

The regional plan shows the principles of the land use and urban structure of areas for the whole region. It's important task is to fit the national objectives together with the needs for the region. The region plan becomes valid only when the Ministry of the Environment has strengthened it. There are altogether 19 regions and their areas cover the whole country.

The urban structure is directed with the master plan. The areas are divided to different purposes in the town planning. The master plan is designed and approved locally. The environmental administration of the country will participate in the control of the general planning and a complaint about the master plan can be made to the court.

The objectives of the plan system apply to the regional structure of the country, the quality of the environment, the a cultural heritage and natural resources, the important road connections or track connections and the energy management. On the countryside a plan is not needed outside the densely populated areas as a precondition for the building but the municipality can have orders on the minimum size of the building site or for example on the minimum distance of the building to the neighbor's limit. If the building does not cause a drawback to the future planning the building permit can be granted. /4/

The control system of the construction

The land use and the building act emphasises the quality, environmental values and the sustainability. There must be a building surveyor in every municipality. The constructor must make sure that the regulations concerning building are observed and therefore he must have skilled designers and the supervisor of the building work available according to the law.

The permission which the municipality admits is needed for the building. The plans of the building must be based on the plan of the area and on other building regulations given by the municipality. The plans, of course, also must meet the demands of the building regulations of the Land Use and Building Act.

New measures of the Land Use and Building Act that secure the quality of the building are the Beginning Meeting of the Building Work, the Inspection Documents and the Service Instruction of the Building. /4/

Forms of the Building Permit

The Building Permit Application process consists e.g. the following:

- Building Permit Application
- The Foreman's Application
- Designer's Application
- The Informing of the neighbor
- Announcement of apartments RH2
- Announcement of Rakennushanketieto RH1

Forms of the Inspection of the building

The Quality Control consists e.g. the following measures:

- Inspection of the Damp Space Structures
- Announcement from the Bomb Shelter
- Application of the Acceptance of the Assembly Room
- Persons in charge of the Control
- Report on the waste management of the demolition work
- Report on the handling of construction waste

Content of YSE 1998 General Agreement Clauses

The YSE 1998 the General Agreement Clauses are basis for the main and subcontracts. It creates the rules between the actors in the construction process. /4/

Parties of the contract

Constructor: natural or judicial person on whose account the building work is done and which ultimately receives the work result.

Subscriber: the contractor's contracting party which has ordered the contract performance. The constructor or the contractor can serve as the subscriber.

Contractor: the subscriber's contracting party which has bound itself to accomplish the work result that has been defined in the contract documents.

Main contractor: contractor in the contractual relation who in commercial documents has been named as a main contractor and on which the constructor includes the management duties of the site in a contractual scope.

Contractor: constructor contractor in the contractual relation who carries out the work which does not belong to the main contract.

Subcontractor: from the contractor's order the second contractor who carries out work.

When agreements, site document, claims et cetera are drawn up, these must be consequentially made according to YSE to avoid misunderstandings, the parties' names which are in accordance with the concepts.

Other important concepts in YSE:

It is worth to pay attention especially to the following concepts: Risk (YSE 55 §), Alteration work – extra work (YSE 43 – 46 §), Inspection of the contract performance – Handing Over Inspection (YSE 70 and 71 §).

Technical and commercial documents separated in YSE

When the general terms of agreement of Building Contract YSE in 1998 were reformed, one of the most significant reforms was directed to the document system of YSE. As distinct from earlier YSE 1983 conditions the contract documents were grouped to two groups, commercial (A) and to the technical (B) documents. Totally new documents also were added to the list of contract documents which in earlier YSE 1983 was not mentioned.

RunkoRYL 2000 Code of Good Building Practice of the Building Frame and External Envelope

RYL Code of Good Building Practice describes a generally accepted standard of the good construction practice. This edition is published as three books: MaaRYL 2000 (earthworks), RunkoRYL 2000 (building frame and external envelope), and SisäRYL 2000 (internal finishes). According to Talo 90 (Construction 90) Classification, RYLs contents deal with building elements and work sections. Chapters describing building elements serve as a support, guide and reminder for design as well as a table of contents for specification writing. Chapters devoted to work sections define requirements for building products and the performance of labor. RunkoRYL, dealing with the building frame and the external envelope for building construction, contains five building element chapters and twenty-nine work section chapters.

Structure of RunkoRYL 2000

RunkoRYL 2000 has been fitted in use one House to 90 nomenclature. RYL 2000 has been arranged to the structures and to the work specifications. The Structure division is suitable for the planning and the compilation of the master format. Building parts refer to the ones to be dealt with in the design the functional parts of the building. The building parts are for example a roof, a partition wall, a window installed to its place and a furniture group. The earthwork elements are e.g. surface structures, plantings and underdrains. The work element refers to the installation of a certain material and performance which is created from it. For example a wall which consists of the setting of bricks and seaming grout is named to be a work part. The work element include the material and the professional work. The work element division is therefore suitable for both building supplies and construction work to handle the quality.

Building part division

The first part of RunkoRYL processes building elements. The headlining of Building part division follows the Talo 90 nomenclature. The numbers of the Building elements are F1...F4. The Building element division have been analysed from the designer's point of view thus that the masterformat can be written according that order. RYL is an instruction to compile the masterformat. The model of the Masterformat is as an appendix of RYL. At the end of each Building part division is a typical structure type in which a designer check list is given.

The work section division

The demands of the work sections are presented in RunkoRYL's second part. The headlining of work section division follows the Talo 90 work section nomenclature order.

Master Format

The Master Format is drawn up by the main designer of the building project who usually is an architect. He supplements the masterformat by the work commentaries such as the element work, acoustic work, green work and painting work. They can be attached to the Master Frmat as appendixes or separate documents. In the fixed appendix of the Master Format includes the Room Specifications. Parallel the documents of the Master Format are the HPAC commentary and the Electricity commentary. The master format is used during the process of the project when necessary by the other participants. The master format has a significant task because of its wide use in the data transfer inside the project. The well done Master Format brings the building partners closer because it determines the quality standard indisputedly. The building parts of Talo-nomenclature have been used already for decades as an analysis bottom of the master format.

The House 90 nomenclature offers the project, building and equipment list for each one of them. The division B can be the following :

- B1 General Information of the Building Project
- B2 The target and situation
- B3 The Owner
- B4 The User
- B5 The Designers
- F1 Foundations
- F2 Frame
- F3 Elevations
- F4 ...

The House 90 – nomenclature doesn't any more include work descriptions as previous revisions. However, the building parts must be determined in the Master Formats. The identity number of the building type is used for the analysing the project-specific building components. Each building component is given its own ID- symbol e.g.:

- PO1, partitioning steel door EI60
- PO2, partitioning steel door EI120
- PO3, partitioning glass door E30.

See the Master Format Annex

The Documents of a Project

The project-specific documents can be divided to either judicial or technical documents.

Judicial documents regulates the business relationship between the subscriber and the supplier and technical documents describe the project. The project-specific documents are drafted separately for every project and the general documents are in use from one project to another.

General documents	Project documents		Always in power
Commercial matters (judicial economical)	• YSE • Subjecting agreements • Forms	• Bid /Tender • Contracts	• Principles of the contract competition of the building trade • Acts and decrees • Officials • " Good building practise "
Technical matters	• RYL • Norms • Standards • Instructions	• <i>Building Masterformat</i> • Work commentaries • Drawings • Condition commentary	

Fig 13 Structure of the documents of the building project and division (RT 16-10286).

1.5 Contractor

The contractor possesses usually the in-house capacity to carry out for example concrete works, erection of concrete elements, earthwork operations and sewerage. A chartered sewerage contractor is often contracted. The company possesses the equipment necessary to carry out basic tasks but does not own specialized equipment such as scaffolding and cranes. Due to lack of funds it is often an advantage to hire equipment rather than owning it. The contractor works usually as a main contractor and/or individual trade contractor. The contractor is usually a member of RT (Confederation of Finnish Construction Industries) and has a collective agreement with all members of staff. /1/

Project Management

The contractor can undertake turnkey contracts as well as main and individual trade contracts with a focus on the following key competencies:

- Calculation and management of main contracts.
- Calculation and implementation of own production within earthwork, sewerage, concrete works and erection of industrialised building components.
- Rendering different types of service. /1/

Contract Forms

Contract forms can be e.g. the following:

- **Main contract** Within this contract form the client negotiates with **one contractor only**. Project management is transferred from the client to the main contractor. The project responsibility, however, still belongs to the client.
- **Grouped contracts** The client may simplify the management to a certain extent by grouping related trades. In doing so, the coordination and the sharing of responsibility become more transparent. As it is the case with individual trade contracts, the coordination still rests with the client, but contrary to the individual trade contracts there will be fewer contracts to coordinate - and thereby reducing the risk.
- **Individual trade contract** Typically the client will start by entering a design agreement with an architect and an engineer. Once the project is ready, the client will enter contracts with a number of individual trade contractors corresponding to the number of trades involved in the construction. **Coordination and management rests with the client** – typically by external consultants. /1/

Risk management

In order to ensure the reputation and the earnings of the company and thereby its survival it is vital to undertake risk management of the project throughout the building project. The risk management applies to such issues as choice of methods, choice of equipment, choice of partners, control of client solvency etc.

E.g. the below listed tools can be used in the risk management:

- Contractor's checklist of received tender documents
- Project journal Accumulated 'hands-on experience' from previous projects.
- Final evaluation including the summing up of experience gathered /1/

Organization and management

In the building projects a Contractor can operate with the following management categories:

- **Project managers** in connection with turnkey contracts and partnering. The project manager is responsible for the design and construction management.
- **Construction managers** in connection with projects in main contracts. The construction manager represents the client in aspects related to the planning and the implementation of individual trade contracts. In turnkey contracts and in partnering the construction manager refers directly to the project manager. The construction manager has the overall responsibility for all work on site. He supervises the work and is typically responsible for the coordination of building site safety.
- **Individual trade contract managers/clerks of work (CoW)** in connection with individual trade contracts carried out as 'own production'. CoWs refer directly to the construction manager. It is the responsibility of the CoW to ensure that the work is carried out within the stipulated time schedule and to ensure that the necessary work drawings, materials and equipment are present at the right time in in the specified quantities. It is also the responsibility of the CoW to ensure and to document the quality of the work carried out. Further it is the responsibility of the CoW to ensure that all work is carried out in accordance with current safety regulations and to ensure that Work Place Assessments (WPAs) are implemented.
- **Foremen:** Management of workers in 'own production' is in the hands of foremen. The foremen are salaried employees and as such they are not financed through the budget of a particular project.

All managers are usually qualified safety managers and coordinators. They are also qualified in the application of the company's quality assurance system. Other employees such as craftsmen are organized in gangs, represented by a ganger. /1/

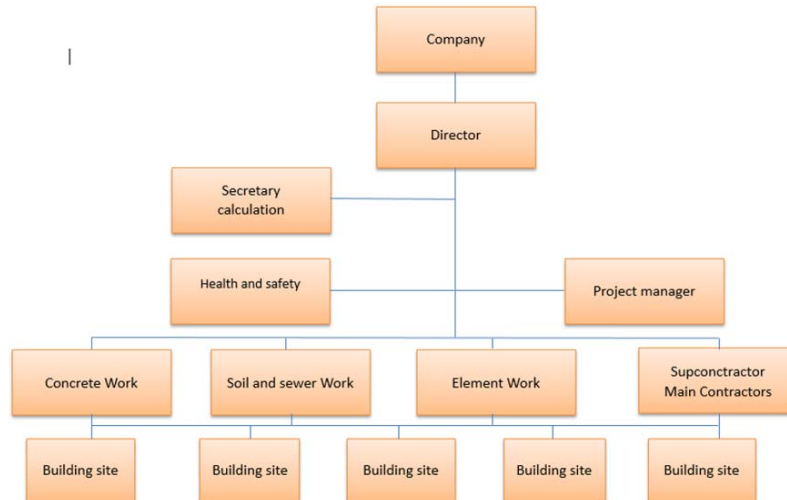


Fig 14 Organization /1/

Remuneration and conditions of employment

The companies usually enter an agreement with all staff groups and have an interest in implementing incentive payment systems at all levels. All members of staff have an employment contract stipulating job description, remuneration and other conditions.

The companies estimate social costs on the basis of current legislation and existing agreements and based on expenditure during the past year. All time work should be carried out on the basis of a piece-work contract and the use of schedules of wages and time elaborated for each trade recommended. The company usually have 'time data base' to be used when assessing the time required for each task. All staff sign an employment contract stating job description, remuneration conditions and other conditions based on TES-agreements. /1/

The Finnish Construction Trade Union represents the major part of all construction workers.



Fig 15 Finnish Construction Trade Union /24/

Communication and logistics

It is considered important that documents, drawings and goods have a continuous and well organized flow through the company at all levels. In order to secure this the company applies tools available.

In cases where the building project is web based, it is important to ensure that all parties involved are well trained and informed concerning the terms for document handling.

In the area of resource management it is important that all trade contractors are informed about the space made available to each one of them at the building site – as well as space available for vertical and horizontal transport at the site. /1/

Safety and Environment management

Work Place Assessment (WPA) is made for all staff groups. All staff members with management responsibilities are trained safety managers. All involved parties know their duties - whether they are clients, consultants or employers. All parties are capable of undertaking the coordination of safety work. They also work out a Plan for Health and Safety (PHS). The companies should possess the equipment necessary in order to carry out dangerous work, and the construction management is capable of giving required instruction in the handling of this. A Work Place Assessment (WPA) is carried out every time dangerous work is carried out. All employees must undergo training and hold certificates as required by authorities.

A safety organisation with a size corresponding of the number of companies, trades and employees is established on the building site /1/

Financial aspects

The company budget envisages the management's expectations in relation to expected turnover as it is distributed on own production, sub-contractors and additional jobs. Social costs are calculated on the basis of specific company expenditure, agreement terms and legislation governing the area

When a building project starts the company management works out a cash budget showing capital needs during the building project in question. A chart account is also elaborated. Depending on the extent of the building project, interim calculations and project stage assessments are elaborated as the project progresses. Final calculations are carried out at the conclusion of a building project. /1/

Tender

The companies participate in tenders as individual trade contractors as well as main- and turnkey contractors. In the case of individual trade contracts the company management calculates directly on the basis of quantities specified in the tender documents as well as registered site conditions.

Main contract tenders are based on Calculation of own production cost, tenders received from sub-contractors and an assessment of additional costs in relation to the project in question.

Turnkey contract tenders are calculated on the basis of accumulated company experience (costs of similar projects already implemented) or by the use of successive calculation – unless it is a tender in accordance to fixed budget. In connection with the submissions of tenders, a risk analysis is always carried out. The contribution ratio is defined on the basis of company overhead costs and the expected profit. /1/

Summing up experience

Construction projects inevitably generate enormous and complex amounts of experience. In most cases this experience is held by a few persons only. Consequently, a lot of knowledge vanished when members of staff left the company. At present a systematic summing up of experience to be used by cost accountants, clerks of work, construction managers and project managers should be made. /1/

2 Tendering

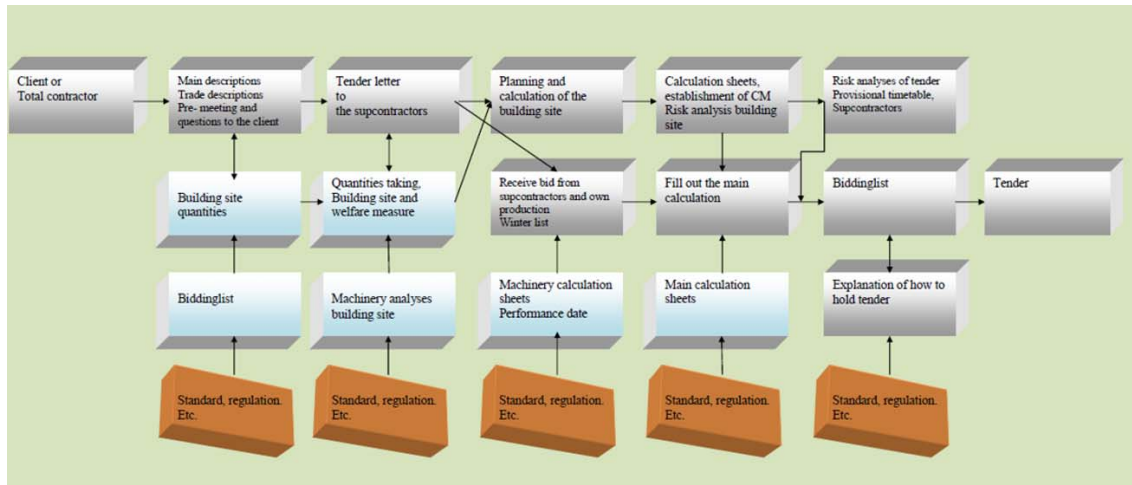


Fig 16 Tender Phase /17/

2.1 Planning the tender

Tendering is a vital part of the company's activities. It is therefore important to plan the tender properly and to carry out a systematic scrutiny of the tender documents - irrespective of project size, contract/tender form and the extend of 'own production'. The companies use to developed their own procedures with respect to legal and technical scrutiny as well as risk assessment. /1/

Tender invitation is a written request produced by the body that wants the construction work undertaken. Contractors are invited to submit an offer for undertaking that work. The contract price is the most important information in the tender because the employer has usually defined the other terms and conditions such as construction time, content of the work and quality requirements.

The contract document include the original tender invitation letter, contract programme, specification of the contract responsibilities, work specifications and drawings, unit price list and the tender form.

/2/

The Contract Programme is arguably the most important document in a contract. It's purpose is to bind the other document together and update them as appropriate. Although technical details are not covered in the programme, it deals with matters concerning project finance and implementation, for instance:

- project description
- parties to the contract
- type of contract
- duties and responsibilities of different parties – employer, main contractor and other contractors
- construction time
- terms of payment
- change orders and extra work
- price escalation
- bonds
- guarantree period

Site administration and other arrangements are presented in some detail within a **specification of contract responsibilities**, rather than in the contract programme itself. The updating requirements for work specifications and drawings are provided by this specification. The document includes information on, e.g. the preparation of schedules, access drawings, temporary work, assistance for sub-contractors, suppliers and communication and information services on site.

The desired final result of the project, that is the technical and other properties and the building, is described in the **specifications, drawings** and norms dealing with general construction procedures (e.g. RYL General Quality Requirements in Construction).

It is often necessary to deviate from requirements which already been approved and specified in technical plans. Thus change orders are frequently issued and extra work may be instructed. These usually affect costs, so reasonable prices of the work are determined in advance according to the **unit price list**. The pricing of these items is part of tendering process and has to be undertaken by every contractor who wishes to tender.

The developer often encloses a **tender form** as part of tender documents, thereby ensuring that comparable tenders are received.

It is pertinent to make a clear definition of **contract programme** as early as possible in order to define what parts of the project will be carried out as 'own production' and, what parts will be carried out by sub-contractors. The main contractor shall also define what common conditions should apply sub-contractors.

Upon reception of the tender documents, the contractor analyses the documents in order to identify any conditions that may not be expedient to the main contractor. A possible outcome of this **legal scrutiny** could be that the contractor asks questions to the client, makes certain reservations in his tender, or chooses not to participate in the tender at all.

/1/

The tender may take place in accordance with the Act on Tender Procedures. Guidelines can be obtained from The Competition and Consumer Authority. Public tenders are usually available in **HILMA- portal**.

Finnish public procurement is subject to national procurement legislation which derives from the European Community directives on public procurement. Under these rules public sector procurement must follow transparent open procedures ensuring fair and non-discriminatory conditions of competition for suppliers.

The regulation of public procurement aims at a more efficient use of public funds in order to ensure value for money on public procurement financed out of general taxation. A further aim of the regulation on public procurement is to enhance the competitiveness of national and European enterprises. When procuring goods, services or works the contracting authority must take advantage of existing market conditions and improve the functioning of markets. /19/

From the tenderer's point of view the objective of the **technical scrutiny** is to create the best possible conditions in order to be able to hand in a precise and complete tender bid on the day of the tender. In order to assess whether sufficient competencies are present, the company produces an overall plan showing the construction process for the entire building project. By analysing the the construction process plan of the project in question (imagining the building process) the management can assess whether the assignment matches company competencies.

The timeline is a planning tool which first of all helps to ensure that such milestones as the day of tender is reached without too many obstacles and secondly to ensure that the subsequent project phases are implemented according to time schedule.

/1/

2.2 Quantity surveying

In parallel with project scrutiny and the definition of construction methods the contractor starts the **calculations**.

Before the actual quantity surveying of materials and time estimation begins it is required to subdivide the calculation into sections. Each section refers to the building components / items as stated in the bid schedules being part of the tender documents. Final prices will be added to the bid schedules at a later stage. In case the tender documents do not contain bid schedules it will be appropriate to subdivide the calculation of direct costs into activities clearly indicating a structural demarcation for example: Substructure, primary elements, completions etc.

Within each activity the different work processes, which shall be carried out in order to complete the said activity, should be stated.

Direct costs include expenses in connection with own production , i.e. labour costs for tradesmen purchase of materials - with a deduction of discounts - but adding the cost of waste, hire of equipment, transport, and building site expenses.

/1/

Yläinen Elementtiluettelo							29.10.2014	
Elementti	Kerros	Taso	ID	Objekti	...	Korkeus	Pinta-ala	Tilavuudet
SENA	Skakeli	AR123 Runko...	Sena 023		0,25 m	1,00 m	1,80 m²	0,45 m³
	Skakeli	AR123 Runko...	Sena 024		0,25 m	1,00 m	3,73 m²	0,97 m³
	Skakeli	AR123 Runko...	Sena 025		0,25 m	1,00 m	15,83 m²	3,99 m³
	Skakeli total						48,10 m²	12,03 m³
	Vesikatto	AR123 Runko...	Sena 016		0,13 m	6,00 m	2,58 m²	0,32 m³
	Vesikatto	AR123 Runko...	Sena 017		0,13 m	6,00 m	1,95 m²	0,25 m³
	Vesikatto	AR123 Runko...	Sena 018		0,13 m	6,00 m	1,07 m²	0,07 m³
	Vesikatto	AR123 Runko...	Sena 019		0,13 m	6,00 m	3,59 m²	0,45 m³
	Vesikatto total						9,19 m²	1,09 m³
	SENA total for all stories						332,52 m²	88,52 m³
Pilarit								
Pilarit	I. kerros	AR1233 Pilarit...	Pilarit 001		0,15 m	2,70 m	1,62 m²	0,06 m³
	I. kerros	AR1233 Pilarit...	Pilarit 001		0,15 m	2,70 m	1,62 m²	0,06 m³
Pilarit total							3,24 m²	0,12 m³
Pilarit total for all stories							3,24 m²	0,12 m³
Laatta								
Laatta	I. kerros	AR122 Alapohj...	Laatta 001		0,24 m	0,00 m	105,96 m²	25,44 m³
	I. kerros	AR122 Alapohj...	Laatta 005		0,15 m	0,00 m	12,77 m²	1,91 m³
	I. kerros	AR122 Alapohj...	Laatta 006		0,15 m	0,00 m	14,72 m²	2,21 m³
	I. kerros	AR122 Alapohj...	Laatta 007		0,15 m	0,00 m	7,25 m²	1,09 m³
	I. kerros	AR122 Alapohj...	Laatta 008		0,15 m	0,00 m	8,82 m²	1,32 m³
Laatta total							149,30 m²	31,97 m³

Fig 17 Quantity Lists

2.3 Preliminary Production Plans

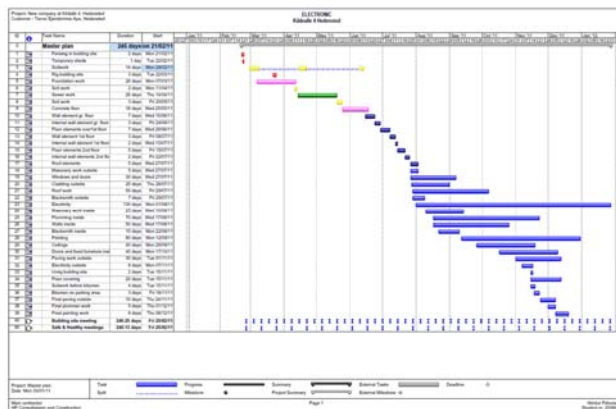


Fig 18 Masterplan

Preliminary General Schedule is to check that the construction time is realistic and to determine the main working techniques and resources needed. The project is presented such that information like construction time, milestones established in the contract programme and phasing of construction through the seasons of the year. The content is usually a bar chart with 10...30 coded items. The preliminary general schedule is connected with other plans like construction documents and general production files e.g. RATU cards.

Personnel Plan is used to inform on the need for primary resources. This information affects, e.g. resource management and the need for site accommodation.

Procurement Plan indicates the use of supplies like own services and sub-contracts.

Equipment Plan is a key for e.g. tower crane and scaffoldings uses.

Preliminary site plan is to inform on site conditions which essentially affect cost estimating.

/1/

2.4 Preparation of Cost Estimate

Taking off and estimating time consumption are very important parts of the contractor's tender bid. In order to be able to estimate the time consumption required in relation to the quantities taken off, it is important that the contractor keeps focus on process quantities, methods applied and waste.

On the basis of the measured quantities and methods applied the time consumption is determined by the use of price lists elaborated by the various trades and by the use of the contractor's own price catalogue (experience cost).

Special forms, so-called **man-hour calculation** forms are used when defining the time required to carry out specific tasks. **Materials and equipment costs** are priced either through tender bids or prices are found on the internet.

Concealed quantities, material waste and piece rate pay should be taken into account.

Once the production figures are entered into the calculation, quantities shall be measured at the building site. Building site expenses are divided into two parts. One part refers to costs related to the establishment and dismantling of equipment and the other part relates to operating costs.

Upon determination of wages for each activity the social costs are added. **Social costs** are paid in accordance with the legislation and in accordance with agreements in addition to the expenditure the company has had during the past year.

Building site costs include expenditure which is necessary for company staff in order to perform their trade contracts. Such expenditures could be: site huts, storage sheds, field workshops including machinery, waste removal, distribution boards and working lights, health and safety precautions, special tools, tower crane, scaffolding and hoists/lifts, vehicles for horizontal transport and cutting and bending machine.

Indirect costs cover costs related to for example stores, distribution, marketing, administration, contract managers, foremen with fixed salary, site accommodation, mileage allowances, tests, security, unpredictable costs and risk.

In cases where **a supplier and a subcontractor** make part of a given activity, an additional fee will be added to their accepted tender bids. This fee covers administration and profit.

The contribution margin expresses in per cent how much profit the contractor wishes to make on the building project. If the contractor wishes to make 15% profit on the building project then the direct and social costs will correspond to 85% of the final tender bid.

/1/

2.5 Compiling the Tender and Tender Negotiations

Once the calculation of own production is terminated and tender bids from sub-contractors and suppliers have been received and accepted it is possible to begin the final calculation of **the main contract**. Like it was the case with the individual trade contract this calculation is also broken down according to the costs required in the bid schedule and according to requirements stated in the building project specifications.

The breakdown may be carried out as follows:

1. Tender bids from sub-contractors with contracts constituting part of the main contract.
2. Costs related to the building site arrangement and operation
3. Costs related to managing the main contract.
4. Costs related to site accommodation – including furnishings, IT, telephone, heating etc.
5. Costs related to security / guarantees
6. Costs related to seasonal winter precautions.
7. Costs related to estimated risks.
8. Any other expenses mentioned in the tender document

Once the main contractor / the individual trade contractor has collected all information needed in order to work out the tender bid, he may complete his bid. Completion of the bid takes place primarily by filling in the bid schedules and by drawing up a covering letter to the client. This information must be included in the covering letter

- 1) The basis for tender bid
 - i. Invitation to tender
 - ii. Minutes from clarification meetings
 - iii. Cancellation letters related to tender documents
 - iv. Relevant legislation
- 2) Assumptions constituting the basis for the tender bid
- 3) Reservations – if any

On the opening date, tender bids are formally opened and read out loud in order to give the contractors who are present an impression of which tender best meets the criteria set out by the client. Subsequently, the client may use a couple of days analysing the bids. During this phase he capitalises whatever reservations the bidders have made trying to fix a value of the said reservations.

/1/

3 Contracting

Table of Contract Forms

A contract form for each project must be determined. Which contract form is most suitable for the project in question? Procedure for building and construction works according to the Danish Act on Invitation of Tenders in Construction and Civil Works.

	Individual Trade contract	Trade contract	Main contract	Turnkey contract
The building owner has entered into a contract with	Each Individual Trade contractor and the consultant of the project.	Each Trade contractor and the consultant of the project The Trade contractor has made a contract with several of the Individual Trade contractors.	The Main contractor and the consultant of the project. The Main contractor has made a contract with all individual trade contractors.	The turnkey contractor. The turnkey contractor has made a contract with all specialist contractors and the project planners.
Organisation	Each Individual Trade contractor reports to the building management who reports to the building owner.	Each Trade contractor reports to the building management who reports to the building owner.	The Main contractor reports to the building management who reports to the building owner.	The turnkey contractor has the building management and reports to the building owner. Project planners and individual trade contractors report to the turnkey contractor.
The building management	The building management, who co-ordinates the Individual Trade contracts, is not included in the tender price.	The building management, who co-ordinates the construction contracts, is not included in the tender price.	The Main contractor is responsible for the building management and the building management is therefore included in the tender price.	The turnkey contractor is responsible for the building management and the building management is therefore included in the tender price.
Participants at building meetings	All contractors and the expert supervision		The Main contractor and the expert supervision	The turnkey contractor and counsellors of the building owner if required
Tender form	Public or restricted procedure			Restricted procedure
Implementation/ tender documents	Made by the consultant and paid as a separate fee			Made by counsellors in cooperation with project implementers. Included in the total tender amount and contract.

Fig 19 Contract Forms /1/

When bids are made on the basis of the Act on Tender Procedures the client has the possibility of negotiating with the bidder. It is not unusual that the client asks the lowest bidding main contractor to present cost saving measures. The main contractor and his sub-contractors and suppliers will jointly analyse the bid and elaborate a 'cost saving catalogue' and identify consequences of proposed savings. Once the savings are accepted, a final contract may be signed on the basis of the reduced bid.

Once the client has awarded the tender to a contractor a contract must be prepared. The contract is based on the tender bid with a deduction of approved savings identified via cost saving measures. The contract cannot include any new issues, but shall be worked out on the basis of the tender documents, the tender bid, results of negotiations including cost saving measures.

A standard contract may be acquired from Rakennustieto-portal. In accordance with YSE "General Agreement Clauses" the contractor shall provide security for the performance of his obligations towards the client.

Once the main contractor has entered a contract with the client he may subsequently enter contracts with his sub-contractors and accept bids from suppliers. Contract conditions will be based upon the tender documents that the main contractor has submitted to his sub-contractor as well as the sub-contractor's bid and the result of negotiations.

The client shall take out and pay for the usual fire and tempest insurance.

/1/

Contractor's obligations and liability

The Act on Contractor's Obligations and Liability when Work is Contracted Out promotes equal competition between enterprises and observance of the terms of employment. Furthermore, it obliges enterprises concluding contracts on temporary agency work or subcontracted labour with other companies, to ensure that said companies discharge their statutory obligations.

According to the Act, before an orderer concludes a contract, it is obliged to check whether the counterparty is entered in the Prepayment Register and the Employer Register, and is registered as VAT-liable in the Value Added Tax Register. Similarly, the orderer must ascertain whether the counterparty has paid its taxes and taken out pension insurances, as well as the type of collective agreement or principal terms of employment it applies to the work. The same information must also be obtained on foreign companies.

The Act is applied if the duration of the work by temporary agency workers exceeds a total of 10 days, or the value of the subcontract agreement exceeds 7,500 euros, excluding value added tax. This refers to the total value of the agreement, without separating the share of work performed.

The orderer need not request the above-mentioned information, if it has good reason to trust that the counterparty will discharge its statutory obligations. Such counterparties include states, municipalities, parishes, public limited companies, state enterprises, companies wholly owned by a municipality, or the equivalent foreign organisations or enterprises. A similar contractual relationship based on trust between the orderer and counterparty can also be regarded as having been established on the basis of earlier contractual relationships.

/19/

4 General Planning and Commencing Construction

4.1 General Planning Phase of the Project

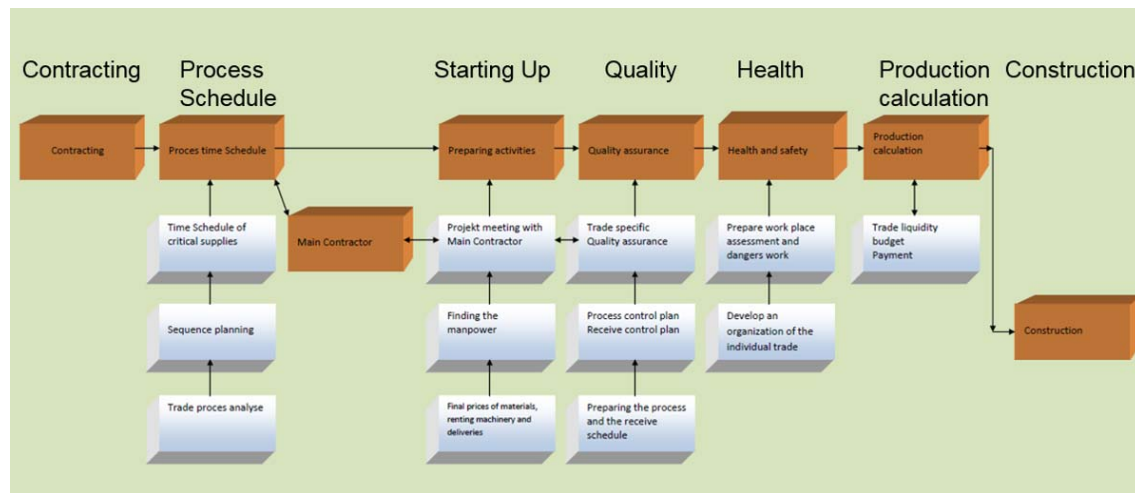


Fig 20 Project Planning Phases /1/

The purpose of a formal project handover after the contracts have been signed and before the building project starts is to ensure that the project manager gets the best possible conditions for an effective and rational start-up. The project manager shall thoroughly scrutinize common conditions, work specifications, drawings, geo-technical reports and similar pre-investigations. The project manager shall also get acquainted with the methods mentioned in the calculation.

It is important that the project manager gets familiar with the **time schedule** or works out a time schedule in accordance with the contract.

In order to finish work within the scheduled time it is considered essential that the work is coordinated in accordance with planned time, that resources and drawings are available at the right time, and in order to be able to work out a cash budget.

Finally the project manager shall ensure sufficient manning as well as the procurement of all necessary permits and approvals. He shall also ensure that all necessary investigations are made.

The risk assessment (also referred to as scrutiny), which was carried out during the tendering phase, is followed up. The assessment takes place well in advance of the actual start of construction and should include:

- Analysis of drawings and specifications
- Analysis of planning and work processes
- Analysis of tender control plan ensure that tasks are carried out in pursuance of current legislation, codes and standards.
- Ensuring a clear demarcation between tasks in own production and tasks carried out by sub-contractors

- Ensuring that safety and environmental issues are systematized

It is the duty of the project manager to analyse – well in advance – whatever risks may occur as work progresses, for example technical problems, missing drawings, communication problems as well as problems related to workforce, suppliers or sub-contractors, in order to counteract failures and delays before they occur.

The project manager makes a personal **inspection of the building site** in order to get familiar with site conditions and its nearest surroundings.

The following should be observed and recorded: Technical installations, access roads, welfare provisions, conditions on neighbouring plots, traffic, cleaning and maintenance of roads, fencing, excavations, demolitions, terrain conditions, the possibility of establishing site accommodation, stores and depots.

/1/

4.2 Start Up

The tasks assigned to the main contractor in relation to planning and mobilizing the construction work are manifold, and for that reason he must be well organized and systematic. His planning includes such issues as:

- Risk assessment
- Time schedules including manning schedules
- Working environment
- Quality assurance (QA)
- Updated work drawings and specifications are available
- Work, including pertinent control, is planned in order to avoid failure or to detect a failure as early as possible.
- Deviations are recorded and handled Project changes are controlled, coordinated and approved by the main contractor and recorded in minutes from site meetings.
- Interim payment certificates are worked out on a monthly basis.
- Sub-contractors understand agreements entered concerning expected outputs.

The main contractor must also ensure that:

- Suppliers and sub-contractors (SCs) receive all relevant documents.
- A project examination meeting is called for with the participation of SCs and staff in own production.
- A review is carried out of the SC's quality assurance plan in order to find out if it corresponds to requirements as defined in the tender documents with respect to type and extent.
- Preceding works are concluded and approved and that succeeding SCs have carried out start-up controls.

A common **folder structure** based directions shall be established. The parties involved must follow these directions. The main contractor is also responsible for organising the building project accounts and must make sure that the quality assurance system is accepted.

It is important that the main contractor follows common procedures with respect to the use of weekly reports of work, machine operator reports, piece work agreements, delivery notes and invoices as well as rules for interim calculations.

The main contractor must be familiar with the building project **organization chart** and must ascertain that all actors are authorized. The main contractor must be familiar with all decision and responsibility levels in the building project and he must be aware of his own mandate and the responsibility he holds in the project in question.

/1/

Meetings

It is the duty of the main contractor to make a plan for **project examination (kick-off) meetings** with the participation of sub-contractors, staff in own production and designers. It is important that all relevant persons involved participate in the meeting in order to secure optimal project implementation. This applies to contractors as well as designers. A successful project examination meeting is characterized by participants who are well prepared – clarification questions have been prepared beforehand. Standard forms to be used in project examination meetings have been prepared.

The main contractor calls for a **starting-up meeting** immediately before construction starts. At this meeting documents relating to the building project will be examined again and last minute questions should be answered. It is important that all sub-contractors and staff in own production participate in the meeting.

The main contractor makes arrangements with the client, sub-contractors and staff in own production concerning the time and frequency of site and **safety meetings**. It is important to take minutes of the meetings because such minutes may later serve as documentation in cases where disagreements may have to be settled by arbitration. Safety meetings serve to examine issues of safety in the common areas of the site. Accidents and near-by accidents are recorded.

/1/

Process planning

The main contractor works out a detailed construction plan in collaboration with the subcontractors. This is done in order to secure an optimal construction process. The construction plan is made as a process diagram using ‘post-it notes’.

In order to get an overview of the work involved in the project, the main contractor works out an overall breakup of the work processes involved in the construction process. This breakup allows for a breakdown into smaller and more transparent activities. This may refer to both main and sub-activities. Normally, the breakup follows contract areas, location and building sections

The main contractor must get an overview of the resources necessary in order to complete the work, and also identify the interdependencies between individual activities. In this way the process planning constitutes the basis for the main time schedule, order, order cancellation- and delivery schedules. The main time schedule is worked out in collaboration with the client and his consultant and on the basis of the construction plan.

4.3 Quality Assurance

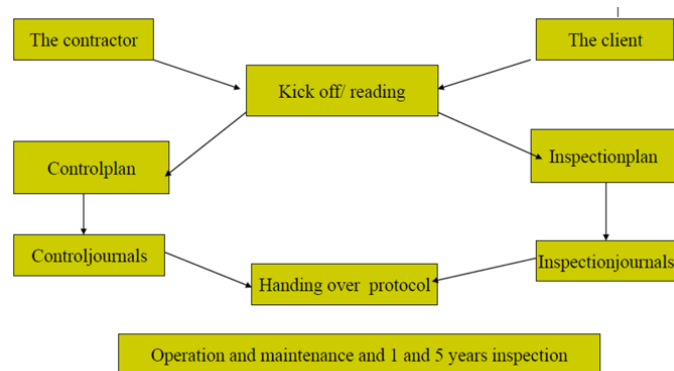


Fig 21 Quality Assurance /1/

Finland's Land Use and Building Act concerning quality assurance of publicly subsidised construction work was issued in the year 2000. The order was issued with the purpose of reducing failure and errors in construction work.

The client must, in conjunction with the main contractor, approve a subject-oriented quality assurance handbook. The different types of forms and documentation used for acceptance check, process control and final check must also be approved. The main contractor shall participate in a project examination meeting together with the client or his consultant. Quality assurance procedures will be defined and approved at this meeting.

Procedures for quality assurance at the up-start of new works must be defined. Procedures for quality assurance at trade contract shift must also be worked out

The main contractor works out a supervision plan for sub-contractors and for work in own production in correspondence with the tender control plan.

Documents worked out by Rakennustieto may be used in this connection. Documents related to handing over issues and to the use of sub-contractors may also be found here.

Sub-contractors' quality assurance procedures, forms and other documentation must be approved and they must be informed that quality assurance constitutes part of the outputs agreed upon in contracts or agreement forms.

The optimal starting point for quality assurance is that quality is well documented in the tender documents in such a way that the following is agreed when contracting:

1. Project examination meetings (kick-off meeting)
2. The contractor's quality assurance handbook
3. Adequate specifications of material quality and workmanship in the building component specifications.

4. Demands for necessary preparations in connection with the execution of work.
5. The contractor's own control, (tender control plan in the work specification).
6. Demands for documentation of the contractor's delivery control, process control and final control.
7. Demands concerning documentation for operation and maintenance, including operational manuals
8. An account of contractor's conditions with respect to trade supervision.
9. Handover, 1- and 2 years inspections.

/10/

4.4 Time and resource plans

Time Schedules

In the beginning of the project Preliminary General Schedule is made. It's length and phasing can base on earlier references or on mathematical formulas. The General Schedule is specified during the following construction phases and finally it bases on the production data e.g. RATU datas.

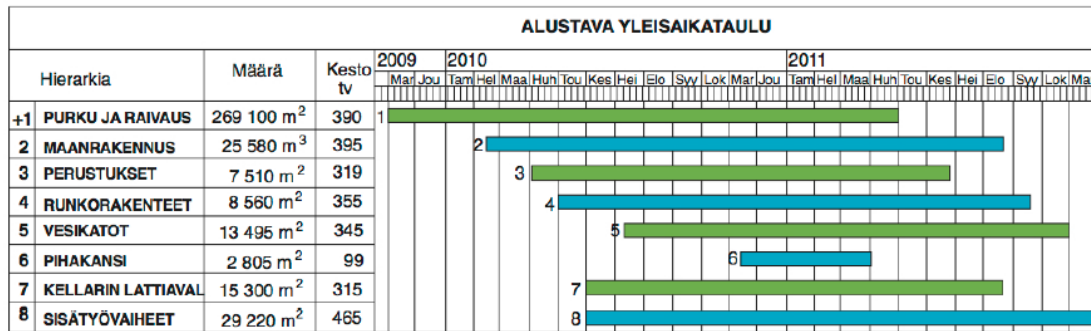


Fig 22 Preliminary General Schedule /14/

Construction Phase Schedules show phases' timelines in weeks.

Viikkoaikataulu																	
Kohde: _____ Viikot _____ - _____ 20____																	
Tehtävänimike ja työkohde	Työryhmä RAM + RM	Työsaavutus	Tavoite- määrä	Viikko							Viikko						
				M	T	K	T	P	L	S	M	T	K	T	P	L	S
Täyttö ja tasaus	2 RM + KK	320 m ² idt/tv	Ruudut 2-5, 7-9														
Lämpöeristeen ja suoja-paperin asennus	2 RM	200 m ² /tv	1-3, 6-8	1	6	2	7	3	8		4	9	5				
Muuraus	3 RAM + 5 RM	45 m ² /tv	225 m ²														
Liittyvät työt:																	
Laatan rauditus		1,5 ruutua/tv									2	8	3	9	4	5	
Imubetonointi		1 ruutu/tv									1	2	3	4	5		

Fig 25 Weekly Schedule /15/

Once the project manager receives relevant documents it shall be decided whether assumed time coordination and manning are sufficient and whether certain activities may be carried out faster. To start with the below listed time schedules are worked out:

- Main work plan
- Rolling time schedules (depending on complexity – days, weeks, months)
- Milestones make part of the time planning indicating start time / finish time, coordination time, approval time
- Definition of average manning, explanation of task sequence and internal relationship between tasks, durations are defined and a time schedule is worked out. /1/

Procurement Plan

Procurements are scheduled sufficiently in advance to enable the supplies in time.

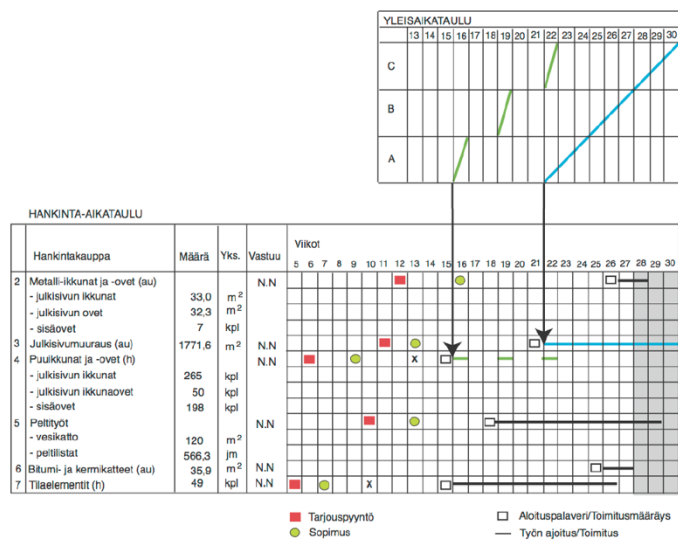


Fig 26 Procurement schedule /15/

Manning and equipment plan

For various reasons it is necessary to work out a manning plan - partly as a part of 'Plan for Health and Safety' (PHS), and partly to provide the company with an overview of which work resources are occupied during a given period of time.

It is possible to work out a histogram showing when there will be a need to level out resources and also showing peak loads on welfare installations.

An equipment plan should be worked out showing which machinery/equipment will be used at given times - referring to own equipment as well as hired equipment. Cranes, lifts/hoists, tents, and containers should also be entered in the plan. /1/

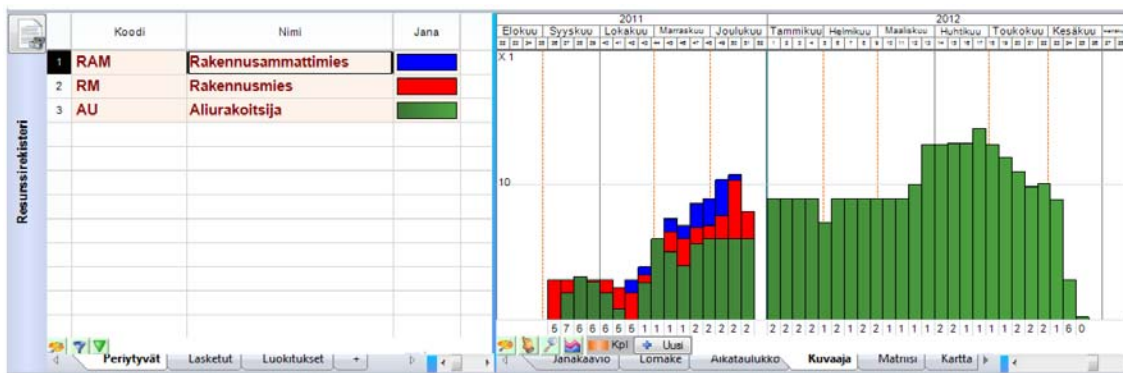


Fig 27 Manning Plan /22/

Production Calculation

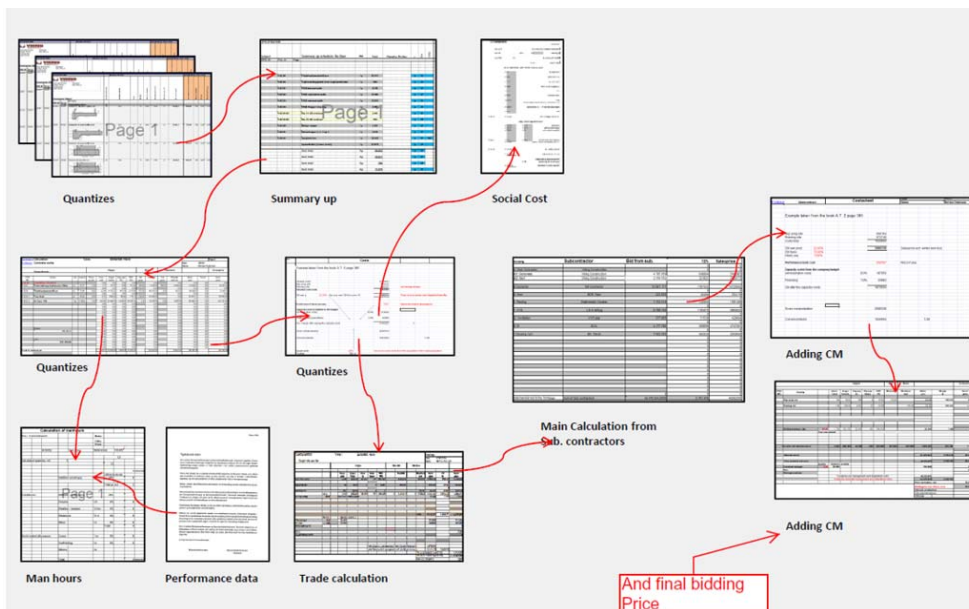


Fig 28 Quantites – Take – Off Work-Flow /1/

On the basis of the changes that have been made during the planning of the building project, the contractor works out a so-called production calculation. Whatever changes have been made during the planning phase shall be worked into the calculation. Such changes could refer to savings on sub-contracts, changed material prices, changes in project, errors identified etc. The revised production calculation will subsequently form the basis for the stage assessment of the building project which usually takes place once a month.

/1/

4.5 Budgetary Objectives

In order to avoid misunderstandings which may result in the delay of payment - or even worse, no payment – it is important that all financial conditions are firmly established. The tender documents shall state payment methods to be used. In order to throw light on amounts to be paid out and times fixed for payment, it is pertinent to work out a payment plan indicating such amounts and conditions.

When payment is based on monthly interim payment certificates it shall be agreed what types of forms and enclosures should be used, as well as a date for submission of the interim payment certificate. Part of defining the financial aspects also includes identification of persons who are authorized to make financial agreements as well as persons authorized to sign such agreements etc.

Payment is only made on the basis of documented work done on site or on the basis of signed agreement forms. A report documenting stages accomplished shall be worked out at least once a month. A cash flow budget showing capital needs over time should be elaborated - indicating expected income and expenditure. The budget is detailed according to needs. It is important to be in control of the entry of expenditure throughout the entire building project. Most companies have worked out an entry system with expenditure accounts. This information is useful in preparing the monthly stage assessment.

/1/

4.6 Work Safety

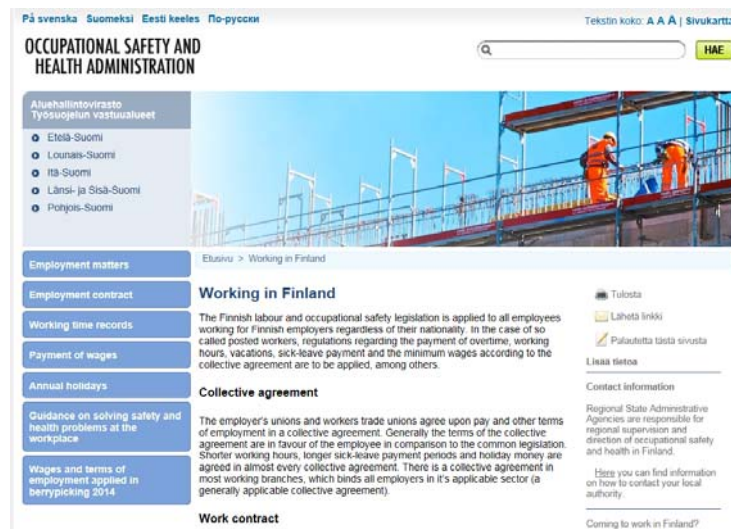


Fig 29 Occupational Safety and Health Administration /20/

In a given project, the main contractor must find out whether it is necessary to work out a **PHS**. In case the main contractor is also the safety coordinator, an agreement to this extent must be entered with the client. The agreement transfers coordinator duties from client to contractor and shall be documented.

The company's general safety handbook shall be subject-oriented. The introduction contains an organization chart indicating who is responsible for what at the building site. Next follows a time schedule for safety meetings to be held. Participants in the meetings are also identified.

The building site must have a safety organization corresponding to the number of actors at the building site and the duration of the construction activity. Safety organisation and procedures relating to safety work shall be identified before construction work commences. Depending on contract type, the main contractor works out a risk assessment of the working environment, including:

- Noise, dust and vibrations
- The use of scaffolding and ladders
- Heavy lifts/ rigging
- Assembly /erecting
- Use of dangerous chemicals etc.
- Fall risk

It is the duty of the main contractor to ensure that staff is certified in the use of equipment and machinery and also to ensure that work with for example epoxy and asbestos is only carried out by staff certified to carry out this kind of work. The main contractor must ascertain that the building site has been registered. He must also ensure that the lifting and

hoisting equipment is registered. For those parts of the sewer and plumbing work where authorization is required the following rules must be observed. With respect to excavation and earth moving work the main contractor must observe current rules. These may vary from one municipality to the other.

/1/

1 Site Info	2 Guidance	3 Work safety Instructions
TYÖMAATIEDOT	PEREHDYTTÄMINEN	TURVALLISUUSSÄÄDÖKSET JA -OHJEET
		
PÖYTÄKIRJAT	TARKASTUKSET	TYÖMAASUUNNITELMA
		
4 Minutes	5 Inspections	6 Building Site Plan

Fig 30 Work Safety Table /16/

The contractor's responsible for equipment used in the building project shall ensure that the necessary approvals have been obtained. He/they must also ensure that the staff operating the equipment has received adequate training when required. More detailed information on this issue such as forms and certificates can be found at <http://www.tyoturva.fi/en>, <http://www.tyosuojelu.fi/fi/workingfinland/>

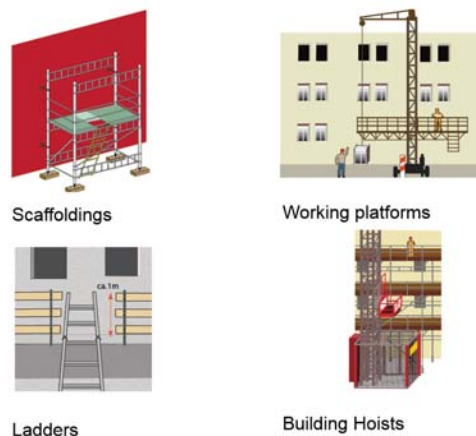


Fig 31 Work Safety Inspections /10/

5 Production Planning During Construction

5.1 General

A construction project can be divided into phases according to the period in which they fall. For instance groundworks, foundations, structural frame and interiors are possible construction phases.

The production planning of each so-called traditional construction phase includes the following parts

- preparation or revision of the site plan
- preparation and updating of the construction phase schedule
- weekly planning
- preparation of several special plans and specification of earlier plans so that they correspond to actual conditions encountered
- plan control, agreements reached in meetings and revisions to plans /2/

During the construction phase it is important to keep track of whatever changes may occur in contract conditions. As a starting point, the contract work will be carried out as agreed in the contract. In case it should prove necessary to change the contract conditions, it is required to draw up an additional contract, stating agreed alterations according to YSE General Agreement Clauses. As a minimum it is required that the agreement is entered in the minutes from the site meeting. However, it is better to fill in an agreement form - can be downloaded from Rakennustieto.

The contractor bears the risk for all work until it is handed over. He is also responsible for maintenance of work done until handing over. Hence, it is important that the contractor takes out an insurance covering his contract area against accidental damages such as theft, wanton destruction and weather impact – areas not covered by the client's insurance against fire and storm.

The client's payment obligations appears from YSE General Condition Clauses. Payments are made on the basis of interim payments – any deviations from this method of payment shall appear in the tender documents.

Work must be carried out in accordance with the agreed time schedule and the contractor is only entitled to extensions of time limits in case of delay of the work as described in YSE. Sanctions in the case of delays will be penalties or compensation. In case of disputes during construction it is important to secure and gather evidence. This may take place by requesting an inspection and survey by experts of the work in question. In this case one of the parties forwards a petition for inspection.

/1/

5.2 Site Plans

A new site plan is prepared in each construction phase. These plans indicate the location of plant and equipment, buildings, roads, storage areas, restrooms and other facilities for the work-force during the construction phases.

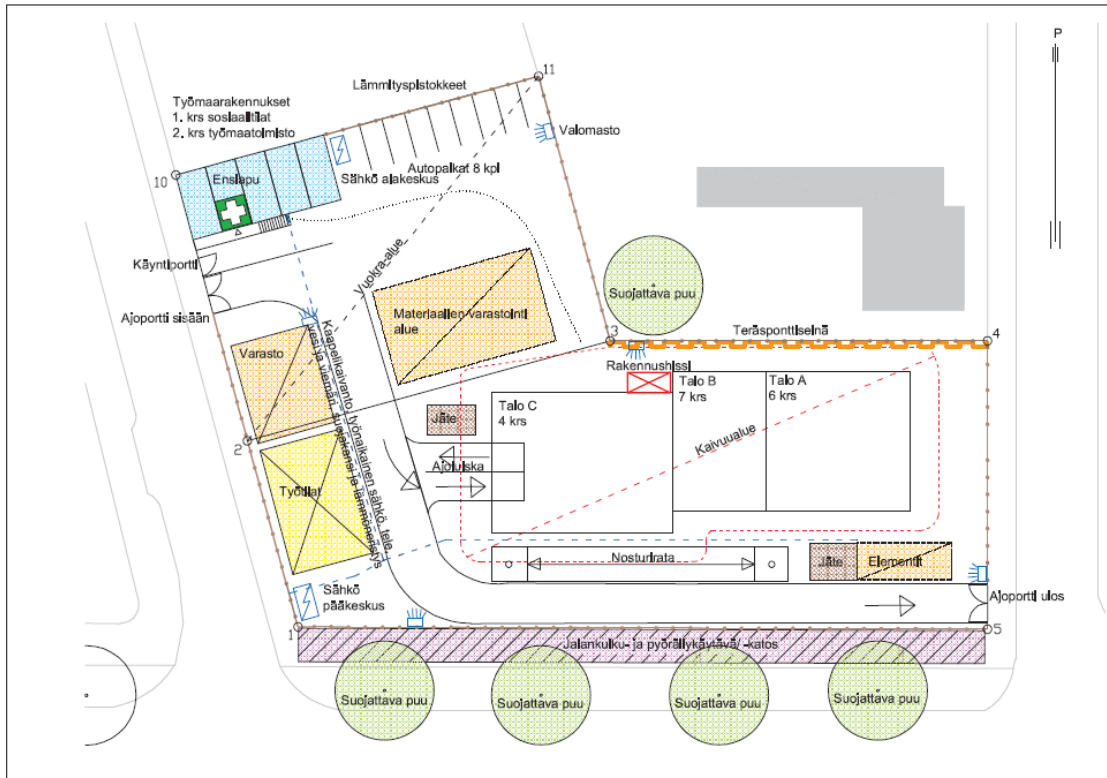


Fig 32 Site Plan /9/

5.3 Construction Phase Schedules

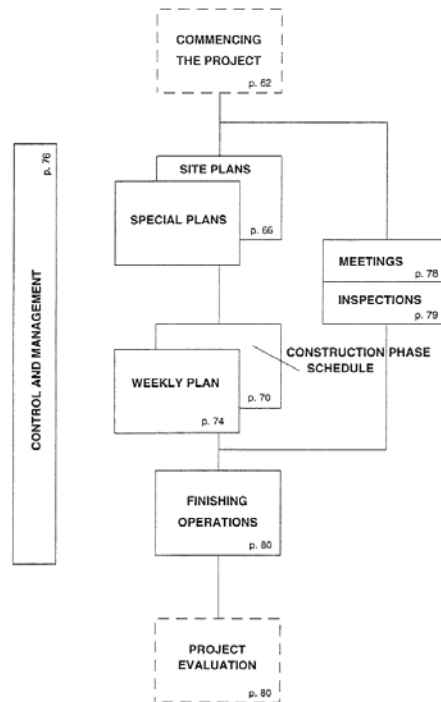


Fig 33 Production planning during the construction /2/

Construction / renovation of a building involves a number of construction processes. Knowledge about the content and the interrelationship of these processes are essential conditions in order to be able to carry out rational construction and at the same time achieve tight management and good quality assurance throughout the building process. A script is worked out with the purpose of familiarizing with the construction processes and thereby achieve a systematic overview aimed at a successful completion of work in own production. The connections to preceding and succeeding activities are noted down. Notes, indicating necessary check points as well as tools and accessories (material catalogues) to be used during construction, are entered. Such notes could refer to scaffolding, crane, form work, barricading, waste containers etc. A materials catalogue listing all necessary materials is also worked out as well as risk assessment of individual activities.

A short description of coherence between individual documents:

- Check points form the basis for quality assurance such as delivery and process control.
- The process diagram forms the basis for the detailed time schedule of own production.
- Risk assessments forms the basis for a plan of action.
- Systematic knowledge about the construction processes forms the basis for the building site arrangement and the financial control.

The main contractor (The individual trade contractor, the turnkey contractor) needs to work out or acquire **the drawings determined for the construction work.**

Examples:

- Building site arrangement plan, where changes will occur as the construction progresses through different stages
- Erection plans for elements and a matching delivery plan
- Casting plan indicating casting segments - design of casting joints
- Bending lists
- Sketches, elucidating and explaining work implementation – possibly in 3D.
- Interim constructions

/1/



Fig 34 Construction Phase Schedule /22/

5.4 Weekly Plan

In a successful building project the keywords are: Planning and Management.
The following issues should be considered when planning and managing a building project (may vary in accordance with the size and type of project in question):

- The framework of the contracted tender time schedule must be enforced.
- Basically, the time schedule shall be realistic – incorporating planned inclement weather days.
- It may be an advantage to include all trades in the detailed implementation planning (this could be done through workshops in connection with the start-up meeting).
- Time-crucial deliveries shall be attuned with the detailed plan
- Running update / status on forthcoming work, supplies and issues that might disturb the planned work should be carried out and recorded in the minutes of the weekly site meetings
- Follow up may be carried out using 1 and 5 week plans respectively

The weekly plan is to undertake the works according to the objectives established in the construction phase schedule. The plan indicates detailed timing on daily work activities and processes, supplies and equipment use, so that the maximum benefit from available resources is achieved.

/1/



Fig 35 Weekly Plan

5.5 Plan control

Based on the outputs jointly defined and by the parties involved in the building project and described in the contract, it is the project manager's task to manage the building process in accordance with:

- The contractual agreement
- The agreed time framework
- The agreed tender sum + funds allocated for contingencies, winter provisions etc.
- The agreed quality assurance corresponding to quality as documented in the tender documents.
- The agreed building site conditions and current requirements concerning safety at the building site etc.

/1/

5.6 Project meetings and negotiations

In order to ensure a satisfactory content when meetings are held, it is recommended to arrange meetings with an agenda based on experience and send to participants well in advance of the actual meeting.

Meeting examples:

- Starting up meeting / project examination meeting
- Site meeting
- Safety meeting

In order to secure the project implementation in accordance with the above mentioned steps, the following meetings should be held during the course of the building project.

- Project examination meeting (kick-off) after contracting / before upstart.
- Starting-up meeting / mobilization meeting immediately before start
- Site meetings normally once a week.

- Safety meetings normally once every second week.
- Meeting for handing over of work after the notice of completion - before occupation.
- 1 year inspection 1 year after handing over.
- 2 years inspection 2 years after handing over

In addition to the above mentioned meetings, the project manager and the trade supervision may call meetings, as and when needed, in order to clarify matters related to details in solutions, financial aspects, time planning and follow-up on quality assurance and safety etc. In order to secure that agreements made at meetings are legally binding for the parties involved it is required to make **minutes** and to approve such minutes. This procedure may require approvals by signatures and shall be duly dated.

Objections raised concerning the minutes may be oral in the next meeting, or in writing, before the next meeting. /1/

5.7 Inspections and Checks

A good draft agreement for quality assurance during tender and contracting facilitates the implementation of quality by project management.

The contractor works out a subject-oriented **quality assurance handbook** based on the company's quality assurance handbook and quality demands in the tender documents. The handbook contains a description of procedures and systems to be used for quality assurance and project management.

The client defines his quality demands in the tender documents in the form of **tender control plans**. During the starting up phase, and based on these plans, the contractor works out his own control plans for delivery control, process control and final control. These plans are filled in during the building project and are handed in at handover.

In order to ensure that the client gets the desired quality, the designer works out a **supervision plan** showing the extent of supervision of the contractor's workmanship and also showing the extent of general supervision of the construction work. The plan is worked out by the designer during the design phase. Supervision shall be conducted in areas where the risk of failure is eminent. /1/

5.8 Finishing operations

The principle of monthly interim **payment** certificates is as follows: By the end of each month, the contractor and the client calculate the total value of work carried out at the site. This amount is deducted the value of work already carried out and paid for. The difference corresponds to the value of the work carried out during the month in question. Payment is carried out as agreed in the contract.

In case of overdue payment, the client is bound to pay interest as from the day the interim certificate was received until the day of actual payment. This mode of payment is the most commonly used – not only between client and contractor but also between contractor and his sub-contractors.

The principle of an instalments plan is as follows: The value of characteristic parts of the building is calculated – for example ‘basement completed’, ‘roof on building’, ‘building heated’ or the like. An instalments plan could also be a plan where monthly payments are calculated on the basis of the initial time schedule.

/1/

Financial follow-up is one of the most important tasks of the project manager. In most cases, the project manager is required to account for the financial position of the project once a month, and the company will form an estimate of his ability to document company finances, which ultimately may have influence on his own payment by results. It is therefore important to build up a system with the purpose of recording actual production costs and compare these costs with the calculated costs.

In this way it is possible to check whether the budget corresponds to actual costs, which reflects the current financial position and allows for a calculation of the final financial result of the building project in question.

The project manager must always be in a position to tell whether the calculated contribution margin is realistic - and if not, explain why.

The financial follow-up on a building project is an ongoing process because, in addition to the above mentioned, there is a constant flow of extra works resulting in additional income and thereby an increase in the contract sum and production costs. Unexpected costs may occur and expenditure to cover these must be entered in the follow-up schedule without delay.

It is usually the duty of the turnkey contractor to work out **operation and maintenance manuals**. In individual trade contracts, the contractors may hand over the material to the consultants who in turn will work out the manuals based on the received material.

/1/

6 Work Plans

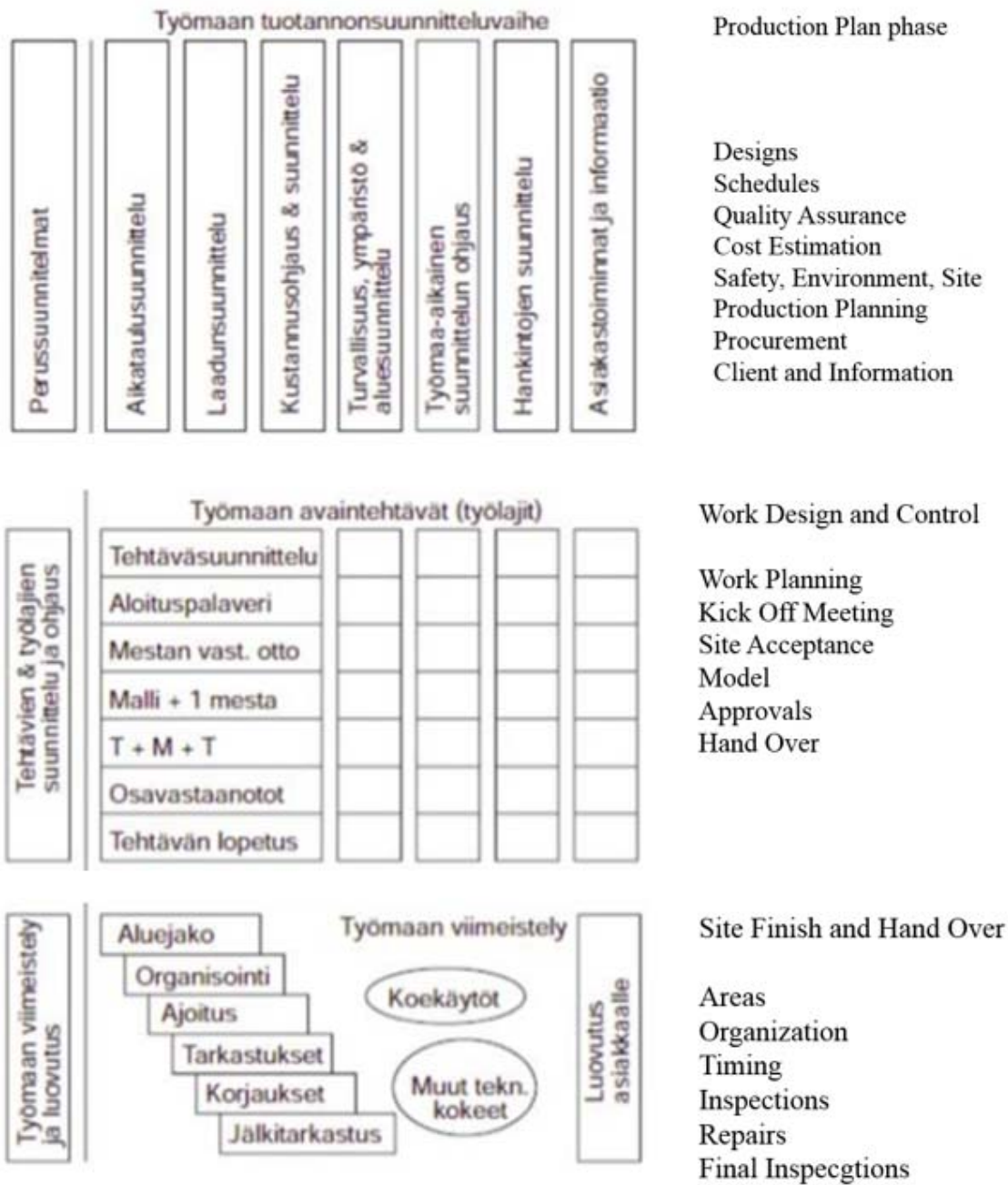


Fig 36 Production planning content /2/

6.1 Kick Off Meeting

In the Kick Off Meeting the whole work plan is studied with the workers. The agenda will include work safety, schedule, resources, performance data, content and quality assurance.

/1/

6.2 Building Site

The preconditions of the Starting Up is that the contracts between the constructor and the contractors are signed and the building permit is granted. In addition many preparing measures have to be undertaken:

- applications e.g Responsible Work Leader
- announcement to e.g. Building Inspection, Fire Brigade, Occupational Safety and Health Administration, Confederation of Finnish Construction Industries RT
- neighbours
- procurements, site huts, connections of electricity, water, district heating, signs, shelters, insurances, guarding
- Building Site Plan: roads, storage areas, equipments
- Inspections

/1/

6.3 Inspections and measurements

The Quality Assurance shall base on e.g. risk analyses, professional skills and circumstances.

/1/

6.4 Work Safety

The work safety is an essential part in the project management, design and construction. The Act on the Work Safety (205/2009) gives orders about the safety in the construction.

A more detailed description of the requirements for the working environment can be found in the executive orders. These include the executive order on asbestos, building sites, noise, the use of technical aids and the use of personal protective equipment.

The employer is responsible for ensuring that the enterprise is compliant with the Working Environment Act. In general the Working Environment Act demands that employers must plan, arrange and carry out the work in a manner which is fully responsible in terms of health and safety.

Employers are obliged to ensure, among other things, that:

- the workplace is correctly fitted out, e.g. for preventing falls and the risk of collapse
- the enterprise trains and instructs its staff so that they can carry out their work without risk
- they supervise staff effectively to ensure that they are carrying out their work correctly and are following instructions

/1/

6.5 Work Plans

The Work Plan includes e.g.

1. Project Info
2. Scope of the work e.g. area, connections to the contracts and the trade
3. Time Planning
4. Cost Managing
5. Quality Requirements
6. Analyse of the Potential Problems
7. Logistics
8. Machinery
9. Work safety
10. Quality Assurance

/26/

FOUNDATION		RT 81-10854																		9742,0	
LIGHT WEIGHT CONCRETE BLOCK FOUNDATION, h=800 mm, upper part insulated block																					
Structure thickness		303 mm																			
Investment annual cost for 50 years		11,40 €/m2/a																			
		Length	Unit/1m found	Material €/m	CWork performance/unit (m, m2, m3, kg)	Total time	Total Wage/1 m foundation	Total Costs/1 m foundation	Total costs/1 m foundation												
		50,5	m	133,07	1,99		98,43	59,84	192,91	9741,96											
Bitum waterproofing 300 mm		1m		2,51	0,05	50,50	2,53	1,34	3,85	194,43											
Footing, light weight concrete block		pcs		53,48	1,09	50,50	55,05	33,28	86,76	4381,38											
Plastering		m2		1,03	0,11	50,50	5,56	3,68	4,71	237,86											
Footing waterproofing		m2		6,45	0,11	50,50	5,56	3,02	9,47	478,24											
Concrete Foundation 600x200 mm		m3		25,02	0,30	50,50	15,15	9,51	34,53	1743,77											
Frost insulation 100 mm , 1m length, inclination 1:10		m2		8,46	0,07	50,50	3,54	1,90	10,36	523,18											
Drainage 110 mm, plastic 1,0 m		m		2,56	0,12	50,50	6,06	3,34	5,90	297,95											
Gravel filling		m3/m		33,56	0,14	50,50	5,00	3,77	37,33	1885,17											
										9741,96											

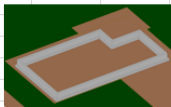
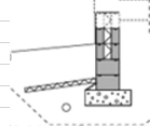


Fig 37 The Foundation Work's checked schedule and costs

The schedule and costs are checked and compared with the General Schedule and the Budget.

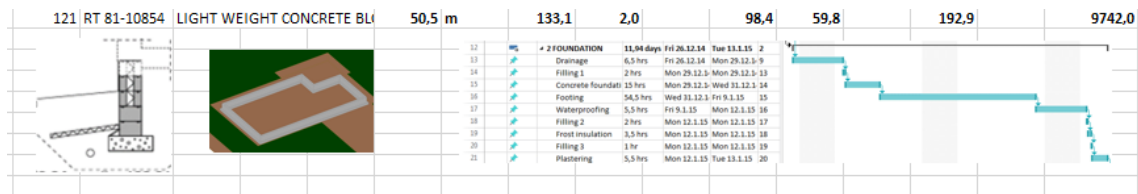


Fig 38 The Foundation Work's checked schedule

The Quality Requirements are expressed in the work specifications. The work specifications usually base on documents like “General Quality Requirements of the Construction”, norms, standards, RATU Production Cards and general product information.

General potential problems are like frozen soil, damaged formworks or late concrete deliveries. Preparation for the problems consists measures like the planning in the kick-off meeting and checking the orders.

The Quality Assurance is usually made by the Project Manager, the Work Leader and the workers. The Inspections include the Check of the Prerequisites, Inspections during the work and the Handing Over.

Viking Contractor Team 1		Production card <u>Foundation and Floor Construction</u>		Execution period: 11.12.2008-13.04.2009																				
Project Extension to cold storage Client Edeka Date 27.10.2008 Done by Óskar Alexander Kristinnson		Quality 1. Formwork -made according to drawings and descriptions. 2. Concrete quality-according to specifications. 3. Reinforcement must be made according to drawings and specifications. 4. Curing concrete - according to specifications and processcontrol plans 5. Photo documentation must be made during the process.																						
Activity description: Making formwork for foundation with forms from Peri Making floor construction in the container covering and fire parapet		Control 1. Control quality and arrangement of formwork. 2. Control concrete's consistency before casting. 3. Control method of laying out concrete, thickness: layers, covering. 4. Control how vibrating is done, see drawing of vibration. - distances between places where it is immersed - vibrator shall not touch the reinforcement		Equipment 1. Hand tools for the concrete crew 6. Safety equipment																				
Material description <table border="1"> <thead> <tr> <th>Object</th> <th>Material</th> <th>Quantity</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td>Formwork PERI TRIO</td> <td></td> <td>529</td> <td>m²</td> </tr> <tr> <td>Concrete 5</td> <td></td> <td>18</td> <td>m³</td> </tr> <tr> <td>Concrete 25</td> <td></td> <td>513</td> <td>m³</td> </tr> <tr> <td>Reinforcement bars</td> <td></td> <td>16079</td> <td>kg</td> </tr> </tbody> </table>		Object	Material	Quantity	Unit	Formwork PERI TRIO		529	m²	Concrete 5		18	m³	Concrete 25		513	m³	Reinforcement bars		16079	kg	Workers 1. Concrete Crew, crew of 4 people. 2. Concrete pump operator 3. Vibrator operator. 4. Concrete truck operator.		Machinery 1. Crane 2. Concrete pump 3. Stick vibrators 4. Concrete truck
Object	Material	Quantity	Unit																					
Formwork PERI TRIO		529	m²																					
Concrete 5		18	m³																					
Concrete 25		513	m³																					
Reinforcement bars		16079	kg																					
Work description 1. Formwork: checked, oiled and put in place. 2. Prefabricated reinforcement placed between forms. 3. Concrete: casted by concrete pump. 5. Each layer compacted by stick vibrator. 6. Curing of fresh concrete-according to descriptions. 7. Casting subfloor 8. Casting screed		Safety plan 1. Wearing safety helmets and boots is obligatory for workers. 2. First aid equipment and telephone must be on site. 3. Safety glasses must be used during concrete works. 4. Ears' protection should be used by worker who works with vibrator. 5. Support on walkie-talkie, gesture communication is also appropriate. 6. No passage under the pump's arm when pump is working.		Demands for machinery and workers Crane's operator: Must be qualified Crane: Shall be on operation area Pump's operator: Must be qualified and well prepared. Pump: Operation area: 25m Vibrator's operator: Must be qualified. Vibrator: Height 5-10m, diameter: 57mm All machinery should be totally operative and properly exploited.																				
																								

Fig 39 Foundation and Floor Production Card

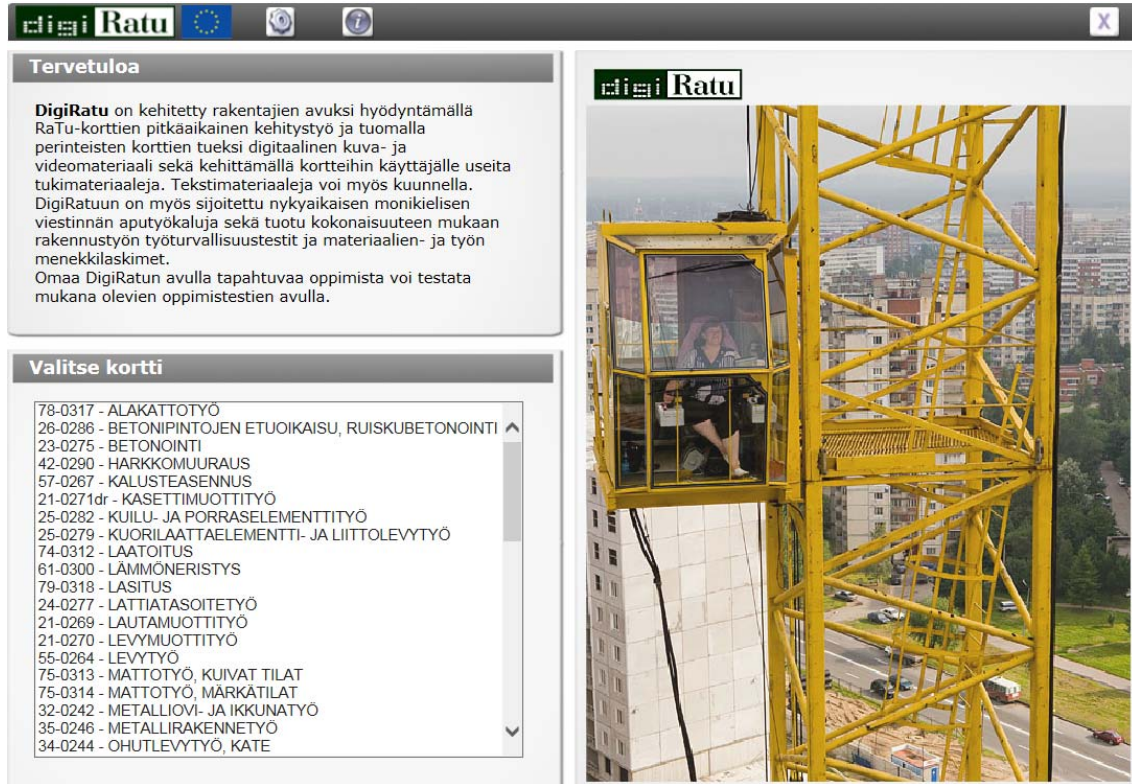


Fig 40 DigiRATU Digital Production Data

DigiRatu is a Finnish digital production database developed on the basis of the RATU production cards created from 1970ies. DigiRATU offers digital picture and video material to support the use of the traditional RATU production cards. DigiRATU is multilingual and includes worksafety and material and performance data tools.

6.5.1 Earthworks

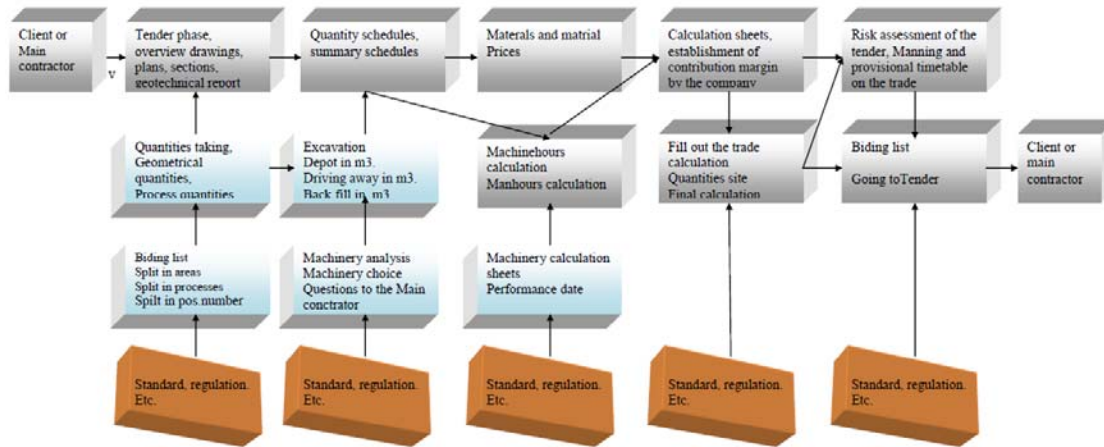


Fig 40 Soil and Sewer works /1/

The Contractor shall carry out all earthworks in such a manner as to prevent erosion or slips and shall limit working faces to safe slopes and height. The Contractor shall ensure that all surfaces have at all times sufficient gradients to enable them to shed water without causing erosion. All top soil shall be removed from the areas of cuttings and embankments.

Excavation shall be carried out to the dimensions, lines, levels and slopes as indicated on the drawings. Should rock be met in the course of excavation, it shall be removed by approved means. Unless otherwise shown on the drawings, all filling for this purpose shall consist of suitable material deposited and compacted by approved plant. /6/

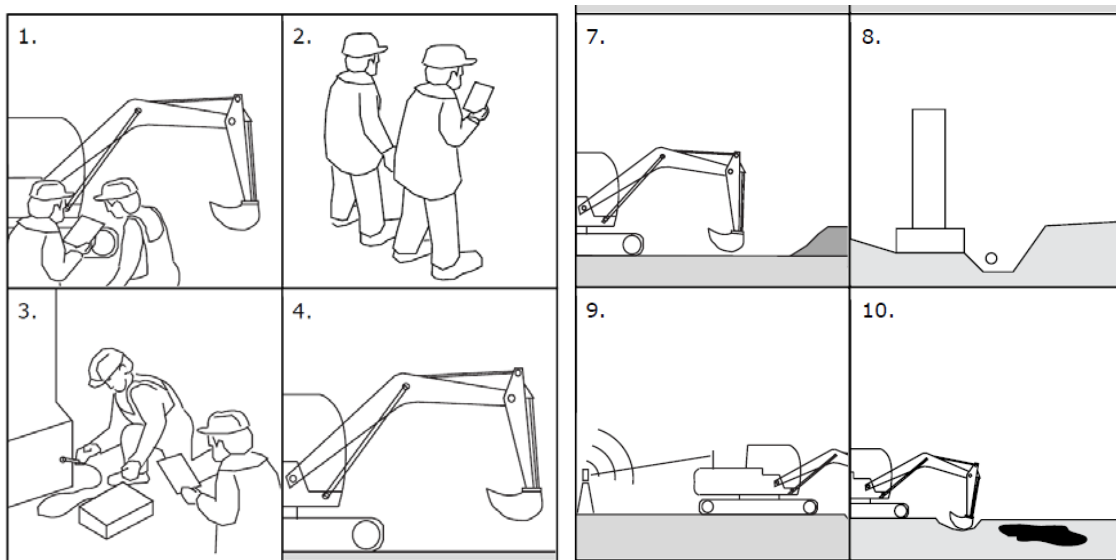


Fig 41 Earthwork Starting Up /9/

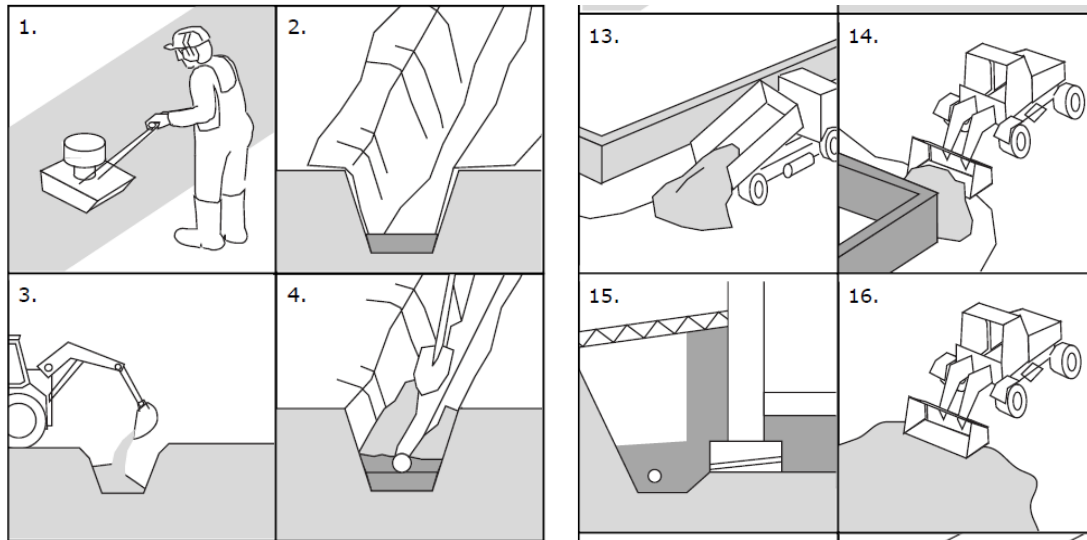


Fig 42 Filling /9/

6.5.2 Piling

Both in-situ and precast piling systems can be used to provide fast and effective foundation solutions. In-situ techniques available include e.g. Bored piling. This piling technique is regarded as non-displacement meaning there is less risk of ground heave.

Precast concrete piles are used in the construction of foundations for a wide range of different structures in the civil engineering and building sectors. As precast piles are suitable for all applications and ground conditions, they provide a very cost-effective piling solution. They are quick to install without producing spoil or arising material in the process, providing a further saving on waste disposal costs.

Precast piles are generally top driven into the ground using hydraulic drop hammers. The variety of segment lengths available, along with specialist piling equipment, makes precast piles particularly suited to restricted access and low headroom sites. /7/

Material and workmanship specifications

The Contractor shall comply fully with the relevant recommendations and shall establish all lines, levels and be responsible for the correct positions of all piles. The maximum permitted deviation at cut off level of the pile centre from the centre point shown on the setting out drawing shall be 75 mm in any direction. Any piles cracked, deformed, twisted or otherwise damaged in anyway or not installed within the specified tolerance shall be rejected at the discretion of the Engineer and replaced or supplemented by substitute piles by the Contractor. /6/.

Precast concrete piles must be reinforced. The minimum number of longitudinal bars provided in a precast concrete section should be four in square piles and six in circular and hexagonal piles and their size shall not be less than 12mm in diameter. In any case, the total cross sectional area of these bars shall not be less than 1% of the cross section of the pile.

For standard steel piles with rolled sections, the dimensional tolerances and weight shall comply with the relevant standards. For proprietary sections, the dimensional tolerances shall comply with the manufacturer's standards.

All pressure treated timber piles shall be branded with a burnt brand impression. This brand shall be sufficiently comprehensive and shall contain such trademarks, manufacturer's name and identification numbers as to allow the piles to be identified.

Working Test Load is a load applied to a selected working pile to confirm that it is suitable for the load at the settlement specified. A working test load should not normally exceed 150% of the working load on a pile. /6/

6.5.3 Concrete Floors

Concrete floors can be made with different techniques but the main phases repeat themselves. First the thermal and frost insulation and the reinforcement is placed on the compressed gravel. Then the concrete is casted and vibrated. Finally the surface is usually polished and curing measures are taken.

Typical concrete floor solutions are

- normal concrete slab on ground which is treated afterwards
- structural floor slab and screed
- concrete floors dried with suction
- concrete floor with plasticizing admixtures

/7/

Floor screeds

A floor screed is usually a cementitious material made from a 1:3 or 1:4.5 ratio of cement to sharp sand. It may be applied onto either a solid in-situ concrete ground floor slab or onto a precast concrete floor unit. The screed may be directly bonded to the base, with a minimum thickness of 40 mm, laid unbonded onto a suitable damp proof membrane which is placed over the slab, with a minimum thickness of 50 mm. If reinforcement is required, this can either be in the form of a fine metal mesh or fibres which are normally polypropylene. The screed may be left as finished, or floated to produce a smooth surface on which to lay the specified flooring or finish. Screeds can also be used to enclose underfloor heating pipes or as a path to route services.

/7/

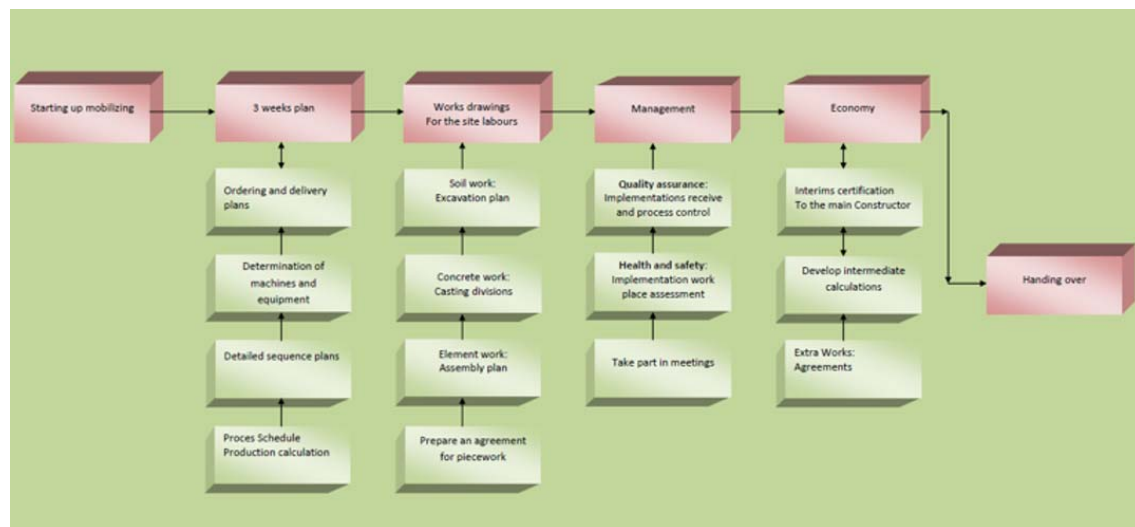


Fig 43 Construction phase /1/

6.5.4 Foundation

A foundation is used to support a building or structure and transmits loads directly to the underlying soil or rock. It must satisfy two fundamental requirements. Firstly, it must provide an adequate factor of safety against failure of the supporting strata. Secondly, any resulting settlement, and in particular differential settlement, should not be detrimental or interfere with the function of the structure.

/7/

The Geological Report presents e.g.

- frost properties of the soil
- drainage principles
- foundation system proposition
- loads and displacements allowed
- foundation depth
- fillings

The foundation designs include e.g. the drainage design, surface gradient design, the actual structural foundation design. and winterworks if needed.

Typical foundation structures are

- piles
- columns
- retain walls
- strip and pad foundations
- bearing ground floor and slab on ground

Foundations can be split into two main types, shallow foundations and deep foundations.

Shallow foundation

Shallow foundations are constructed relatively close to the ground level. Shallow foundations can only be used where the soil at that level is capable of adequately supporting the load. They are founded at a minimum depth to resist damage from frost, and in cohesive soils, for example clays.

Shallow foundations can be sub-divided into the following main types;

- Strip foundations (footings) – a linear foundation which generally support walls.
- Pad foundations – a discrete square or rectangular foundation supporting columns or piers.
- Raft foundations – a large single foundation supporting a whole structure.

Shallow foundations are generally constructed using in-situ concrete but some substructure elements can alternatively be constructed in precast concrete in part or whole to improve speed of construction on site.

/7/

Deep foundations

A deep foundation is used to transfer loads from a structure above ground through upper weak strata of soil to a more competent one at depth, beyond which shallow foundations become both impractical and uneconomic. The most common form of deep foundation is provided by using piles which can be categorised as either replacement or displacement.

/7/

Replacement piles

The primary system is Rotary Bored Piles. Piles can be installed with diameters between 300 mm and 3.0 m. Single large diameter piles have been used on projects to support individual columns rather than the traditional method of using a group of smaller piles which tend to have more complex pilecaps and restraint systems. The single piles are designed assuming no restraint from the substructure and have a simple pilecap thus increasing speed of construction.

Geo-thermal piles incorporate flexible plastic pipes within the pile reinforcement cages. The completed concrete piles provide a conduit for the energy derived from the ground and are used in heating and/or cooling of the structure.

/7/

Displacement piles

These include precast concrete driven piles, steel (top or bottom) driven piles and jack-down steel piles. The steel cased systems are filled with concrete following the installation. Precast concrete driven piles are available in section sizes up to 350 mm diameter or 400 mm square.

/7/

Pilecaps

At the head of the pile or pile group there is a pilecap which provides a connection between the pile and the ground slab and/or superstructure elements (columns or walls). Pilecaps incorporating a multiple pile system comprising three or more piles require no additional restraint. A pilecap for a single pile will require restraint in orthogonal directions provided by either a suitable connection with the ground slab or by ground beams. Similarly a pilecap incorporating two piles will require restraint in only the weaker direction again by providing either a suitable connection with the ground slab or by ground beams.

/7/

Design and specification

Foundations should be designed using the Eurocodes, particularly EN 1997-1 and specifically for the design of concrete structures EN1992-1-1.

/7/

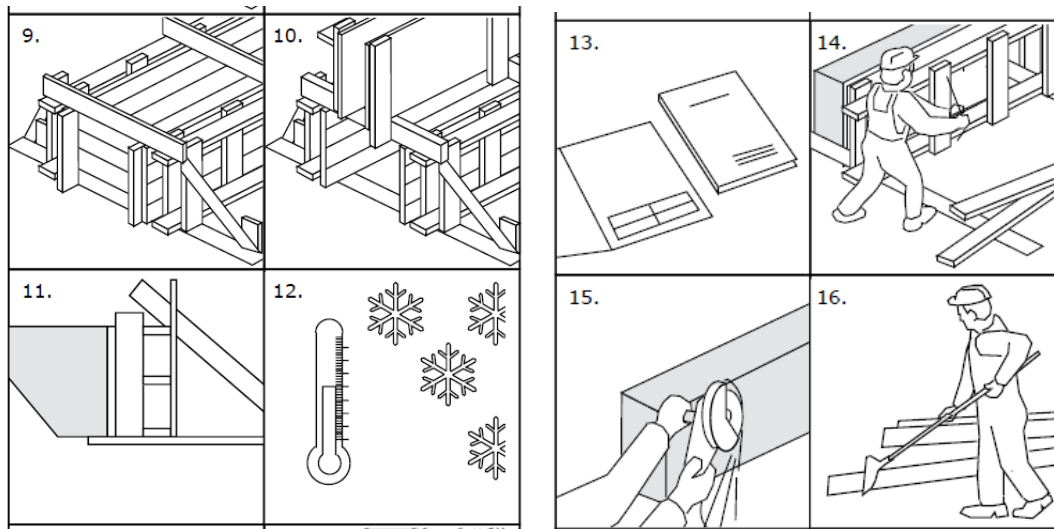


Fig 44 Foundation Formworks /9/

6.5.5 Concrete Frame Works

The Building Frame Options

The building frame's task is to lead the loads down to the foundations and to the soil. The most important demands for the frame are economy, strength and stiffness. The frame has to a certain extent to be able to bear the exceptional loading situations, eg. natural disasters and fire. The frame can be built in situ, with a partial prefabrication or with the full prefabrication. The frame systems can be divided as follows:

- bearing walls and slabs
- column-beam-slab
- bearing walls , beam and slab
- shell structures
- lift-slab
- arches and vaults

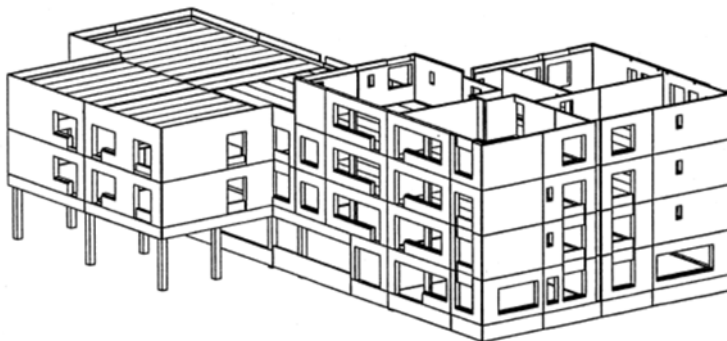


Fig 45 Concrete Unit Frame /13/

The in Situ Concrete Frame work phases are formworks, reinforcement and concreting. The quality assurance plays an important role in the concrete works.

Formwork

Formworks can be divided as follows:

- Small traditional formworks
- Formwork Systems
- Small Formwork Units
- Big Formwork Units
- Permanent Insulated Formwork
- Stay-In-Place structural formwork

Traditional timber formwork is built on site out of timber and plywood or moisture-resistant particleboard. It is easy to produce but time-consuming for larger structures, and the plywood facing has a relatively short lifespan. It is still used extensively where the labour costs are lower than the costs for procuring reusable formwork. It is also the most flexible type of formwork, so even where other systems are in use, complicated sections may use it.

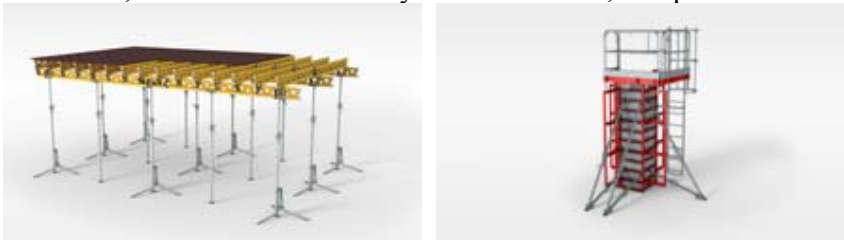


Fig 46 Formwork systems /8/

Engineered Formwork System is built out of prefabricated modules with a metal frame usually steel or aluminium and covered on the concrete side with material having the wanted surface structure steel, aluminum, timber, etc. The two major advantages of formwork systems, compared to traditional timber formwork, are speed of construction, modular systems pin, clip, or screw together quickly and lower life-cycle costs

Permanent Insulated Formwork is assembled on site, usually out of insulating concrete forms (ICF). The formwork stays in place after the concrete has cured, and may provide advantages in terms of speed, strength, superior thermal and acoustic insulation, space to run utilities within the EPS layer, and integrated furring strip for cladding finishes.

Stay-In-Place structural formwork systems is assembled on site, usually out of prefabricated fiber-reinforced plastic forms. These are in the shape of hollow tubes, and are usually used for columns and piers. The formwork stays in place after the concrete has cured and acts as axial and shear reinforcement, as well as serving to confine the concrete and prevent against environmental effects, such as corrosion and freeze-thaw cycles. /5/

The Formwork Plan includes the structural design and the usage design; the choice of formworks, liftplan, storage areas and the weather protection.

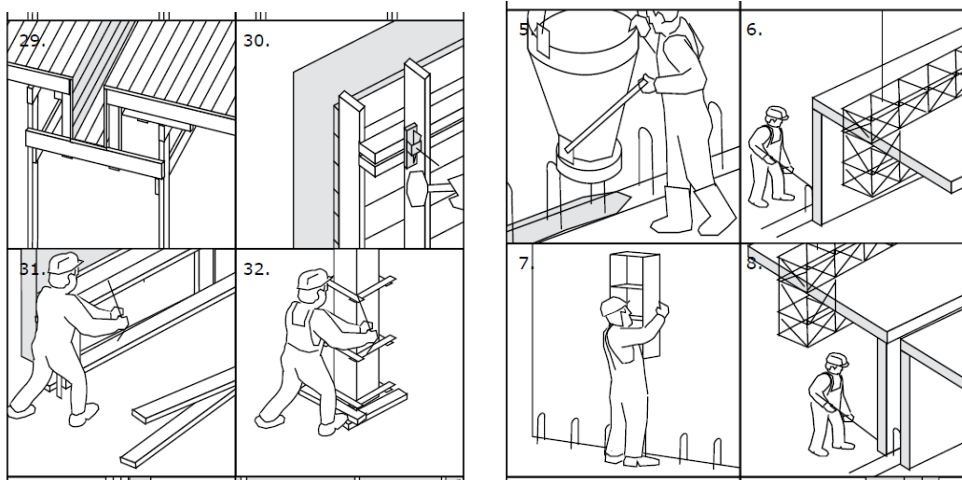


Fig 47 Formworks /9/

Rebars

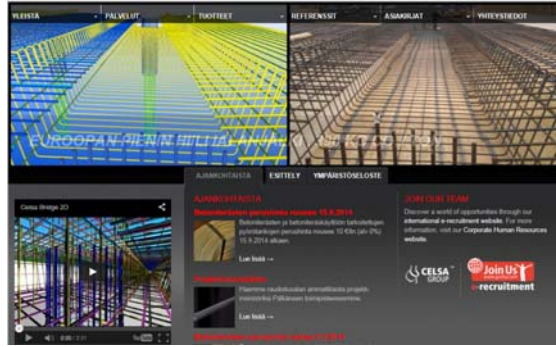


Fig 48 Reinforcement /5/

/23/

The rebar is a common steel reinforcing bar, an important component of reinforced concrete and reinforced masonry structures. It is usually formed from mild steel, and is given ridges for better frictional adhesion to the concrete.

Concrete is a material that is very strong in compression, but virtually without strength in tension. To compensate for this imbalance in concrete's behavior, rebar is formed into it to carry the tensile loads.

While any material with sufficient tensile strength could conceivably be used to reinforce concrete, steel and concrete have similar coefficients of thermal expansion: a concrete structural member reinforced with steel will experience minimal stress as a result of differential expansions of the two interconnected materials caused by temperature changes.

Although rebar has ridges that bind it mechanically to the concrete with friction, it can still be pulled out of the concrete under high stresses, an occurrence that often precedes a larger-scale collapse of the structure. To prevent such a failure, rebar is either deeply embedded into adjacent structural members, or bent and hooked at the ends to lock it around the concrete and other rebars. This first approach increases the friction locking the bar into place while the second makes use of the high compressive strength of concrete.

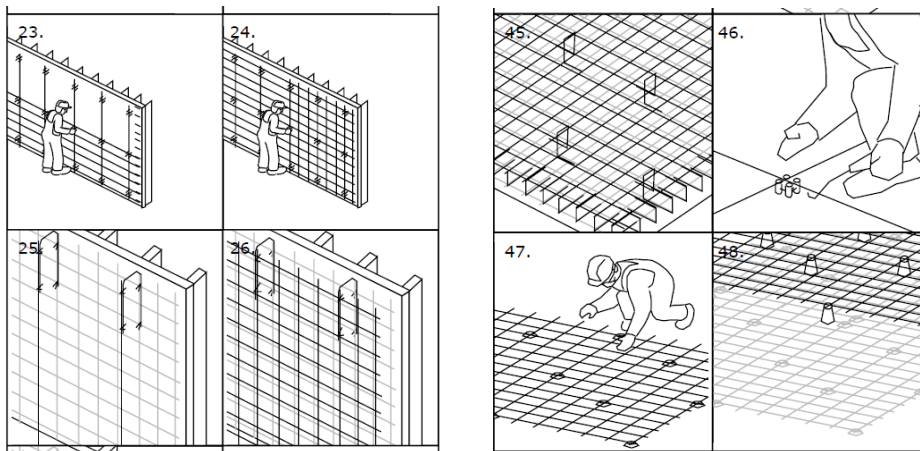
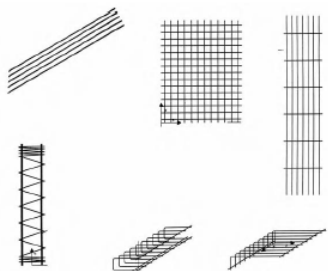


Fig 49 Reinforcement /9/

Common rebar is made of unfinished steel, making it susceptible to rusting. As rust takes up greater volume than the iron or steel from which it was formed, it causes severe internal pressure on the surrounding concrete, leading to cracking, spalling, and ultimately, structural failure. This is a particular problem where the concrete is exposed to salt water, as in bridges built in areas where salt is applied to roadways in winter, or in marine applications. Epoxy-coated rebar or stainless steel rebar may be employed in these situations at greater initial expense, but significantly lower expense over the service life of the project. Most grades of steel used in rebar cannot accept welding, which could be useful to bind several pieces of rebar together. Special grades of rebar steel and welding rods make welding by expert welders possible.

To prevent workers from accidentally impaling themselves, the protruding ends of steel rebar are often bent over or covered with special plastic "mushroom" caps. /5/



Tuollisen työmaarakordituksen peruskomponentteja: katoa Liikaa tiukko kirjotuksen lopussa.



Fig 50 Rebars and meshes /5/

Hotroll reinforcement rebar diameters in Finland are 6, 8, 10, 12, 16, 20, 25 and 32 mm.

Meshes are produced in square and rectangular shapes, e.g. symbol 12/10 – 150/600 means that

- main rebar diameter is 12 mm
- seconray rebar diameter is 10 mm
- main rebar spacing is 150 mm
- secondary rebar diameter is 600 mm

Concrete casting



Fig 51 Concrete casting /5/

Concreting Plan

Concreting Plan presents information like e.g. concrete volume, concrete qualities, formworks, reinforcement, quality control, resources and work safety. Machinery Plan presents information about the machinery and service. Work Order Plan informs about Casting Schedule, Work Foreman and Control. /5/

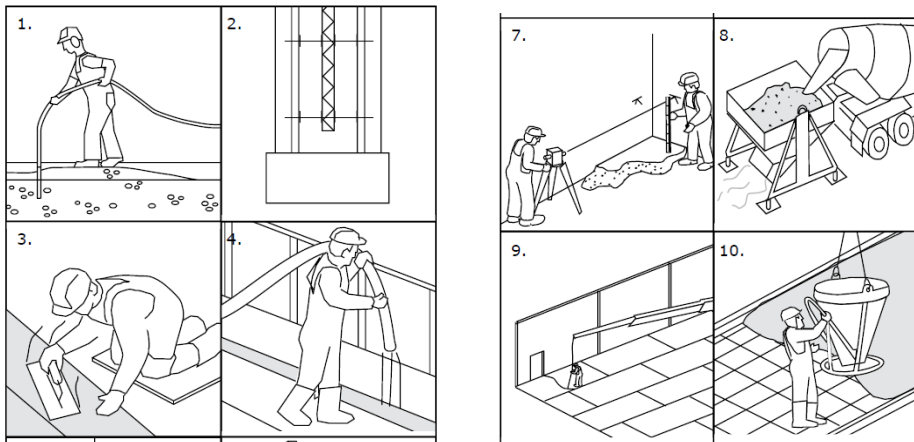


Fig 52 Concreting / 9/

6.5.6 Prefabricated Concrete Unit Works

To ensure the safe and effective Erection of the Prefabricated Concrete Frame the Erection Plan has to be made according to the EuroCode SFS-EN 13670 The erection of Concrete Structures.

The Erection Plan presents e.g.

- erection order
- lifting machinery
- work groups
- propping
- fixing
- joining
- tolerances and quality requirements

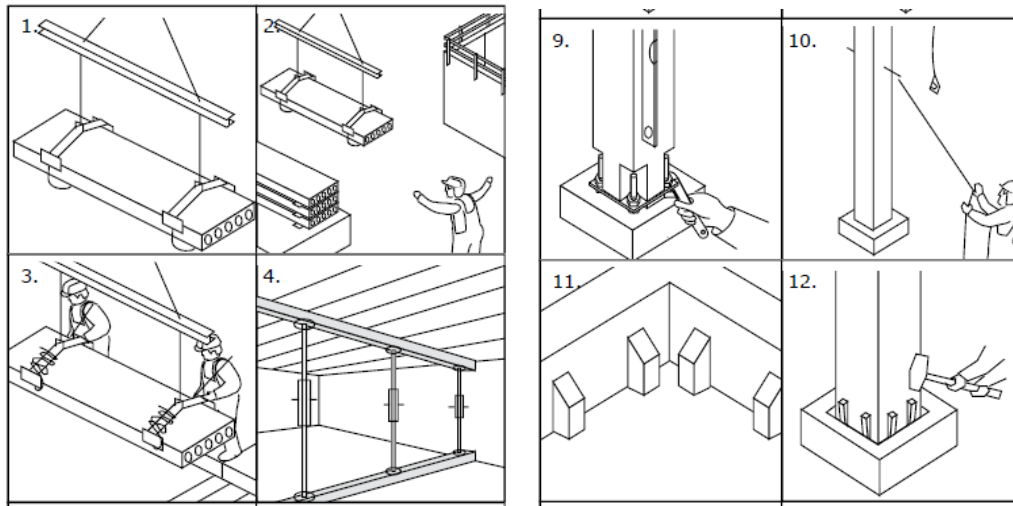


Fig 53 Prefabricated Concrete Unit Works according to RATU /9/

The Steel Frame Erection is accomplished in Finland according to the SFS-EN 1090-2 standard. Similar guides are available as well for the Timber Frame Works.

7 Handing Over

The contractor informs the client about the time of completion of the work. The client then convenes a handing-over meeting to take place within 10 workdays of the time indicated. In case the work composes several contracts, all contracts shall as far as possible be completed before the handing-over meeting can take place. Prior to the handing-over meeting, the contractor examines the work in order to establish possible essential defects.

The decision whether work is completed on time or not solely depends on the predefined work completion time as set by the contractor in the completion notice, whereas the handing over time is decisive for transfer of risk, responsibility etc. In case essential defects are established during the handing-over meeting, the work cannot be handed over. An essential defect is defined as a defect that impedes occupation. In case a defect is deemed essential the contractor shall rectify the defect and a new handing-over meeting is convened. Postponement of hand-over due to essential defects may result in delay and consequently in the payment of penalties. In cases where only minor defects are identified the client may withhold part of the contract sum until the defects have been rectified.

The handing-over date affects:

- Who bears the risk for the construction work – including duty of maintenance.
- Respite for submission of final accounts
- Defects assessment
- 2-years rule for complaints
- Deadline for rectification of defects
- Reduction of contractor's security bond
- Determination of the limitation period

In cases where the tender documents state that the contractor shall submit documentation for operation and maintenance, a request for the handing in of such documents must appear in the invitation for the handing-over meeting. Concluding the handing-over meeting, reasonable time limits are set for the contractor's rectification of 'non-essential' defects as well as the amount to be withheld from the contract sum, and a date for a new examination of the project. Once the building project is handed over to the client also the the responsibility for coordination of health and safety as well as the safety plan are handed over. Finally, all documentation pertaining to the management of health and safety throughout the building project is also handed over to the client.

The main contractor should only conduct a handing-over meeting with his own sub-contractors after handing-over has taken place with the client. In this way he maintains his right to claim rectification of defects from a given sub-contractor in the work carried out by the said sub-contractor, and which may be established during his hand over to the client. By doing so, the main contractor also ensures that his time limits for complaints towards the subcontractor run for a longer period of time than the client's time limits for complaints against himself. In this way the main contractor can avoid ending up in a situation where he will be made responsible for defects caused by the sub-contractor

The client summons the contractor for an **inspection** of the work which shall take place one year after handing-over, at the latest. The client also summons the contractor for a **final inspection** of the work which shall take place at the latest 30 days prior to the expiry of a 2 year period after handing-over

Once the project has been handed over to the client it is expedient **to sum up the experience** gathered. Subsequently, a report is produced and handed over to the company.

/1/

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Master format example

F CONSTRUCTION ENGINEERING

F1 FOUNDATIONS

F11 Pad Foundation

AN01 Pile foundation

- reinforced C30/37
- stiff fastening to the pole

AN03 Strip foundation

- reinforced concrete strip, C30 /37
- rock anchors TW20 s 1000mm L = 1000+ 1000mm
fastening to the rock

F11 quality requirements

- * RunkoRYL 2000 23.42 is followed
- * quality of the surfaces by 40 class 2
- * tolerances insitu by 39, section 2 class 1
- * measures and reinforcement according to the structural designs
- * freezing must be prevented.

F13 base floors

AP01 Hollow core slab 265 mm, cell polystyrene 50 + 125
among others, ventilated base floor

- hollow-core slab 265 mm
- polystyreenboard NS 50 mm, width 1000 mm
- ventilated space 600 mm

AP06 Reinforced concrete slab h= 100 mm, light gravel insulation 300 mm

- reinforced concrete slab 100 mm, C30/37,
central mesh reinforcement 8-150 B 500 K
- the protection paper
- light gravel 300 mm
- drainage

F13 quality requirements

- * RunkoRYL 2000 23.45 is followed 23.46, 25.53, 61.411, 61.413 And 61.42
- * quality of the surfaces by 40 class 2
- * tolerances insitu : by 39, section 5, normal class elements:

F2 FRAME

F23 Stairs

PO01 Element stairs, b = 1260 among others, h = 3000

- prefabricated 2-lane stairelement, width 1260 mm, step 270 mm, rise 176.47 mm, layer height 3000 mm
- step surfaces, front edges and front chests ground mosaic concrete, shade and graininess according to architect, finish once in factory and once on site
- the space of stairs and the wall is seamed
- RunkoRYL 2000 23.47 is followed 25.54 and RT 31-10066
- quality of the lower surface by 40 class 2
- tolerances: Valmisosarakentaminen, part E, soon 4.9, normal class

F24 Bearing partition walls

VS01 Reinforced concrete unit 180 mm

Stair room and lift shaft

- reinforced concrete 180 mm, C30/37
- thickness of the wall 200 mm, if the flat is closer than 2 metres of the stair room or the lift shaft

RunkoRYL 2000 25.51 is followed

- * quality of the surfaces by 40 class 2
- * tolerances: Prefabricated Unit Construction, part E, section 4.10 normal class
- * $R_w=60\text{dB}$
- * fire resistance REI180.

F3 FACADE

F31 Facades

US01 Bearing Concrete sandwich-element 160

- inner panel reinforced concrete 160 mm, C35
- insulation, mineral fibre wool 240 mm, class 02.005
- vent channels
- outer panel reinforced concrete 70 mm, C35 weatherproof, rustproof reinforce
- granite plates 300 x 600 x 30 mm, colour architect , polished burnt the part and the part along
- seams elastic seam mass

US02 Betonisandwich-elementti 80 + 70 mm, mineral fibre 240 mm

- as US01
- inner panel reinforced concrete 80 mm, C35/45

F31 quality requirements

Reinforced concrete

- * RunkoRYL 2000 25.52 is followed
- * quality of an outer surface and inner surface by 40 class 2
- * tolerances of elements: Concrete Unit Construction, part E section 4.10 normal class

Insulation

- * RunkoRYL 2000 61.411 is followed
- * Insulation is tightly connected to a warmer surface

Seaming

- * class 1 is followed, RT 82-10527

Ventilation

- * the ventilation pipes are extended from the surface, about 20 mm out and inclination downwards

Granit tile

- * RunkoRYL 2000 431.42 is followed and RT 30-10314
- * tolerances of plates RunkoRYL 2000 table 431:T1
- * overlaps according to the architect's instruction
- * vertical joint 6 mm and horizontal joint 15 mm, vertical joints to level of the surface of the plate and horizontal joints
- Plate surface 5 mm deeper

Brick tile

- * RunkoRYL 2000 25.14 is followed
- * allowed tolerances of brick plates by 40 table T class 2
- * integrity of the brick plates by 40 section 7 table 3
- * Run overlap of 1/3 stones
- * vertical joint 15 mm and horizontal joint 15 mm,
- vertical joints to level of the surface of the plate and horizontal joints

Plate surface 2 mm deeper

Brickwork

- * RunkoRYL 2000 411.431 is followed
- * ready surface that has been masoned RunkoRYL 2000 table 411:T4 class 2
- * tolerances of the masoned wall RunkoRYL 2000 411:T1, 411:T2 and 411:T3 OF tables class
- * integrity of the brick stones by 40
- * ½ overlap of the stone, seaming to full seam.

F32 WINDOWS

IP01 3 glass tree aluminium MSE window, frame depth 175 mm

- frames and setting industry paint wood, frame depth 175 mm, EPDM gasket,
- grade II glasses or Float glass, thickness according to the screen size
- painting of aluminium parts at least 430.3
- surface bushings standard quality
- factory-painted mountain list 12 x 45 mm, inside window
- sealing from inside with polyuretan
- seaming from outside with 2 component seaming
- water plates powderpainted aluminium 1.5 mm

RYL WORK SECTION EXAMPLE

23 Concreting

Contents

- reception of the concrete
- transfers
- casting
- compaction
- coarse levelling
- assisting work.

Instruction

The definitions are presented in a term directory at the end of the book.

- mould work which is dealt with in chapter 21
- reinforcement which is dealt with in chapter 22
- concrete surfacing which is dealt with in chapter 24
- concrete unit work which is dealt with in chapter 25 r
- correction of concrete surfaces which is dealt with SisäRYL 2000 in number 26
- crushing and patching which are dealt with in chapter 27.

Reference

SisäRYL 2000 general quality requirements of building work 2000. Inner work of the house building.

23.1 Concrete

Demands

The strength class and other properties of the concrete are according to the designs. The properties of the concrete connected to the environment class are according to the publication by 32. Concrete equals the Building Regulation demands of Finland and the demands set in the publication by 15.

The used cement is according to standards in Finland. Mixture materials and the water are according to the regulations and publication by 15.

Instruction

In the part of RakMK B4 has been presented demands for the concrete quality control of part materials and work performance and from stating of the competency up to strength class C60/70.

In the publication by 15 the additional instructions have been presented up to the class C100/120.

If concrete fills the publication by 32 demands, it will reach an about double service life with respect to B4 demands of the RakMK.

The concrete it is recommended to fulfill the demands of the publication by 32.

The choice of the concrete examples have been given in regulations of the Concrete Unit Construction. For example in the part J are instructions for the balconies and in D choice of the concrete of facades and structures.

References

- B4 concrete structures. Instructions 1987. Finland's building regulations
- by 15 concrete norms. RakMK B4 and high strength additional instructions of concretes. Finland's Betoniyhdistys r.y.
- by 32 instruction of preserve of concrete structures and service life dimensioning. Finland's Betoniyhdistys r.y.
- by 43 rock materials of the concrete. Finland's Betoniyhdistys r.y.
- Regulations of the Valmisosarakentaminen part D Betonijulkisivus, part J Betonielementtiparvekes. RTT concrete industry.

Instruction

Composition of cement, quality requirements and competency criteria it has also been presented in the European standard SFS EN 1992-1-1 and 2. The properties of the concrete, concreting and the stating of the competency also presented in the EN standards.

References

SFS ENV 197-1 Cement. Composition, quality requirements and competency criteria.
SFS ENV 206 Concrete. Properties, making concreting and stating of the competency.

23.4 In Situ concreting

Demands

Before the concreting a written concreting plan is made. During the concreting a concreting report is made. The concreting is made according to the concreting plan so that concrete fills the moulds carefully and surrounds the reinforcement. The concrete cover thickness of the reinforcement must be according to the designs. When concreting floors, the instructions that have been given in the publication by 31 are followed.

Instruction

The matters presented in the concreting plan and in the reports are presented in the form by 401. Concreting methods have been presented in the publications RIL 149, by 201 and by 32. The concreting methods of floors have been processed in publications by 31 and BLY 5.

Instruction

The protection thickness of the concrete covering of the reinforcement has been given in the publication by 32 in table 3.3. In section 3.3.4 it is presented how much from the strength can differ from the strength if the thickness of the concrete covering is increased.

References

BLY 5 production methods of concrete floors. Finland Concrete association r.y Finland's Betonilattiayhdistys r.y.

by 31/BLY 4 concrete floors. Classification, päällystettävyyss planning instructions and building instructions. Finland

Concrete association r.y Finland's Betonilattiayhdistys r.y.

- by 32 säilyvyysohje of concrete structures and service life dimensioning. Finland's Betoniyhdistys r.y.
- by 201 textbook of the concrete technology. Finland's Betoniyhdistys r.y.
- by 401 concreting record. Form. Finland's Betoniyhdistys r.y and Rakennustietosäätiö
- RIL 149-1983 Betonityöohjeet. Finland's Rakennusinsinööris Union.

Instruction

The concreting methods are described in Ratu method cards 106 M2 and 23-0013. In the cards it is described from methods work wholeness, team, materials machines and equipment, method of work, industrial safety and quality assurance.

References

- Ratu 106-M2 Concrete slab on ground
- Ratu 23-0013 Concreting work. Methods.