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COMPARISON OF PUBLIC CONSTRUCTION PROJECTS BETWEEN BRAZIL AND FINLAND

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ABSTRACT

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Brazil and Finland are countries on different sides of Atlantic Ocean with a completely different culture and climate. The contrast creates a very interesting opportunity to make a comparison of construction projects and procedures. FIFA Football World Cup will be held in Brazil year 2014 including a lot of public construction projects.

The focus of this work was to study the procedures of construction supervision and public construction projects in Brazil and in Finland in order to make a comparison. The work was made for the Tribunal de Contas do Paraná, which is the main authority of supervision in Brazil. The objective was to grant tools for improving the efficiency and functionality of public construction projects in Brazil by using Finnish system.

First, the Finnish system of public construction projects and supervision was presented. After that, a brief presentation of Brazilian system and finally, a comparison and a conclusion based on the research results. The information was collected from the countries legal documents and from interviews with professionals working with public construction in the city of Curitiba in the state of Paraná, in Southern part of Brazil.

The thesis was a part of a project with Federal University of Brazil and Tribunal de Contas do Paraná. Selected students of civil engineering and architecture were working for Tribunal in supervision of public construction projects connected to the Football world cup to be held in various cities including Curitiba in Brazil 2014.

Keywords: Public Construction Projects, Brazil, Finland, Comparison, Tribunal de Contas, Supervision, Civil Engineering

TIIVISTELMÄ

Oulun seudun ammattikorkeakoulu & Federal University of Paraná
Rakennustekniikka, Talonrakennustekniikka

Tekijä:	Mikko Knuutila
Opinnäytetyön nimi:	Brasilian ja Suomen julkisten rakennushankkeiden vertailu
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Sivumäärä:	63 + 3 liitettä

Suomen ja Brasilian välissä on Atlantin valtameri. Kulttuurierojen ja ilmaston lisäksi eroavaisuuksia on paljon. Tämä suuri kontrasti luo hyvin mielenkiintoisen mahdollisuuden vertailla julkisen rakentamisen eroja. Vuonna 2014 Brasiliassa järjestettävät jalkapallon maailmanmestaruuskilpailut vaativat paljon julkisia rakennushankkeita.

Työn tarkoituksena oli tutkia Brasilian ja Suomen rakentamista, käytäntöeroja ja rakennusvalvontaa vertailun tekemiseksi. Työ tehtiin brasilialaiselle valvontaelimelle Tribunal de Contasille. Työn tavoitteena oli tarjota työkaluja Brasilian julkisen rakentamisen kehittämiselle ja tehostamiselle käyttäen suomalaista mallia.

Ensimmäisessä osassa suomalainen julkisen rakentamisen ja rakennusvalvonnan käytännöt ovat esiteltyinä. Seuraavaksi käsiteltiin brasilialainen malli ja viimeisessä osassa esitellään vertailu ja ja tutkimustulosten perusteella tehdyt johtopäätökset. Tietolähteenä käytettiin molempien maiden oikeudellisia asiakirjoja sekä useille brasilialaisille julkisen rakentamisen ammattilaisille tehtyjä haastatteluja. Työ on tehty Brasilian etelä-osassa Paranán osavaltiossa, Curitiban kaupungissa.

Opinnäytetyö tehtiin osana Paranán valtiollisen yliopiston ja Paranán Tribunal de Contasin yhteistyöhanketta. Rakennustekniikan ja arkkitehtuurin opiskelijat toimivat Tribunal de Contasin avustajina valvoen jalkapallon maailmanmestaruuskilpailuihin liittyviä julkisia rakennushankkeita.

Asiasanat: Julkiset rakennushankkeet, Brasilia, Suomi, Vertailu, Tribunal de Contas, Rakennusvalvonta

RESUMO

Universidade de Ciências Aplicadas de Oulu & Universidade Federal do Paraná
Engenharia Civil, Produção

Autor:	Mikko Knuutila
Nome da tese:	Comparação de obras públicas entre o Brasil e a Finlândia
Supervisores:	Pekka Kilpinen (OUAS), Mauro Lacerda Santos Filho (UFPR)
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Páginas:	63 + 3 apêndices

O Brasil e a Finlândia são dois países em diferentes lados do Oceano Atlântico que possuem muitas diferenças culturais e climáticas. Assim, comparar os procedimentos de projetos públicos e fiscalização de obras mostrou-se bastante interessante, até porque em 2014 haverá no Brasil a Copa Mundial de Futebol que envolverá muitas obras públicas.

O trabalho realizado para o Tribunal de Contar do Paraná tem como objetivo comparar os procedimentos de supervisão de construção pública dos dois países, fornecendo ferramentas para a melhoria de eficiência e funcionalidade dos projetos de obras públicas no Brasil utilizando o sistema Finlandês. O trabalho foi realizado para Tribunal de Contas do Paraná.

Primeiramente o sistema Finlandês é apresentado, em seguida o sistema brasileiro e por fim há a comparação dos sistemas com base nos resultados obtidos na pesquisa. As informações foram extraídas de documentos jurídicos de ambos os países e de entrevistas com profissionais que trabalham com construção pública no Sul do Brasil, no estado do Paraná, na cidade de Curitiba.

A tese faz parte do um projeto da Universidade Federal do Paraná (UFPR) junto com o Tribunal de Contas do Paraná, no qual os estudantes de Engenharia Civil e Arquitetura supervisionam os projetos públicos de construção ligados a Copa do Mundo de Futebol que será realizada em várias cidades, incluindo Curitiba, no Brasil, em 2014.

Palavras-chave: Obras públicas, Brasil, Finlândia, Comparação, Tribunal de Contas, Supervisão, Engenharia Civil

FOREWORD

This work is the first final thesis made in cooperation of UFPR and OUAS. Despite problems and delays, the thesis was successfully completed in an understanding and flexible environment and I am really happy with the result and the experience.

I want to thank the Federal University of Paraná for my exchange studies for over a year in Brazil. The experience has been a once in a lifetime experience and unforgettable for my personal and professional life. Especially, I would like to thank Professor Mauro Lacerda whose efforts for this project and his constant support and trust will be remembered. I would also like to thank Professor Rogerio Lemos for support, information and companionship.

Special thanks to the secretary of civil engineering graduation program Lídice Oro and secretary of civil engineering post-graduation program Ziza Nichele. For partnership, I want to thank my dear friend Lars Niemeyer. For the opportunity and information, I want to thank Tribunal de Contas do Paraná, especially the coordinator of civil engineering department Luiz Henrique Barbosa Jorge. Also I would like to thank Oulu University of Applied sciences for granting me the chance and courage for my exchange project on a very experimental basis, even in the difficult situations. Pekka Kilpinen, the coordinator of my thesis and for his visit to Brazil which gave me a lot of new perspectives to improve my exchange experience. International Coordinator, Katja Kurasto, who always encouraged and helped with my exchange program.

I would also like to thank my parents Miia and Tarmo Knuutila. Artur Magalhães, Solange Vianna Sprung and Herbert Sprung for hosting me in Brazil and giving me a flying start to Brazilian culture, language and important contacts for my thesis. Finally, thank you Gabriela Louise Barco Brasil, and your family for your support with everything, especially Portuguese language and culture during my stay in Brazil.

CONTENTS

1 INTRODUCTION

The thesis is executed in Brazil in the city of Curitiba during an exchange program based on a contract between Oulu University of Applied Sciences and Federal University of Paraná (UFPR). The thesis is done completely in English with abstracts in Finnish and in Portuguese. The project managing and scheduling of the thesis are executed by the author. Various Brazilian professionals from operating authorities and professors both in Brazil and Finland were consulted. Coordination is conducted by both universities.

The study is a part of a project between the UFPR and Tribunal de Contas do Paraná (TCP). The subscriber of the study is Tribunal de Contas do Paraná. The subject of the project is supervision of public construction sites principally for the 2014 FIFA Football world cup held in June 2014 in various cities of Brazil, but also for other public construction projects. The contract of TCP and the UFPR is considering a group of civil engineering students that will supervise various construction sites for TCP in Curitiba. The objective for the study is to recognize the principal differences of the procedures in public construction.

The group of students for the project was chosen 10th of May 2012.The project encountered delays of several weeks because of strikes of the Federal University and the bureaucracy of the authorities. The group consists of 25 students divided into three groups with a group leader and a coordinating teacher. The responsible person for the project was professor Mauro Lacerda Santos Filho. This study is conducted in the very beginning of the project working with the basic functions.

The project started in the beginning of the year 2012 and will be finished in 2014 for the football world cup. The long term objective of the project is to create a continuous convention between Tribunal de Contas do Paraná and Federal University of Paraná to improve the supervision of public construction in Brazil. The objective of the thesis is to make a comparison of Finnish and Brazilian systems on the procedures of a public construction project. The thesis

will include several introductions, examples and curiosities because of the cultural contrast of the two countries compared and the new nature of the project. The basic information of the study is summarized in the Output Information Note (Appendix 1).

The Finnish system of public construction is exemplary. The Finnish system will be presented in order to find ways to develop Brazilian public construction providing a different point of view for students and for authorities, as well. The study is focused on improving public construction projects and supervision in cooperation with TCP. The Brazilian system is presented to provide a base for a comparison and for Finnish companies interested in the Brazilian market.

The objective is to introduce a different, Scandinavian way to operate. The main objective is to grant tools for a more efficient public construction, better supervision system in Curitiba, Paraná and later for the rest of Brazil. Thesis will work as a base for the future research. Other researchers including Matti Karppinen will continue the research and also a master thesis is planned for better results.

2 CURITIBA, PARANÁ

2.1 Introduction to city of Curitiba, basic conditions and infrastructure

The city of Curitiba was founded in 1693 and it became an independent capital of the state Paraná in 1853. Curitiba has the first university of Brazil, the Federal University of Paraná (UFPR) which was founded in 1912 having over 20000 students today. UFPR has an open contract with Oulu University of Applied Sciences (OUAS) for exchange programs and cooperation. (7, 8)

Figure 1.Central Station in Curitiba. The BRT-system.

Curitiba is located in south region of Brazil about 100km from the sea with an altitude of 945m above sea level. The high altitude makes a big effect on the weather making it the coldest state capital in Brazil. The surface area is 435 km^2. The population of Curitiba is 8^{th} biggest city nationwide; 1.75 million people

with a density of 4023 people/ km^2 (IBGE/2009). The population in the metropolitan area is 3.2 million people. Curitiba is a cultural melting pot with immigrants from Eurasia, Middle-East and South America. (7, 36)

The economy of Curitiba is based on industry, commerce and service being the second biggest car manufacturer in the country. Curitiba has two airports, good infrastructure and public transport. It has an exemplary urban design having developed the first Bus Rapid Transport system (BRT) in the world and it has been copied to several cities all around the world. Curitiba is also stated to be the ecological capital of Brazil. It won the Globe sustainable city award 2010 for its green values, planning, recycling and big green area; 51m^2 per inhabitant. (7, 9, 10 and 36)

3 LAWS CONTROLLING CONSTRUCTION IN FINLAND

In Finland the laws provide the guidelines for construction activities. Finnish people are law-abiding citizens. The legislation is strong and sanctions for disobedience are serious. The supervision is effective and the laws are compact, clear and functional. The most important law controlling construction activities is the land use and building act with 220 sections considering construction and land use. Following chapters summarize the most important parts of legislation controlling construction supervision in Finland.

3.1 Land use and building act

3.1.1 National building code 13 §

Finland's national building code is a document giving regulations, guidelines and instructions regarding construction activity. It is an important document supporting legislation with further, more technical demands and guidance such as examples for construction activities. It will be discussed more in chapter 3.2

3.1.2 Building ordinance 14 §

Every municipality is required to have a building ordinance. It is a document giving regulations for local construction, such as location, size of the constructions and the preservation of built heritage. The building ordinance is a document helping to create a well-planned living environment taking matters of local importance into account. Together with the land use planning act the Finnish urban planning becomes a strictly controlled, carefully designed and high quality system. (11)

3.1.3 Chapters 3-8: Land use planning

The land use planning is a strict and a hierarchic system providing wide autonomy for local authorities. The system is divided in three levels; each level is more precise and detailed than the other. (Figure 2) The widest level,

Regional Land Use Plan acts on national scale including national level plans and main focuses for development and construction on the Finnish territory. It is designed by a regional council and approved by the Ministry of the Environment. The regional plan is based on the national guidelines of the land use and a joint master plan. It states, for example, the main areas of production, land use and roads. (11)

The second level is a local master plan which is more precise including plans for land use inside a city, such as residential, commercial and productive areas. It is a document integrating the services and resources for a bigger area. The most precise plan is a local detailed plan which is a street level design planning the properties and constructions. For example, the borders of the properties and other important features for construction are marked completely with the construction rights and restrictions for the property. (32)

Figure 2. The system of land use planning in Finland (http://www.ymparisto.fi/default.asp?node=4773&lan=en Retrieved 5.3.2012)

3.1.4 Building permit 125 §

Building a construction requires a building permit. All construction activities require a permit, including renovations. The granting of building permit is the responsibility of a local authority called the Construction Supervision (Rakennusvalvonta) controlling construction supervision. The applications are processed and during the design procedure the authorities consult and give guidance to the constructor in order to improve the quality of the construction and ensure the suitability of the project. In order to a building permit to be granted, the project has to be designed following the building ordinance, land use plans, legislation and national codes. The project is also required to have a principal designer and a responsible overseer. (1, 11)

3.1.5 Chapter 20: Execution and supervision of construction work 149-154 §§

The construction work must be done according to the Finnish legislation and regulations. The supervision is based on inspections in the end of important phases of the construction. If the supervising authority encounters a construction defect, a part of the site or the whole site can be paralyzed until the error is repaired. A construction site has to keep an inspection record, a document including all the visits and notes of the supervisor during the time of construction. (11)

In Finland construction materials have to be suitable for the intended use and marked with a CE mark or a similar standard. The building cannot be taken into use before the final inspection and other required inspections. The inspections include operational tests of the systems used in the construction such as heating and electricity. Finnish standards are discussed more in chapter 3.4.1.

3.1.6 Chapter 22: Management of built environment 166-170 §§

The constructions and environment have to be maintained in a manner that meets the standards for health, safety and does not ruin the atmosphere of the

surroundings. The responsible person for an unfinished or an abandoned building which compromises the safety or disgraces the surroundings can be forced to modify the construction. (11)

3.1.7 Chapter 24: Coercive measures and sanctions 177-186 §§

A construction work without correct documentation can be stopped. Activities against the legislation, codes or regulations will be punished. The responsible person can be condemned, given a penalty or a fine for disobedience. The supervisors have the right to enter a construction site in order to supervise and to obtain necessary information to conduct the supervision. The police can assist the supervising authorities if necessary to execute the given orders or to stop the construction site. Therefore the cooperation of different authorities is functional and effective. (11)

In Finland the regulations of supervision are part of the legislation. It is possible to hold responsible persons accountable for neglecting or breaking the regulations and they can be punished. The Finnish supervision system is very effective. The people working on supervision are educated professionals and the legislation is compact and unambiguous. (11)

3.2 National building code of Finland

The National Building Code is a collection of documents providing additional regulations and guidance for construction work. The provided regulations are legally binding, but the additional information, guidance and examples are only a presentation of a good construction method. The code is divided in 7 parts starting from A to G (Figure 3). The structure of a code is generally divided in three parts. The first part is a direct quotation of the legislation. The second part is an additional regulation clarifying the legislation and providing more technical regulations for various subjects. The third part is a commentary which provides an example or guidance to further clarify the code. An example page of code is provided in Appendix 2. (1)

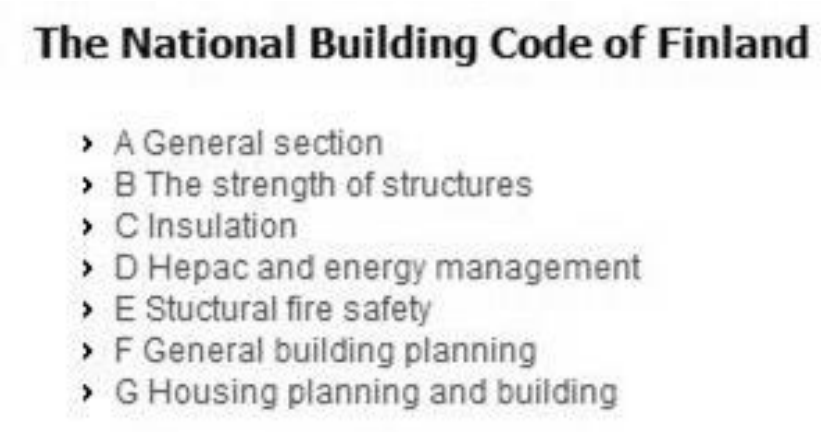

Figure 3. The National Building Code of Finland (http://www.ymparisto.fi/default.asp?contentid=357799&lan=fi&clan=en Retrieved 12.3.2012)

3.2.1 A1 - Supervision of construction and technical inspection.

The most important part of the code for this study is A1 – The supervision of construction work. The person with the biggest responsibility is the one starting the construction project. Necessary knowledge of legislations and regulations or the responsibility to employ personnel with these qualifications to control the project is obligatory. Also, the personnel executing the construction activities must be qualified and the qualification must be evaluated using competence factors described in the building code. The construction supervision authority has to approve the responsible designer and principal overseer for the construction site. Additional exterior supervision can also be demanded by the authority. (1, 12)

The responsible overseer of the construction site is evaluated before assigned as responsible. Sufficient qualifications, education and experience are compulsory for the responsible engineer. The requirements can vary depending on the complexity of the project. The responsible overseer is responsible for maintaining the connection with the supervising authority since the beginning of the work and for the reviews on determined stages of construction work. Other

responsibilities include controlling construction defects, quality, logistics, availability of current plans and on-site supervision documents. The supervision document of the construction site is a document ensuring the appropriate execution of the construction work including inspections, reviews and an on-site diary. The document is used to facilitate the supervision of the construction site. (1, 12)

Inspections during construction

The inspections are the most important means of supervision in Finland. Construction work is not allowed to be continued if the agreed inspection has not been conducted. The performance of the reviews is agreed between the responsible engineer and the authority. The review can be conducted in the important stages of construction work when inspected structures and objects are still visible, for example reinforcement of the foundations, bearing structures, humidity control or final inspection.

The first inspection during construction concerns the location and the elevation of the construction. The work cannot be continued without the first inspection. A base inspection will be conducted when the excavation, quarrying, reinforcing and other ground works have been completed. Other possible inspections are, for example, foundation, structural, HVAC and plumbing inspections which are conducted when the review is possible. The overseer is responsible for informing the supervisors regarding the inspections.

The most important inspection is the final inspection. The building can be taken into use only after the final inspection. The supervision document and other inspections are reviewed and the construction will be stated ready. The objective of the final review is to ensure that the construction work is done correctly according to the laws and regulations in a good construction manner avoiding defects. The inspections are conducted to ensure that necessary activities have been made properly. All of the inspections and comments are noted in the supervision document. The operation and maintenance instructions

are presented in the review. Various tests to insure the proper functionality of the construction are conducted in the final inspection, for example heating, ventilation, plumbing, air tightness and electricity systems are tested in order to ensure the quality and functionality of the construction. The tests are conducted by a designated group, not necessarily by the supervision authorities. (12)

A construction site has to be maintained and the work conducted in such a manner that it does not endanger other constructions, infrastructure or people outside of the project. The site should be maintained organized not to disfigure the environment with construction waste or disorder. Safety and order of the construction site are important factors in Finland.

3.2.2 A2 - Building designers, requirements and plans

Part A2 describes the requirements of the personnel working in responsible positions in the Finnish construction industry. Several requirements have been set for the designers, responsible engineers of the construction site and supervisors. A typical requirement is university education and professional experience. The requirements are listed in the National Building Code.

Every construction project needs a responsible designer. The principal designer is responsible for the plans of the project in one’s area of profession, for the coordination of other designers and also for the communication with the authorities. The principal designer is required to have a sufficient amount of education and experience depending on the complexity of the project. (12)

Construction projects are divided in classes depending on the complexity. The classes are C, B, A and AA starting from the least demanding. The qualifications are given to the responsible overseer, architect, engineer, foundations, HVAC and plumbing designers and construction physics. Level C project is a minor construction which does not require engineering education, such as a small storage or a garage. Level B is a typical construction project with a maximum of two floors. Class A means a project with typical structures and requirements and has the basic requirement for an engineer or an architect.

In order to achieve the class A, the designer is required to have necessary education, university credits from design and professional designing experience at least for three years. Table 1 shows the description for the categories of difficulty of structural design. (1, 12)

The AA-level is the most demanding level of designing. The designer is required to have sufficient amount of education for structural designing, construction physics and material in question, for example, concrete, steel or wooden structures. In addition, the designer needs to have a 5-year-experience in A-level designing. An AA-class construction is a construction with high demanding architecture and/or challenging structures and designed to be used by crowds, for example a sports stadium or a complex office building. The projects have been divided into risk levels depending on the amount of people using the construction. (12)

TABLE 1. The categories of difficulty of design according to the National Building Code of Finland. Page 13. Online. Retrieved 6.11.2012. Available: http://www.ymparisto.fi/download.asp?contentid=23440&lan=fi

4.2.3 Guidelines: RAK Categories of difficulty of structural design tasks

4.2.3.1	**AA** (LUBD 48, 1) SPECIAL DEMANDS	**A** (LUBD 48, 1) BASIC DEMANDS	**B** (LUBD 48, 2) SMALLISH building or technical system, or one with CONVENTIONAL technical properties	**C** (LUBD 48, 3) MINOR
GENERAL BASES FOR CLASSIFICATION OF DIFFICULTY Structure classes See. RakMk B4, B6, B7	Building or space • Which is heavily loaded, has large point loads or large dynamic loads; • Which is 30 m or more in height measured from the top of the foundations to the highest beam; • Which is especially demanding in terms of stability; or • Which is used by large numbers of people at the same time. Load-bearing structural element which • Has to be made on site and has spans of over 15 m; • Has an abnormal joint construction; • Is a demanding special structure; or • Is designed in class 1. Alterations or repairs in which the static function of a structure otherwise in class 2 is substantially changed.	Building or space which is of normal size and construction. Load-bearing structural element which is designed in class 2. Project may include separately designed class 1 structures (difficulty category AA).	Building or space, • Containing conventional house-type structures; or • Which is a maximum of two storeys and is generally frequented by people on a temporary basis, such as a smallish store or agricultural building with a maximum floor area of 300 m^2 and maximum spans of 6 m. Load-bearing structural element which is designed in class 3. Project may include separately designed class 1 and 2 structures (difficulty category AA and A).	Small, single-storey building or space not intended for permanent habitation or work and with structures that can be adequately shown in the building design.

4.2.3.2 STRUCTURAL FRAMES	**AA** (1)	**A** (2)	**B** (3)
Concrete *) Finnish classification for the compression strength of concrete, expressed as a strength of a cube with 150 mm edge.	• The building is over 8 storeys • The load-bearing capacity of the structure is dimensioned for a concrete strength of over K40* . • The structure is prefabricated and has spans of over 25 m; or • The structure is tensioned.	• The load-bearing capacity of the structure is dimensioned for a concrete strength of maximum K40*. • The basement of the building has retaining walls of block construction.	The load-bearing capacity of the structure is to be dimensioned for a concrete strength of maximum K20 *.
Timber	• The building is a 3-4 storey block of flats; or • The structure is prefabricated and has spans of over 25 m;	• The building is designed using gang-nail trusses.	The building is a conventional, maximum two-storey house and the strength of timber used in strength calculations does not exceed T24 (C24).
Steel	• The building is over 8 storeys; or • The structure is prefabricated and has spans of over 36 m; or • The load-bearing capacity of the structure is dimensioned for steel with a yield stress in excess of 355 N/mm^2.	• The building is a maximum of two storeys and is intended for living or working on a permanent basis and the structural steel members of the frame and the joints between them are not standard; or • The building is 3-8 storeys regardless of intended use.	• The building is a maximum of two storeys and is intended for some other use than living or working on a permanent basis; or • The building is a maximum of two storeys and is intended for living or working on a permanent basis and the structural steel members of the frame and the joints between them are standard.

3.3 Public Procurement Act 30.3.2007/348

The public procurement act obliges to bid public purchases that exceed a set value. Public purchases include public construction projects, goods and service purchases. The act is valid in the area of Europe in the countries of the European Union. The bidding circumstances are required to be arranged equal for the bidders. Information of the purchase has to be announced in public. The objective is to make the most economic purchase possible. The law affects purchases made with the public money.

The threshold values for the national bidding procedures are for purchases of goods over the value of 30 000€, for services over 100 000€ and for construction projects the value of 150 000€. Public purchases that exceed 137 000€ in goods and service and 5 278 000€ in construction projects have to be announced in EU member countries. The announcement can be made in an EU magazine or on the internet in the site for public construction projects. (http://ted.europa.eu/TED/main/HomePage.do Retrieved 21.10.2012) (13)

3.3.1 Purchase procedures

Purchase procedures can be performed in two manners; open procedure or limited procedure. In the open procedure, the call for tenders is published in the electronic bidding system for open tendering. Whereas in the limited procedure, the participants are chosen and invited for the bidding after the project has been published.

The candidates are chosen before the comparison of the tenders. Participants with a criminal record such as corruption, tax evasion or other criminal activity have to be excluded from the bidding. The background of the bidders such as economic situation, the tax register, technical performance and professional capability can be checked before the approval. The most profitable offer or the offer with the lowest price has to be chosen. Other deciding factors can be, for example quality, technical attributes, sustainability or life-cycle costs. Tenders

that are exceptionally low in quality and/or price can be excluded after a review of the tender with the bidder. (13)

The objectives of The EU Public Procurement Act and the tendering procedures are to improve the quality and equality of competition in public construction projects. The legislation improves the transparency of public purchases and reduces the possibility of tax evasion and fraud. The international awareness of the costs of public construction is also improved using the system of public tendering.

3.4 Act on the contractor´s obligation and liability when work is contracted out (1233/2006)

The objective of the act is to promote equal competition between enterprises and to ensure that every operator manages their responsibilities for the society such as taxes and other fees. In practice, the contractor is obliged to check that the contracting partner and subcontractors have paid the taxes, registered into the Trade Register, obeyed terms of employment and fulfilled other required social responsibilities. The act is working to prevent unreported employment and tax evasion which is becoming a problem in the Finnish construction industry. The act also promotes a more open construction industry together with the public procurement act. (14)

3.4.1 Building standards

Several countries have national standards for construction and Finland is one of these countries. Finnish standards association (SFS) controls the standards used in Finland. It consists of the state of Finland and of professional, commercial and industrial organizations. SFS is a member of international Organization for Standardization (ISO) and the European Committee for Standardization (CEN). The abbreviation for Finnish standards is SFS. The abbreviation stands for the organization in which the standard has been confirmed. The typical standards used in Finland are SFS, EN and ISO standards. (16)

The standards used in Finland include standards on construction materials and building, civil engineering and Eurocodes. The European Union has a project called Eurocode which aims to unify construction design standards for all Europe. It contains designing standards for wooden, metal and concrete structures. CE marking or a corresponding certification is required for construction materials used in Finland. CE marking is used in materials which follow the standards. Second to Jukka Ahtela standardization has a strong positive economic effect on the market and innovation. European standards have replaced national standards and improved trading inside the internal markets of European Union. (15, 17)

The Finnish construction industry is very organized, controlled and standardized. The construction materials are fabricated with modular measurements. The bricks, insulations, wood structures and other materials are all produced with standard measures. With compatible standards, construction work is simple and lean.

The use of prefabricated products is common in Finnish construction industries. Elements produced in factories under controlled circumstances provide a fast, secure and high quality manner of construction. The quality of prefabricated products in Finland is high due to strictly controlled standard system. The use of prefabricated concrete elements, wooden elements with thermal insulations and prefabricated beams and columns is common in Finnish construction sites. Also the market for prefabricated, wooden houses is strong in Finland. (1, 15)

3.4.2 RT Building Information File

The first RT Construction information files were published in 1942. It is a private, non-profit making foundation providing technical guidance and information files for different construction projects. Building Information Group has developed a complete system to design constructions from the beginning to the structures, scheduling and expenditure. RT Building information files include several studied exemplary structures for roofs, walls and other structures. In

addition, it has a wide database of the Finnish construction history and publishes new guides and other publications for modern construction. (1, 19)

The system contains different kinds of construction information files. The information cards are made for different situations of a construction project. The guides provide basic information for construction industry, from the history to construction physics, and to the material information. Also, a collection of legislation can be found from the information files.Important information files include structures and complementary elements such as doors and windows. First a structural file includes a general presentation of the subject such as a wood frame. The second part contains examples of different structures and solutions with detailed drawings that can be used as a part of the design. The information files include technical information with concrete solutions that can be used in a construction. (18)

Other available cards are information cards for different works conducted in the construction site such as painting or framework. The Ratu files include information for designing of the work, the duration, the description of work phases and supervision of the correct performance. Information files are available for construction, interior design, infrastructure, HVAC and real estate. The building information system is developing and improving system which is updated to the level of modern construction and provides useful information for operators in the construction industry. (18)

4 PROCESS OF PUBLIC CONSTRUCTION PROJECT IN FINLAND

The condition of public infrastructure is controlled by the municipality. When a new construction or a renovation is required, the procedures to plan a new purchase are commenced by the municipality. The first step is the necessity plan for the construction. What are the current and future capacity requirements of the premises? What will be the trend of population change? Is it possible to combine services or constructions? Correct scale, optimization and suitability for the subscriber are the most important features to be observed. In figure 4 the process of a Finnish public construction project is described.

Figure 4. Process of a public construction project in Finland.

The second step is project planning which is the first plan for the project. The project plan is used to make a call for tender. The project plan includes all the

basic features of the construction such as the size, structures, preliminary cost estimate and scheduling. It also includes the design for application of the construction permit.

Next, the tendering is published as the law of public purchases requires. Depending on the size of the project it is published nationally or throughout Europe. After that, the offers are bedded and the most economic or profitable offer is chosen. The contracts are created using the General Conditions of Contract YSE (Rakennusurakan yleiset sopimusehdot 1998) which include a standard model for a construction contract. The contract is the most important and the strongest document regarding construction. There are two different types of contracts: a contract between professionals and a contract between a professional and a one-time-builder. After signing the contract, preparations for construction work can commence. The actual construction work begins after the granting of the construction permit. (1)

During the construction work the supervision is continuous. Workers on site are responsible for the quality of the work. Engineers and the responsible overseer follow the daily routine of construction work and control the logistics. Principal designers and other designers visit the site when necessary. The subscriber and/or consultant supervise the construction and the supervision authority visits the site for the inspections or random control visits. Also, inspectors from different unions can visit the construction site to review the working conditions and safety of the site. (1)

Meetings are arranged in several occasions during the construction in order to follow the development of the work. The most important meeting is the first meeting before the construction work to ensure that every operator has the correct idea of the objective. When the construction is finished, a final inspection is required before the building can be taken into use. The contractor has a responsibility of a guarantee up to ten years after the construction work and possibly even more depending on the contract, for example a life cycle contract for a road or a bridge can be signed for 50 years or more. (1)

5 CONSTRUCTION SUPERVISION

The construction in Finland is administered by the Ministry of the Environment. On a regional level, 13 Regional Environment Centers are subordinates of the Ministry. Local construction activities are supervised by an authority called Construction Supervision. Every municipality has an office or at least a responsible person for construction supervision. The supervision of public construction sites is based on technical advising, continuous control of the project and inspections on important parts of the construction. The objectives of supervision are different for a professional constructor and one-time-builder. The competence of the people working on a construction project is an important factor in Finnish construction industry. The principal designer, the responsible overseer, as well as people working in supervision are required to have necessary education and experience. Evaluation is conducted for the responsible personnel. (11, 34)

5.1 The Land Use Plan and Building Permit

The architecture, size, location and other basic features are noted in the land use plan. The areas are divided into different groups with symbols and colors. Each color symbolizes a different region. The properties are divided and for example, the size of the construction is noted on the plan. In the figure below is shown an example of the Finnish land use plan from Oulu, in the region of University of Applied Sciences. Orange color signifies residential area, green stands for the parks and green areas, white for roads and purple for educational regions. Underneath there is an aerial photo of the same area.

In Finland, construction supervision starts in the beginning of the project in the early planning phase of the project, when the construction permit is applied. In the planning phase the authorities take part in the project consulting the constructor and noting issues needed to be taken into account during the construction. (1)

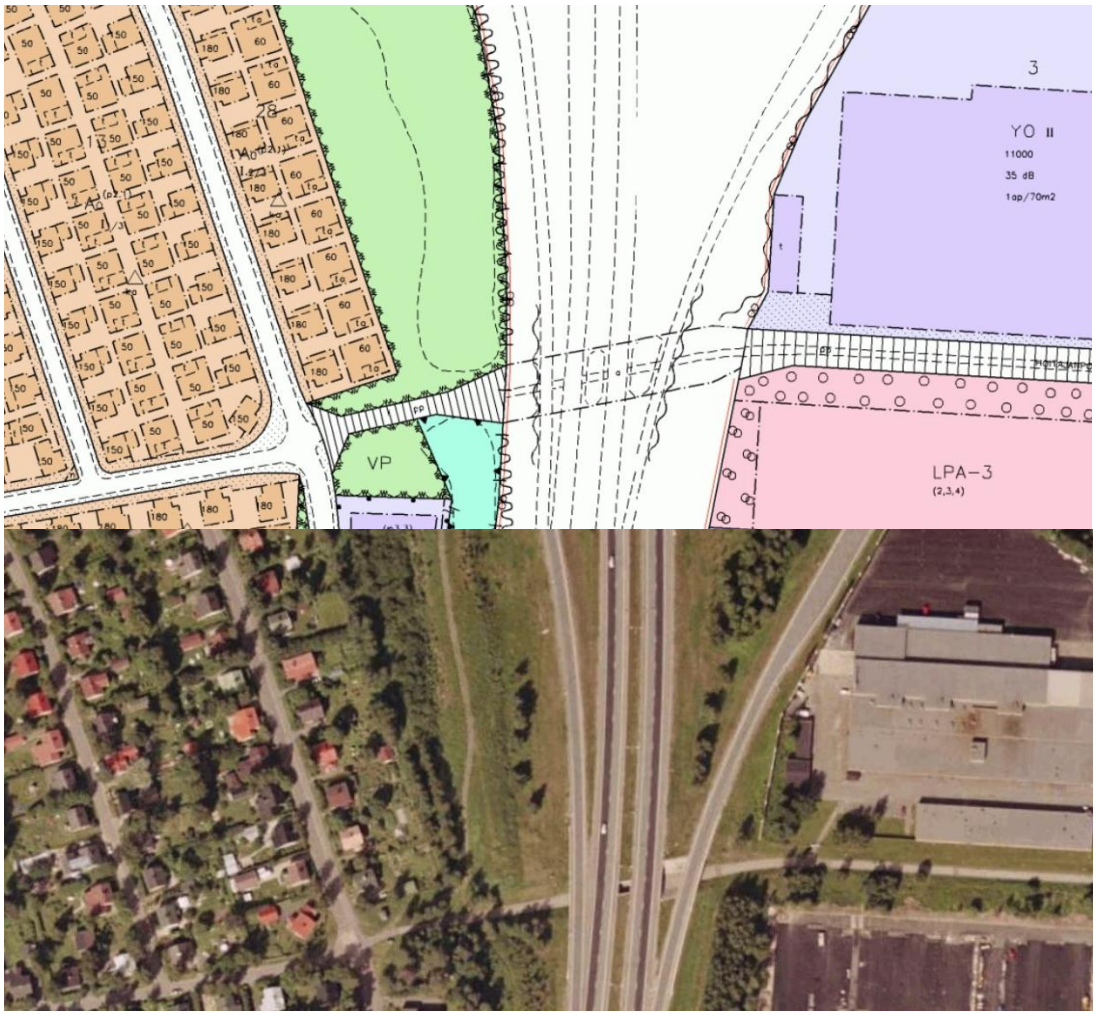

Figure 5. The Local Detailed Plan of OUAS region and an aerial photo.

5.2 Plans, arrangements and safety

When the construction work begins, the authorities follow the construction project continuously. After the construction permit is approved, the designing continues to become more precise. Authorities along with the designers, engineers and workers ensure that construction is built as it is planned. The responsibility of supervision is divided among the different operators of construction project. The responsible designer has the responsibility to control plans and communicate with the other designers and operators of the project. The subscriber or consult of the subscriber have responsibility to follow the

construction site, but the responsible overseer has the biggest responsibility of the construction work dividing the responsibility with other engineers on the construction site.

The establishment and basic services of construction site are supervised as well for they affect the safety of the workers and the people passing the construction site. People held responsible in the event of accident are the principal designer and overseer of the site. (1, 3)

5.3 Quality

The authorities supervise the quality of the construction, technical properties and construction defects. Finnish climate sets a high quality demand for construction physics. The temperature variation during the year, which can rise over 60 degrees Celsius, makes the thermal insulations, foundations, moisture control and high quality materials and work very important factors for the functioning of the structures. In figure 6 a principle drawing illustrates an example of a Finnish thermal insulated construction. In Finland a small market, high price level and high customer demand control the quality of construction in the private sector. Houses with low quality are not sold.

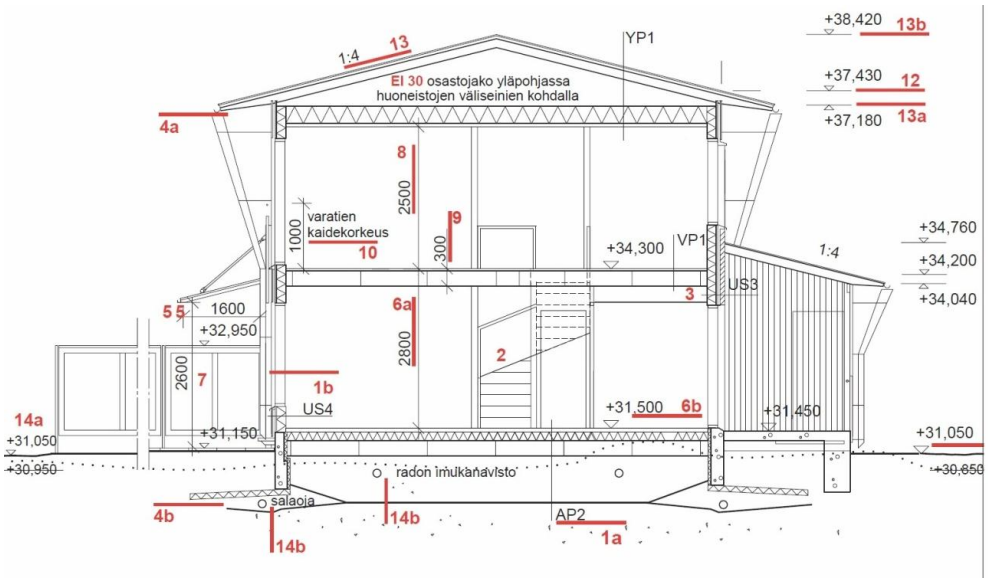

Figure 6. A principle drawing of a thermal insulated house.
(2004.RT 15-10824. Construction information file. Principal drawings.)

Finland is focusing on energy efficiency. Building regulations were updated 1th of July 2012. The requirements of constructions are modified into a more energy efficient direction. In practice, the constructions will require more thermal insulation or more insulating materials and very airtight constructions. The objective of the development of building regulations is to achieve the efficiency requirements set by European Union for the year 2017. (42)

RALA - The association of construction quality

The association RALA (Rakentamisen laatu) was founded 1997. It is a non-profit association focusing on better construction quality, equal competition for companies and aiming to decrease tax fraud. RALA grants certifications for people and companies that are socially responsible and maintains a list of the certified operators. The operation of RALA is based on law, act 1233/2006 discussed in chapter 3, 4. The act obligates the constructor to inspect the background of a company and subcontractors working on a project to see whether they have executed their social duties such as taxes and other fees. (20)

RYL - The general quality demands of construction industry

RYL (Rakentamisen yleiset laatuvaatimukset) is a publication by the Building Information Group including the general demands on quality requirements on construction work. It shows the minimum quality level of construction work. It has been made by the professionals of construction industry including technical information considering the quality of construction work. The subscriber can use RYL to evaluate the quality of the construction and demand a refund or a repair if the quality is not as required. RYL exists for different areas of construction such as infrastructure, painting and surface. (21)

5.4 Finnish Society

Finland is a very highly educated society. There is highly educated staff available for market and for the state. People working with construction are typically well educated for their work. A big role in supervision is possessed by the principal designer, responsible overseer and the contractor.

The Finnish tax system is disciplined. Taxes grant the funding for a working society and a large percentage of Finnish taxes go for the society. Construction is controlled efficiently, because a major part of Finnish wealth consists of built environment and infrastructure. According to the Corruption index by Transparency International 2011, Finland is among the least corrupted countries globally and therefore the tax usage is effective. (24, 25 and 45)

5.5 State-owned companies

Public construction projects are typically controlled by state-owned companies specialized in construction projects. Also municipalities can perform a construction project if capable or in cooperation with the government. The funding for the budget can be applied from the municipality, government or even from EU if the project is significant enough.

The biggest state-owned company operating in the field of public constructions is Senate Real Estates (Senaatti Kiinteistöt). It works with the control and development of estates, rental of premises and investment. The customers for the company are for example government offices, ministries, universities, schools, prisons and the army. The Senate Real Estates controls Finnish real estate assets. In the year 2011 the company owned 11 000 constructions with the personnel of 251. As it finances itself it is not a part of the national budget. (25, 26)

6 BRAZILIAN SYSTEM

The Brazilian system is a complex system compared to the Finnish one. The connections between organizations, authorities and responsibilities are really hard to understand. Even the people working for public supervision do not have a clear vision of the operators working on the field. Procedures, regulations, laws, codes and documentations are very bureaucratic and the system changes and develops slowly.

6.1 System

The Brazilian system for most of the activities is divided to 3 hierarchic levels: Federal, State and Municipal levels. These levels are divided in a hierarchic manner. Each level has its own laws, regulations and secretaries. Brazil is a very big nation, with a bigger area than the European Union. Many states have completely different surroundings, lifestyles and climate from the wild Amazonian rainforests to Megalopolises like São Paulo to small villages. Therefore compatible federal laws are difficult to be established. (2)

6.1.1 Federal level

Federal level is the national level with the headquarters located in the capital city, Brasília. Federal authorities work with national scale construction projects. For example, Federal Tribunal de Contas supervises federal projects such as federal universities and federal hospitals. The federal system consists of several ministries such as ministry of education, ministry of health and ministry of justice. Federal government coordinates public money and creates an annual budget for the year including construction projects. (2)

6.1.2 State level

State level is the next level from the federal level, for example the state of Paraná. Paraná has 399 municipalities. The state level is a more regional level. The state of Paraná was chosen as an example because of its similarity with

Finland in population, area and for its level of development. The state of Paraná is considered as one of the most developed states of Brazil. (5, 2)

6.1.3 Municipal level

Municipal level is the lowest and the most regional level. The municipal level is also the most varied one in the scale of population, size and development. Some municipals have only very small budgets and technical capabilities to maintain and develop infrastructure and constructions. (4)

6.1.4 Tribunal de Contas – Court of Audit

Tribunal de Contas (TC) is an institution that was originally founded to supervise public accounts, personnel, purchases and expenditure of public money. It has operation in every operational level in Brazil, mainly in federal and state levels. It has the largest responsibility in supervision of public construction projects. TC supervises the supervision. Tribunal de Contas evaluates the prices of constructions and projects. It will be discussed more in chapter 8. (4, 23)

6.1.5 CREA - Regional Council of Engineering and Agriculture

CREA is a construction engineer union. The biggest responsibility of CREA is to supervise that every construction site is controlled by an educated engineer and that the documentation is correct. Each engineer working with civil engineering in Brazil has a personal CREA number that is shown on a construction site as a mark of the responsible person. (22)

CREA Paraná will also attend the supervision project of public construction projects with Tribunal de Contas Paraná and the Paraná Federal University. In the Paraná state there are hundreds of paralyzed public construction sites for reasons unknown, according to the coordinator of civil engineering in the Tribunal de Contas do Paraná Luiz Henrique Barbosa Jorge. In 16th of September 2012 the number of paralyzed construction sites in Paraná was 697. Paralyzed projects are a big problem in Brazil. The main responsibility of CREA

in the project is to work with these paralyzed sites and to study the reason for paralysis. (2, 22)

6.2 Laws, codes and procedures

The legislation, codes and guidelines are complex, wide and ambiguous in Brazil. The Federal, State and Municipal levels all have separate laws and the laws are complicated. The civil engineering legislation lacks the engineering point of view and technical knowledge. According to professor Lacerda there are excellent laws and codes in Brazil, but they are not used as supposed because of the very complex form. The most important legislation for the supervisors second to the interviewed personnel was the General conditions of contract, CGC and the procurement act. (2, 4)

6.2.1 General conditions of contract – CGC (Condições Gerais de Contratos)

CGC is a state level document regulating and guiding to assign contract with a contractor. A contract is one of the most important documents in a project. A contract works as a proof and insurance for all of the parties in project dividing responsibilities. There are different versions of the CGC depending on the operational level. The CGC of Paraná state provides regulations for example on the quality, price, payments, scheduling and the warranty. (4, 5 and 44)

6.2.2 Procurement act - LEI Nº 15608 - 16/08/2007

There exists a procurement act for both Federal and State levels. State level act for tendering is used on state level projects. For example, when planning a new school for the city of Curitiba state and municipal acts are used for making a budget for the school depending on the constructor of the project. Lei de Licitação 8666/93, federal procurement act is commonly quoted and used in the supervision of public construction sites. It is followed as the basis of design for the project and budget in public projects. The Federal legislation is very approximate compared to the state level legislation of Paraná. (4, 5, 28, 29)

In comparison, Finland and other countries of European Union have the Public Procurement Act for public purchases, which obligates the project to be tendered openly and internationally when exceeding the limit values. (Chapter 3.3) This law enables more equal and transparent public procurement procedures. The system of open tendering could prove practical for a nation with a big area such as Brazil.

6.2.3 Civil codes and Regulations

In addition to the most used legislation by the supervisors, a lot of regulations are marked to be used in public construction projects. Especially the guide for public construction project that will be discussed in chapter 8.1 has several references to various legislations. Also several institutions and associations provide additional regulations and guidance for different levels of projects such as CREA (discussed in chapter 6.1.5), ABTN (Brazilian National Standards Organization) and INMETRO (National Institution of Metrology, Quality and Technology). Other regulations provided in the guide for public construction projects include following sources:

- Code of Municipal projects – (Código Municipal de Obras)
- Federal Constitution § 1 Art.167 – (Constituição Federal)
- Manual of Public Works - Constructions – (Manual de Obras Públicas – Edificações)
- Manual for supervision of projects - (Manual de fiscalização de Obras) (2, 37)

According to the engineer Luiz Henrique Barbosa Jorge other procedures exist which are noted in the internal documents in case of a fraud or a defect. It is also possible for the TC to set penalties for the disobedient contractors. (4)

6.3 Project for supervising public construction sites

This study is based on a project of supervision of public construction projects. Parties of the project are the Federal University and Tribunal de Contas do

Paraná. The objective for the project is to supervise public construction projects for the FIFA Football World Cup that will be held in Brazil 2014 in various cities, including Curitiba. Later the project is supposed to consider other construction projects in Paraná and finally the entire country.

Tribunal the Contas has an underestimated budget and personnel to supervise every public construction site in Paraná. The objective is to improve this situation with the help of the University and students of civil engineering and architecture. A group of students was chosen to help TC to supervise construction projects. The group was named EMEA – (Escritorio modelo de Engenharia e Arquitetura). Because of it completely new concept the project has had problems with bureaucracy and strikes of the Federal University. (2, 4, 27)

The lack of resources in supervision is one of the problems, which is an interesting fact because the economy in Brazil is fast growing with a large federal budget, income and resources. The use of the vast resources is not controlled sufficiently and there is a danger of public resources to be lost. Brazil is known to have a reputation for a corrupted society. Corruption, low productivity and misuse of public money have a massive effect to a nation that could be one of the most powerful nations in the world. When these problems will be under control, Brazil will be one of the most powerful nations on a global scale. (2, 4, 5, 24, 33, 38, 45)

6.4 Supervision of State level construction

The state level construction sites are supervised by supervisors working in regional offices. Offices divide areas of responsibility. Supervisors have several construction sites on a wide geographical area, they have a big responsibility and principally they are overloaded with work. The resources for supervision are underestimated. Interview was conducted with one of the supervisors working in the field of state level construction site supervisors, João Geraldo Pereira. The objective of the interview was to clarify and understand the overall situation and

procedures of the supervision from the point of view of a supervisor working in the field. The interview was performed in Curitiba, 5th of July 2012. (5)

6.4.1 Interview with João Geraldo Pereira, supervisor of public construction sites on state level in Curitiba region

Civil engineer Pereira works for the state of Paraná supervising construction sites observing the development on the construction sites. He visits various construction sites following the work phases, reporting and controlling that everything is proceeding as it should. His responsibility is to evaluate the progress of the site in order to execute the monthly payment for the contractor. (5)

The state of Paraná is shared to 14 regional offices which share the states supervision of the 399 municipalities, in average 28, 5 municipals per office. Every office has about 10 employees. Thus, every employee has construction sites for more than 2 municipalities each. The regional office of Curitiba, the capital city of Paraná, is controlling public constructions in more than 10 municipals with a staff of 9 people: a responsible civil engineer, 7 civil engineers and one technician. Simultaneously engineer Pereira has had more than 20 construction sites and recalls colleagues with even more than that. Efficient supervision is not possible with such resources and workload. At the moment there are only few construction sites because of the reigning government that has been slow to start construction projects, states Pereira. (5, 36)

Mr. Pereira works for the State Department of Highways (Departamento de Estradas de Rodagem do Estado do Paraná DER). His responsibility is to supervise construction sites in the area of Curitiba and near municipalities. In his work Engineer Pereira uses mainly three acts for budgeting and contracts: Federal and Municipal Procurement Acts 8666/93 (Lei de Licitação) and General Conditions of Contracts. This legislation works as a base for the supervision. (28, 29, 30)

In the municipal level typical problem is the lack of engineering capability in the design of the projects. In these situations the projects has to be designed in cooperation with the state or other municipalities. The cooperation can result in a construction for both the state and the municipal uses. For example, a school can be designed to work during the day as a municipal and in the evening as a state level school. In some cases projects have been designed by people without suitable education. (2, 5)

According to engineer Pereira the major problems in public constructions at the state level in Paraná are the unfinished or unsuitable projects and unfinished spreadsheets and calculations. The lack of resources in supervision and the dishonesty of the contractors are also significant problems. Work is often unfinished or of low quality depending on the contractor. Because of the strong economic situation in Brazil, it is hard to hire new engineers for the state. Companies are hiring all available and best engineers to work for the private sector. Therefore Brazil has lack of competent engineers. Mr. Pereira mentions one small, but significant strategic error during the interview. The supervisors are approaching the retirement age, but new engineers have not been employed by the state to continue the supervision. Therefore important professional knowledge will be lost in the change of generations. (2, 4, 5)

In the interview Mr. Pereira points out that it is difficult to exclude a contractor from the competition if one is connected to politics, even with a bad reputation. The mentioned fact leads to the single biggest problem in public construction projects and the nation of Brazil, corruption. Corruption is paralyzing the success of Brazil. The public money that could be used in developing the society, improving the quality of life and social system is now vanishing in the different levels of bureaucracy and to people abusing the system. Corruption has an effect on the daily lives of Brazilian people. Corruption has to be cut off from the system by severe legal punishments and operation prohibitions. (2, 4, 5, 24, 33, 38, 45)

7 TRIBUNAL DE CONTAS

Royal treasury (Erário Régio) was founded in 1808 and was renamed to Tribunal de Contas (TC) in 1891. Tribunal de Contas da União (TCU) is a federal accountability office of Brazil. TC is an institution supervising the expenditure of public resources: purchases, responsible personnel, accounts and other activities. It is divided into three levels: Federal, State and Municipal levels. Furthermore, TC legislates, makes regulations, supervises elections and also has an educational department. Tribunal de Contas is a large institution with a wide range of responsibilities. TC is presented in this study for its role in the supervision project, responsibility with the supervision of public money and it is also the subscriber of the study. (31)

7.1 Federal tribunal de Contas

The headquarters of the Federal Tribunal de Contas da União (TCU) are located in the capital city of Brazil, Brasília. TCU supervises federal construction sites such as federal hospitals, universities, military projects. High command of the TCU consists of plenary of 10 ministers and two chambers with 7 ministers each. Authorities controlling various secretaries from different professional areas are managed by ministry, public the ministry president and vice president. (31, 32)

7.1.1 Tribunal de Contas do Paraná

Tribunal de Contas do Paraná works for the citizens of Paraná, the state and 399 municipalities. It supervises the use of public money in public purchases and informs citizen about the results. According to engineer Jorge from the Tribunal de Contas it supervises the supervision by controlling the accounts, money spent and suitability of the projects. An interview was performed with the coordinator of department of civil engineering in Tribunal de Contas do Paraná Luiz Henrique Barbosa Jorge in the TC headquarters in Centro Cívico, Curitiba in 26th of June 2012. The objective of the interview was to understand how

public supervision works in Brazil and especially in the state of Paraná. The interview is summarized in the following chapters.

7.1.2 Process of a public construction project in Brazil

Public construction project in Brazil starts with a basic project. To be accepted as a project for funding, it is required to have a basic project. A basic project is a plan for the basic features including the design, preliminary budget and schedule. The project has to be well planned and described and it must be designed by a capable engineer or an architect to ensure an equal and just tendering. Especially when the project is outsourced unambiguous project is important, in order to the project to succeed as designed. (2, 4)

TC supervises public projects before and during the construction to verify the result. During the project development of the construction and the expenditures are followed on a monthly basis. According to engineer Jorge, “Tribunal de Contas supervises the supervision of public construction sites and that the contracts and the execution of the project are made in the most economic and legal way.” When an irregularity is discovered TC has to inform the municipal or state supervisor to handle the problem. TC does not have the authority to communicate directly with the contactor. (4)

Tribunal de Contas do Paraná has 20 engineers and architects working with the supervision of public construction sites in 399 municipals. The supervision is divided into the coordination office and seven inspection units. Each unit has one or two workers. The people working in inspectorates are focused on state level projects whereas the staff of the coordination office is more focused on the municipal region, states engineer Jorge. (4)

To explain the documentation and procedures of a public construction project, Mr. Jorge uses an example of a municipal school. In order for a school project to start, it has to be included in the budget for the coming year, at least one year before the construction work. The budget is the first analyzed document. After accepted for the budget, the project requires an authorization for tendering by

the responsible authorities. In case of a school the authorities are Secretary of Education and governor of the state. The Secretary makes a request and the necessary paperwork for the governor of the state. After approval of the governor, the project development can begin.

The project is conducted depending on the technical capabilities of the municipality. Either the engineer of the municipality or Secretary of Education executes the project. Otherwise the project is tendered for professionals outside the municipality. After that, the project is tendered. The document used for tendering is the Procurement act 8666/93 (Lei de Licitação). The procurement act includes the necessary regulations, procedures and values for the project. The companies that participate in the tender offer their price for the project. After the tendering a contract is signed with the winning contractor. A responsible supervisor and manager are required for the project. After signing the contract, an Order of the Service (Ordem de serviço) is required for the construction work to begin. (2)

The payment is executed monthly according to the finished work. For example, if 5% of the construction is completed, 5% of the value is paid. The supervisors follow the development of the construction and evaluate a suitable payment according to the development. When the construction work is completed, the guarantee time is the following six months, on which the project stays open. During this time all detected defects, faults and low quality are required to be repaired and after that the project will be completed. According to the National Civil Code of Brazil the guarantee for a building is 5 years. (2)

“Despite the name basic project, the idea is far from basic”, states Jorge, ”In the procurement act the basic project means a complete design of the project, a complete documentation of all the required elements, materials and features to be used in the project.” For example in a school project it means foundations, frames, floors, ventilation electricity and furniture, et cetera. (2)

7.1.3 Common problems and solutions

Common problems with public construction projects in Paraná are the low quality of the projects, construction defects and the lack of capable professionals. "The fact explains the number of paralyzed, stopped and abandoned projects and low quality of public construction", states Jorge, "For this reason we have a lot of problems".

Federal and state levels have sufficiently educated engineers working; the biggest problem is the smallest municipalities on municipal level. Typically municipalities have the least resources to maintain the public infrastructure. When few resources are available, suitable and proper projects are vital to avoid exaggeration and vanity. To resolve this problem municipalities require help from the state levels in form of cooperation and counseling. (4)

A big problem mentioned by Jorge is the dishonesty of the operators, contractors and politicians working with public construction. Overbilling occurs in public construction projects according to the report of TC (33). If the example school is highly overprized, the fact has to be verified using calculations, tables and spreadsheets of the prices, materials and work in order to verify the result. When verification is completed the process for regaining the money can be started. One type of fraud by the contractor is the use of different, cheaper materials in the project, for example the planned granite tile is replaced with a cheaper ceramic tile. In this case, the money should be returned, but these frauds can only be discovered on the sites that are supervised, which means of 20 engineers supervising the region of 399 municipalities. The resources for supervision are drastically underestimated. (2, 4, 5)

To improve the situation of public construction in Brazil it is possible to apply Finnish supervision system. The first solution is to adjust the supervision resources to fit the current economic situation and the growth of Brazil. Proper supervision improves the efficiency of public investments providing better results. Education of the supervisors and personnel working on responsible

positions require suitable education. Seminars focused on good design could be organized for example. On the long scale the focus on a good education is vital for a fast growing society and welfare. The projects and design should be well planned and suited to a genuine necessity. The most important result of a construction project is the produced premises. Control, strict coercive measures, sanctions and operation prohibitions against frauds, defects and corruption improve the competition and the construction market significantly.

8 COMPARISON OF FINNISH AND BRAZILIAN SYSTEMS

Finland and Brazil are completely different countries with different cultures. The location, climate, geography, population are not only different but complete contraries. Because of the big differences, a comparison is very difficult or almost impossible. Then again contrasts always present a good chance of cooperation and development. There is always a chance to learn from each other.

Brazil is a very large nation. Citizens of Brazil have different points of view of their country. The contrast inside Brazil is remarkable. The study for a comparison for the public construction systems has been conducted between Finland and the state of Paraná. The population and area are relatively close and culturally Paraná is close to the European culture. In table 2 a comparison of basic features of Finland and Paraná are shown.

TABLE 2. Differences of Paraná and Finland (35, 36)

	FINLAND	**PARANÁ**
Population	**5 400 000**	**10 400 000**
Area km^2	**303 900**	**199 300**
Population density	**17,8**	**54,40**
Number of Municipalities	**336**	**399**

8.1 Guide for the public construction projects – Obras Públicas

8.1.1 Introduction

The comparison of Finnish and Brazilian systems and procedures for public construction projects is based on the results of the study and the guide - Obras Públicas published by Tribunal de Contas. In this chapter the most remarkable differences are listed.

The guide for public construction sites is a document with more than 90 pages about public construction projects and supervision. It is produced by the Federal Tribunal de Contas. The guide for public constructions describes the procedures of a public construction project on a very basic level. It is intended for a person working with public construction projects without education in technical area. In addition to this document another, more technical guide for professionals on technical aspects would be very important in order to develop the system. (37)

The guide is mostly made by layers and economists. The text has a lot of citation to legislation but it is almost completely lacking technical information. The information is very compact lacking more detailed and specific explanations and examples. The main focus is on the costs. The cost of the construction is mentioned on several occasions but the quality or the suitability for the users is not stressed. Technical information is very narrow and chapters describing important parts of the project, such as the Necessity Program which is only on one page without any guidance on evaluation of the necessity considering important factors, for example users of the construction or predictions of population growth on the area. In every construction project, especially with low resources, it is vital to design the project well in order to avoid the waste of resources. (2, 37)

8.1.2 Legislation

The laws and regulations control strictly the construction industry in Finland. The laws are unambiguous. Finnish law is the basis of the legislation. The legislation is supported and focused by national codes and regulations and standards which are clearly mentioned in the legislation. In Finland a single legislation controls every citizen. The construction legislation is based on technical facts and made in collaboration with professionals. (1)

Being a big nation, Brazilian legislation is more complicated and more depending on the location. The system is divided in 3 levels and the legislation

is also in different levels. Brazilian legislation is complex and ambiguous. The cultural differences between Finland and Brazil are significant. The obedience of laws is different between Brazil and Finland. Finnish people are obedient to the legislation because it is clear and strict. Brazilian legislation is complex and the big population and difference in income also affect the situation. Also, the honesty of the contractors is different. Frauds happen in every country, but according to the report of TCU a big quantity of public projects are overpriced in Brazil which indicates to dishonesty of the operators. (2, 11, 33)

In Finland both public and private constructions need a license, a building permit. When an application for a construction permit is submitted, the responsible authority Construction Supervision inspects the plan, demands changes and recommends modifications to improve the project. After the procedures, a building permit is given and the construction work can begin. A building permit is required for all significant construction activity including renovations. (1, 11)

Breach of contract, fraud, tax evasion and corruption are crimes both in Brazil and in Finland. In Finnish legislation the coercive measures and punishments are severe in case of crime. The laws are the strongest documents of a nation. The law must be well written with no room for interpretation. The history of contractors has to be recorded in Finland (chapter 3.4) to avoid problems and companies with criminal background to work. Illegal activities cause problems in both countries and extreme measures are needed to reduce the effects of these activities. Also an update, combination and unification of Brazilian legislation are required in order to improve the system. Bureaucratic, complex legislation has a strong reducing effect on the competitiveness of Brazil. (2, 38)

8.1.3 Requirements and classification for construction industry

The principal designer and the responsible overseer of the construction are required personnel on every construction project everywhere in Finland. They are required to have a necessary education and experience for construction

industry. Principal designers are classified according to qualifications. The classes are C, B, A and AA. The classes can be achieved with credits from the university and professional experience in the area of work. Personnel working with construction supervision are also required to have appropriate qualification. The principle designer is responsible for the plans and the responsible overseer for the construction site activities. In Brazil a construction engineer with a diploma can work in any position regardless the experience and qualifications. To improve the Brazilian system, education and respect for engineering need to be observed carefully, states Mauro Lacerda. (2, 6, 12)

8.1.4 Design

A big difference between systems of construction supervision between Finland and Brazil is the focus on preparations, designs and plans. In Finland the state of the infrastructure of municipals is controlled continuously. When a public construction or a repair is required, the necessity is carefully evaluated. Constructions are planned on a necessity, genuine need based on continuous research of population, state of the infrastructure and knowledge from similar projects. Brazilian guide mentions a viability study, which is the cost-benefit comparison of the construction to other built public constructions. The stress is on the price, not the suitability or quality. Using the building permit system, the viability of the construction will also be controlled and compared to other construction automatically. A short note stressing a necessity program is included in the Brazilian guide for public construction with a short description, but without technical information how to conduct a study for necessity. (2, 37)

In Finland a construction project is made for a necessity. Careful planning and identification of the genuine necessity is an important part for a successful project. Suitable premises are the objective of a construction project. Technical features surrounding the premises such as walls, roofs and floors are secondary. In Brazil every project is assessed with a price tag. Price is a very important factor for a construction project, but definitely not the most important. The budget only guides the design. More important features are suitable areas

for the premises, location, and a good design to gain the maximum value of the project. This philosophy is important for every construction project, especially in Brazil. (1)

The guide states the choice of territory being fundamental for a project and it includes information on choosing the location for the construction. The Finnish law controlling construction is named “The Land Use and Building Act”. In Finland the use of territory is controlled even when owned by a private person. The system of the land use is a three level system controlling the development of the city. In order a project to be accepted, it has to be planned on the land use plan. (11, 12, 37)

For example a high-rise construction cannot be constructed on an area with only single houses or a factory in the middle of the center. In the figure 7 is shown a construction in Curitiba where a high-rise construction is built next to smaller house. In Finland this type of construction would not be allowed. In the land Use Plan the areas to be constructed and the future visions are marked. Planning the future is important for controlled growth, sustainability and comfortable living circumstances. Territory control is important for a big scale country as Brazil. (11, 12)

Figure 7. Two neighboring constructions located in Curitiba.

8.1.5 Project

A good plan is very important in order to accomplish correct budget and tendering. In Brazil the importance of design should be stressed a lot more. If public authority does not have capable people in designing projects, an experienced professional designing project should be obligatory. According to Mauro Lacerda and other professionals, low quality or unfinished projects and the design of projects is one of the major problems. The resources and capabilities of public supervision should be re-evaluated to fit the current

requirements. Brazil is living an economic boom with a fast growth and vast public resources. (2, 4, 5, 6)

When a project is well planned and completed, it needs to be tendered and contracted. In the European Union remarkable public projects and purchases has to be published and tendered openly in the EU market area. The Public Procurement Act of the European Union obligates an open tendering procedure for public construction projects. A similar system of open tendering, for example in national level or in the South America region would improve competition and transparency which is required by Brazilian legislation. (13)

A contract of the project is one of the most important documents for a project, for it brings security for both contractor and the client. In Finland the construction contract is a guide and standard contract General terms of contract (YSE 1998 – Rakennusalan yleiset sopimusehdot). An example of standard contract demonstrates visually the contents and the most important parts of the contract. A standard contract used in all the country gives more controlled, secure and faster procedures to contract a project. A standard contract applied in the Brazilian system would unify, improve and standardize the procedures of contracting of public projects. (1)

8.1.6 Execution

Finnish construction projects are observed and information is collected to databases giving a clear and current idea of the costs, duration of the work and other features of construction. National code for construction determines the minimum level of construction quality. It is illegal to construct below the level of the code. The small Finnish market determines high quality for the constructed environment. (1, 12)

The system of construction supervision is different in Finland and in Brazil. In Finland the supervision is conducted by authorities in Construction Supervision (Rakennusvalvonta). It inspects the drawings, designer and principal overseer. In addition it grants the building permit and demands necessary secondary

supervisors. During the construction phase, it supervises the construction with random visits and inspections on important parts of the construction. Construction Supervision observes the whole project and executes all the supervision. In Brazil Tribunal de Contas supervises the expenditure of public money and accounts and projects. TC does not conduct technical supervision. Federal, State and Municipal level supervisors are overwhelmed with work and do not have enough resources to supervise every construction site sufficiently. (4, 5)

An institution or a secretary which concentrates solely in the supervision of construction projects might be an option to improve the supervision of construction. The authority of the supervisors is an important feature for the functionality of the supervision. The project with Federal university and TC of Paraná including more personnel to supervision is a good start to develop the system. Effective supervision with correct resources improves the efficiency of public investments and reduces wasted resources.

8.1.7 Cultural Differences

The climate differences and cultural differences between Brazil and Finland create remarkable contrast which also affects the systems of the countries. The climate differences are significant between Finland and Brazil. The annual temperature variation in Finland can be more than 60 degrees Celsius from minus 30 degrees to plus 30 degrees or even more. Harsh winter and low temperatures impose demanding requirements for example for the structures, foundations and construction physics. In Finland every residential, industrial, and financial constructions needed to be kept warm require thermal insulation and heating system. The fact increases drastically the cost of infrastructure and the demand on quality in materials and work. Humidity control, construction physics and foundations are very important features for the functioning of a construction. For example, construction defects can break the structures or increase the maintenance costs. The determinate feature for construction is not the purchase price, but the maintenance costs such as heating of the water and

premises, ventilation and energy costs. For this, the premises are designed to fit for the people with as little wasted space as possible. (1)

The education, competitiveness and work efficiency in Brazil and in Finland are in completely different levels. According to the Global competitiveness report 2012-2013 by Global Economic Forum, Brazil is in the 48th rank when Finland is the number three. The biggest problems in Brazil are inadequate supply of infrastructure, inefficient government bureaucracy, inadequately educated workforce and corruption (38). To improve efficiency and competitiveness, concentration should be focused on developing the educational system and investments on new technologies, tools and instruments to industrialize and modernize construction industry and to improve the quality of life in Brazil. (38)

9 PROBLEMS DURING FINAL THESIS

A big personal problem for me in the beginning of my exchange studies was the Portuguese language. I arrived to Brazil with only very basic survival language skills. Later on, during the project my poor language skills proved to be disadvantageous. Eventually, regarding the circumstances the result is satisfactory.

Being a new project for every operator, unexpected difficulties occurred and had to be solved during the project. An agreement between TCE and UFPR for supervision is a new concept. All of the contracts and procedures had to be made from the beginning. Also, the international cooperation between the universities in the form of a final thesis is new for Oulu and Curitiba. Strikes and the bureaucracy of the Brazilian system made the beginning of the project difficult. The project started really slowly and the beginning was delayed and limited time for exchange caused challenges. Finally, the contracts were signed and the project was started.

Public construction projects for the football world cup have stimulated a lively debate in Brazil. Many projects have been inadequately planned and in ambiguous circumstances in several cities where the world cup will be held. Also the media has taken part in the public discussion on construction sites; states Daniel Castellano in the article of Gazeta do Povo considering the construction site of the football stadium Baixada. (39)

Some problems have occurred during the project, for example; the renovation of the stadium of Atlético Paranaense for the world cup. The project received public money but the project was altered after the start of the construction. Professor Rogerio Lemos studied the budget of the stadium. Several peculiarities were found from the budget of the project such as in the structural design. The stages of the design were badly unfinished when the construction work had already begun. The real cost of the project was impossible to be predicted because of the stage of the project. Secondly the execution and the

development of the project were unclearly contracted and defined by the constructor, public authority and FIFA. The construction activities were undefined and the original schedule was exceeded several times. Also, parts of the project and principal designer were changed unexpectedly. For example a retractable roof was added to the project and the concrete design was modified suddenly. Gas, waterproofing and automation systems were undefined. In addition to all of the obscurity of the project the source of the money was undefined. The case will be studied more during the project. (6)

10 FOLLOWING RESEARCH

The objective of this research was to work as a basic research for following researches studying differences of public construction between Brazil and Finland. The research was conducted by field work and interviews with several professionals in the field of construction supervision. In the future, deeper studies into the differences of the systems are required. The potential of Finnish, Scandinavian and European systems in improving and developing the Brazilian system is worthwhile to study. The exemplary Finnish system provides ideas and tools to improve the Brazilian system. The key factors are the understanding of cultural differences and application of the two different systems.

More focused researches of public construction and modernizing the supervision are planned with international group of students. Areas such as supervision, project planning and development of legislation should be studied more. This study is planned to be continued as a master thesis in the future. The objective of the master thesis is to continue the study on a deeper level and to apply proposed improvements in the Brazilian system. Other researchers are also interested to continue this study, including Matti Karppinen.

11 EPILOGUE

Several big differences were encountered between Brazilian and Finnish construction projects and procedures during the study, as expected. In Brazil it is possible to find unique pieces of marvelous engineering, such as the Itaipu dam, the urban planning of the capital city Brasília or the metro of São Paulo. In Finland, the levels of engineering and social system are of very high quality, exemplary system in global scale. The average quality of constructions in Finland is excellent and there are only few exceptions, whereas in Brazil the basic engineering is usually the problem. A very big nation such as Brazil needs a big number of well-educated engineers to design a working infrastructure to ensure the growth, development and improvement of the quality of life in Brazil.

This work has been interesting and challenging because of the contrasts between Brazil and Finland. The cultural difference is remarkable. Brazil is a mixture of global cultures having inherited a Latin system from Portugal for historical reasons. Brazil has grown far from the colonial period to be one of the biggest countries to influence world economy and politics. Now it is time for Brazil to find a modern and the best way to control the whole country.

Finland is a small country in Northern Europe. It has a small population and small significance in the global economy and politics, but it has created an exemplary social security system, educational system and several global, world class companies. The fact that Finland was ranked as the third most competitive country in the world despite the European financial crisis in the global competitiveness report is a marvelous achievement. Also in several other studies such as welfare and education studies Finland is among the top performers. If the Finnish system of control and education can be adapted to Brazil, results could be very promising. All the efforts towards this development are worthwhile. (38)

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APPENDICES

Appendix 1. Output Information Note

OUTPUT INFORMATION NOTE

Author Mikko Juhani Knuutila

Subscriber The Federal University of Paraná & Tribunal de Contas do Paraná

Contact person of the subscriber and contact information

Name: Mauro Lacerda

E-mail: maurolacerda1982@gmail.com

Title The comparison of public construction sites in Brazil and in Finland

Description The final thesis is a general comparison of public construction projects, supervision and procedures in Brazil and Finland.

Objectives The objective is to discover differences of the systems and to grant tools and examples to improve Brazilian system of public construction and supervision of public construction projects

Schedule The Project started in 01.01.2012 in Curitiba, Paraná, Brazil and it will be concluded in the end of the year 2012.

Appendix 2. Page 10 from The National Building code of Finland part A2

4
DESIGNERS' QUALIFICATIONS

Land Use and Building Act, Section 123

The person drawing up a building or special design...must have the training and expertise required by the type of building project concerned and the demands of the duties involved.

The qualifications required in designing are judged according to the intended use of the building and the spaces within it, the structural loads and fire loads, the design, calculation and dimensioning methods, environmental requirements and in addition to the above any unconventional aspects of the design approach...

Design and management duties can be classified in requirement classes in order to specify the minimum qualifications. The minimum qualifications shall be prescribed by decree, and more detailed regulations and guidelines will be issued in the National Building Code of Finland.

Land Use and Building Decree, Section 48

Persons drawing up a building design or special design shall have a construction-related university degree appropriate for the planning functions in question, or an earlier construction-related higher-level vocational or other degree, and sufficient experience of working on the type of planning in question.

Buildings that are small or have ordinary technical properties may also be designed by persons with a college-level qualification in construction or in the relevant line of special study, or a corresponding earlier qualification if they are sufficiently experienced.

In addition, a person who does not possess one of the aforementioned qualifications but is deemed to have the skill required in view of the type and extent of the construction work or design task, may also carry out minor design works.

The person in charge of the design in its entirety and of its quality (*principal designer*) and the person in charge of special design shall also possess solid professional ability to manage the design in its entirety.

When the qualifications of designers are assessed, the provisions of section 123, paragraphs 1 and 2, of the Land Use and Building Act are taken into account. More detailed provisions are issued in the National Building Code of Finland.

4.1 Assessment of designers' qualifications

4.1.1 Regulation

A designer's education and experience together make up the designer's proficiency. The qualification required is the designer's adequate proficiency in relation to the demands of respective design task.

4.1.2 Regulation

The building supervision authority will ascertain the degree of difficulty of the design task in relation to the characteristics of the building project and the demands set for the building by the environment, separately for each building permit application. On this basis, the building supervision authority will assess the demands of the task in relation to the proficiency of the designer, which includes examinations passed by the designer and other studies undertaken by him plus experience and evidence of it in the relevant design field.

Guidelines

In ascertaining the degree of difficulty of the design task for each project, the grounds set out in the advisory tables given in 4.2 below, which can be used as reference. Correspondingly, the guidelines given in the tables of grounds for proficiency can be used in assessing the designer's qualifications.

In assessing the designer's qualifications, a certificate issued by the certification body for the relevant design field may be taken into account.

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Appendix 3. Terms of provisional reception

TERMO DE RECEBIMENTO PROVISÓRIO

Identificação

Contrato:		**N° da OS / OFB:**	
Objeto:			
Contratante:			
Contratada:			

Por este instrumento, atestamos, para fins de cumprimento do disposto no art. 25, inciso III, alínea "a" da Instrução Normativa nº 4 do Ministério do Planejamento, Orçamento e Gestão – MPOG, de 12/11/2010, que os serviços (ou bens), relacionados na O.S. acima identificada, foram recebidos nesta data e serão objetos de avaliação quanto à conformidade de qualidade, de acordo com os Critérios de Aceitação previamente definidos pela Contratante.

Ressaltamos que o recebimento definitivo destes serviços (ou bens) ocorrerá em até ___ dias, desde que não ocorram problemas técnicos ou divergências quanto às especificações constantes do Termo de Referência correspondente ao Contrato supracitado.

De Acordo

CONTRATANTE	CONTRATADA
Fiscal Técnico do Contrato	**Preposto**
_____ *<Nome>* **Matrícula:** *<Matr.>*	_____ *<Nome>* *<Qualificação>*

_____, _____ de _____ de 20_____.

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