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COMPUTER PROGRAM DEVELOPMENT FOR HOUSE COST CALCULATION

Bachelor's Thesis 2010

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ABSTRACT

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Computer Program Development for House Cost Calculation, 34 pages,
4 appendices

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Tutors: a content tutor from the Saimaa University of Applied Sciences –
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The main purpose of this project was to develop a program, which can calculate the cost of houses. This program should accelerate a matching process between a company and users. Also the program should contain a database of building materials.

The program language is PHP. PHP is a modern computer language for the development of web programs. The writing of a program code was based on the official PHP manual and a little support from a programmer in the company. For making the database of building materials Finnish handbook Rakennusosien kustannuksia 2009 and company experience were used.

The final result of this thesis consists of the web program part, which calculates prices of houses, and the written part. The full version of the program has restricted access and is available only to the company's employees, but the short version can be found on the official site of the company Uhtuatalo Oy in open access. The written part contains some information about writing process, program testing and comparing with analogs. Also this part includes functions describing of the program.

Keywords: program, PHP, MySQL, web, company, database, calculation, cost, price, Rakennusosien kustannuksia 2009

1 INTRODUCTION

The main idea of this thesis is a development of a program, which calculates costs of houses. The main purpose of this program was a compilation of preliminary house specification. House specification must include cost information about materials and works. This specification will be used by the company's employees. This program should accelerate the process of estimating housing costs in comparison with traditional estimation methods.

The development of the program was started on a trilateral meeting: director of the company, programmer and me. The main goals of the meeting were discussion of key parts of the program and allocation of responsibilities between members. The meeting defined function borders and computer language of the program and types of houses for calculation.

During the thesis writing a lot of different materials were used: computer literature for writing a program code, pricelists from suppliers, old company estimates. The evaluation of actual material and work costs were executed by competent employees, using information from the Internet. Using actual information about costs is the most important thing for the estimation of housing cost.

The company Uhtuatalo Oy has experience in the development and application of its own computer programs in practice. The application of its own programs is an advantage on the building market. The development of own programs takes a lot of time, but it will save time in the future.

2 STARTING CONDITIONS

Writing a program is a challenge and it is important to describe the starting situation. A development of correct time schedule can save time in the future and help to estimate the real term of writing the program. Absence of correct task planning and distribution of tasks can lead to loss of time.

On the preliminary stage tasks, resources and time were analyzed. It was necessary for the estimation of function borders of the program and time. The preliminary stage defined main program parameters such as language, structure and functions.

2.1 Starting point

The company Uhtuatalo Oy had ordered the development of cost estimation program a year ago. This program was used on the Internet web site <http://www.uhtuatalo.fi/> and could calculate a house price for the site's visitors.

The interface of the program was simple. The site's visitor could choose a number of storeys, type of material and area of the house and then the house price. Figure 2.1 shows the screenshot of the old program, used in the company Uhtuatalo Oy.

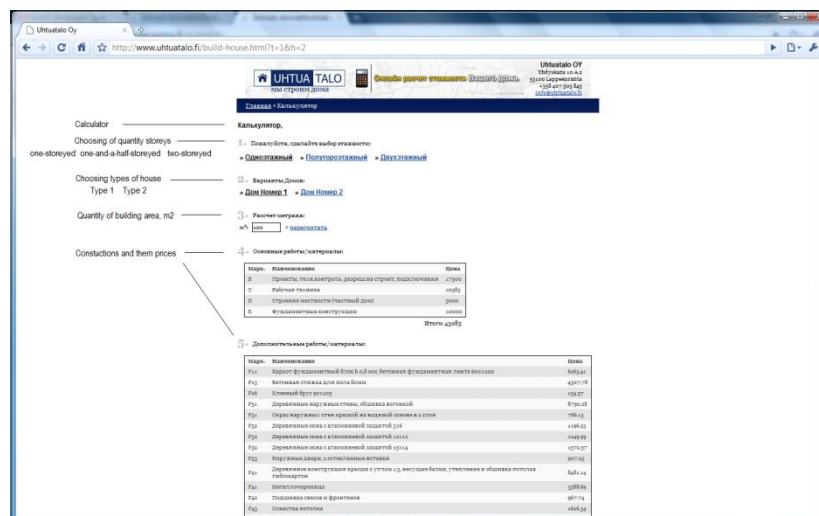


Figure 2.1 Old program screenshot

The program gave a possibility to choose one of the six house types. Every type differed from others by the number of storeys and material. Also using this program a visitor could change the house area and received recalculated price. The main disadvantage of this program was an impossibility to update the estimation specification. Also this specification could work only with a readymade specification and had no data base of building materials.

The company management analyzed these disadvantages and decided to create a new version of the program, which can meet the demands. Also this new version contained inner database of structures and materials.

2.2 Target setting

The definition phase started from a trilateral meeting. The participants of this meeting were company's director, company's programmer and me. The aim of the meeting was to conclude the key parts of the program and distribution of tasks for every participant. It was necessary to discuss program interface, development of the program environment, main program functions and program evolution.

PHP+MySQL were chosen in the capacity of the program language for several reasons:

- This computer language is pretty simple. Therefore, this language makes it possible to learn the most functions in a short term of time
- PHP's programs can be used on the Internet without a local installation in each personal computer. To use the program it is necessary to only have an internet connection.

For successful realization it was decided by the company to divide the program into two parts:

- Inner version, which will be used for detail calculations of every house
- User version, which will be used by company site's visitors for preliminary price calculations.

On the meeting program functions were worked out and function borders were defined. During the development some functions were changed and program borders were broadened, but it was important to define the main functions at the beginning for correct estimation of execution time.

Also on the meeting, base types of houses were chosen. The base types of houses will be used in both versions of the program (inner and user versions). These types differ in materials and number of storeys. Other types of houses are not popular and will not be used.

By materials:

- timber house
- brick house.

By number of storeys:

- one-storey house
- one-and-half storey house
- two-storey house.

3 PRELIMINARY WORK

The first phase of work – preliminary work – started after the definition phase.

This phase included several stages:

- confirmation of language
- development of program algorithm
- development of preparatory programs
- study of program language – PHP+MySQL.

3.1 Confirmation of language

The choice of language occurred on the trilateral meeting. Language of the program was chosen from languages, which were used by the company's programmer or me earlier. These variants included:

- Delphi
- Microsoft Excel (Visual Basic Application)
- C/C++
- PHP+MySQL.

PHP+MySQL have more advantages than other languages. Programs on PHP can be used on the Internet without installation in local computers. This advantage tipped the scale to the PHP direction. It was decided that the greater part of the program would be written on PHP+MySQL.

Before program writing, it was necessary to organize and delimit function borders of the program. A Microsoft Excel application was chosen for it, because of simple structure and high-performance mathematical apparatus.

3.2 Development of program algorithm

Development of program algorithm is one of the most important stages in writing programs. On this stage it was necessary to estimate the borders of the program, define and optimize program actions. Possible mistakes on this stage can lead to loss of time in the future.

The structure of house elements was defined at the beginning of this stage. It was decided to use a three-level system of elements. This system predetermined that each element of the house was included in a parent group and each parent group was included in a parent object. A visual scheme of this structure can be seen on Figure 3.1.

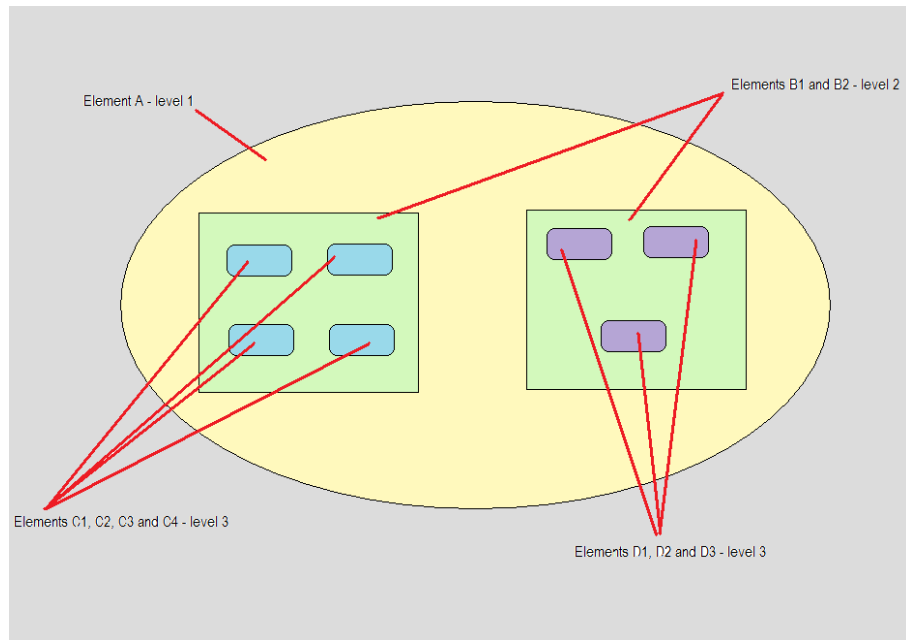


Figure 3.1 Three-level system of elements

Figure 3.1 shows relationships between objects, groups and elements. Elements C1-C4 and D1-D3 are common elements of the house. Elements C1-C4 are included in the parent group B1, and elements D1-D3 are included in the parent group A B2. The element A (orange oval) is a parent object and includes two groups B1 and B2. It is not clear without a real example.

For example:

- level 1 – frame
- level 2 – internal walls, external walls
- level 3 – internal wall №1, internal wall №2, external wall №1, external wall №2.

«Frame» is a parent object and includes two parent groups: «internal walls» and «external walls». Each parent group includes common elements: the group «internal walls» includes such elements as «internal wall №1» and «internal wall №2», and the group «external walls» includes such elements as «external wall №1» and «external wall №2».

Possible complications of the structure are conditioned by difficulties with stock of elements. The program should save a database with elements from different houses and should not lose them, because each program user should have possibility to input, edit and delete elements. For organization of this process a three-level system is used.

The calculation of the cost is possible only for common elements. The cost of groups and objects is calculated as a summary cost of the included elements. The total cost of the house is a summary cost of the elements included in the house. An extra result of calculation is the total specification of elements and their costs.

Also it was necessary to link the inner version to the user one. The final specifications can be created and corrected only in the inner version. The user version makes it possible to browse the final specifications, created in the inner version. This approach links the inner version to the user one.

3.3 Development of preparatory programs

The preliminary phase of the thesis was used for definition with required mathematical functions. The Microsoft Excel application was used for the elaboration of mathematical functions used in the program. Preliminary elaboration makes it possible to specify and improve the mathematical apparatus of the program.

Future program in Microsoft Excel was tried to be realized. The calculation process was realized through three tables:

- The first table was used for the calculation of finishing in the house. This table can be seen in Figure 3.2;

Nr	Name of room	m2	Floor	m2	Price €	Wall	m2	Price €	Ceiling	m2	Price €
101	Makuuhuone 1	9,00	tammiparketti	9,00	15,00	paneeli+saunasuoja	36,00	45,00	maalaus	9,00	15,00
102	Makuuhuone 2	9,20	tammiparketti	9,20	15,00	paneeli+saunasuoja	36,00	23,00	maalaus	9,20	15,00
103	Tuulikappi	2,20	laatoitus, kuivat tilat	2,20	20,00	paneeli+saunasuoja	11,30	52,00	alakato+maalaus	2,20	20,00
104	WC	2,20	laatoitus, kuivat tilat	2,20	10,00	paneeli+saunasuoja	13,30	12,00	maalaus	2,20	10,00
105	Halli	7,90	laatoitus, kuivat tilat	7,90	20,00	laatoitus	24,00	121,00	alakato+maalaus	7,90	20,00
106	Keittiö	17,30	laatoitus, kuivat tilat	17,30	20,00	paneeli+saunasuoja	42,00	12,00	maalaus	17,30	20,00
107	Olohuone	34,90	tammiparketti	34,90	15,00	paneeli+saunasuoja	60,80	12,00	maalaus	34,90	15,00
108	Makuuhuone 3	10,00	tammiparketti	10,00	15,00	maalaus	42,90	12,00	maalaus	10,00	15,00
109	Makuuhuone 4	10,70	tammiparketti	10,70	15,00	paneeli+saunasuoja	42,90	1,00	maalaus	10,70	15,00
110	Tekninen tila	6,90	muovimatto	6,90	10,00	paneeli+saunasuoja	26,40	56,00	maalaus	6,90	10,00
111	Varasto	11,00	muovimatto	11,00	10,00	laatoitus	31,90	35,00	maalaus	11,00	10,00
112	Pesuhuone	6,70	laatoitus	6,70	10,00	paneeli+saunasuoja	22,00	35,00	paneeli+lakkaus	6,70	10,00
113	Löylyhuone	5,90	laatoitus	5,90	10,00	paneeli+saunasuoja	22,00	35,00	paneeli+saunasuoja	5,90	10,00
114	Pukuhuone	18,80	laatoitus, kuivat tilat	18,80	20,00	paneeli+saunasuoja	34,00	35,00	maalaus	18,80	20,00
115		0,00	laatoitus	0,00	10,00	paneeli+saunasuoja	0,00	56,00	alakato+maalaus	0,00	10,00
116		0,00	laatoitus	0,00	10,00	paneeli+saunasuoja	0,00	46,00	alakato+maalaus	0,00	10,00
117		0,00	laatoitus	0,00	10,00	paneeli+saunasuoja	0,00	48,00	paneeli+lakkaus	0,00	10,00
118		0,00	laatoitus	0,00	10,00	paneeli+saunasuoja	0,00	12,00	paneeli+saunasuoja	0,00	10,00
119		0,00	laatoitus	0,00	10,00	paneeli+saunasuoja	0,00	23,00	paneeli+saunasuoja	0,00	10,00
120		0,00	laatoitus	0,00	10,00	paneeli+saunasuoja	0,00	57,00	alakato+maalaus	0,00	10,00
Sum		152,70									
Total sum				m2	€		m2	€		m2	€
			laatoitus	12,6	80,00	maalaus	42,9	12,00	maalaus	140,1	145,00
			laatoitus, kuivat tilat	48,4	90,00	laatoitus	55,9	156,00	paneeli+saunasuoja	5,9	30
			tammiparketti	73,8	75,00	paneeli+saunasuoja	346,7	560,00	paneeli+lakkaus	6,7	20
			muovimatto	17,9	20,00						
			Floor sum	152,70	265,00	Wall sum	445,5	728,00	Ceiling sum	152,7	195,00

Figure 3.2 The table for the calculation of finishing

Every row in the table corresponded to one room in the house. The row contained information about material of finishing, area of finishing and cost of finishing. The table calculated the finishing of floor, walls and ceiling in each room and their total values.

- The second table was used for the calculation of elements in the house. This table consists of small parts, used for the calculation of each element: walls, roofing system, floors, foundation, windows and others. Small part for the calculation of windows can be seen in Figure 3.3;

Ikkunat /Окна/Windows						
Выбор типа по материалу/ Type by material	Количество/ Quantity	Тип/Type	Стоимость окна (выбрать из списка), € / Price	Стоимость окна (здать самому), €/Own price	Стоимость работ и сопутствующих материалов/ Working price	Окончател ьная стоимость/ Total price
Puu-alumiini-ikkunat	1	puualumiini-ikkuna, MSE/AL, 12x12, valk. maalatu	395,00	0,00	48,42	443,42
Puu-alumiini-ikkunat	1	puualumiini-ikkuna, MSE/AL, 12x12, valk. maalatu	395,00	0,00	48,42	443,42
Puu-alumiini-ikkunat	1	puualumiini-ikkuna, MSE/AL, 3x6, valk. maalatu	395,00	0,00	48,42	443,42
MSE-puuikkunat	1	puuikkuna, MSE, 3x12, valk. Maalattu	377,00	0,00	48,42	425,42
MSE-puuikkunat	1	puuikkuna, MSE, 12x16, valk. Maalattu	377,00	0,00	48,42	425,42
MSE-puuikkunat	1	puuikkuna, MSE, 12x16, valk. Maalattu	377,00	0,00	48,42	425,42
MS-puuikkunat	1	puuikkuna, MS, 6x6, valk. Maalattu	377,00	0,00	42,11	419,11
MS-puuikkunat	1	puuikkuna, MS, 6x6, valk. Maalattu	377,00	0,00	42,11	419,11
MS-puuikkunat	1	puuikkuna, MS, 6x6, valk. Maalattu	377,00	0,00	42,11	419,11
Metalli-ikkunat	1	metalli+ikkuna, teräsrunko 12x12, maalattu	756,00	0,00	74,37	830,37
Metalli-ikkunat	1	metalli+ikkuna, teräsrunko 12x12, maalattu	756,00	0,00	74,37	830,37
Metalli-ikkunat	1	metalli+ikkuna, teräsrunko 6x12, maalattu	756,00	0,00	74,37	830,37
					Итого/Sum:	4694,22

Figure 3.3 The table for the calculation of windows

Every row in this table corresponded to one type of window. Each type of window is unlike any other type by material or dimensions. One row calculated the total cost of one type. If the house included several types of elements, the table calculated the total cost of windows as the sum of costs.

- The third table was used for the calculation of the total cost of the house. This table can be seen in Figure 3.4.

Метраж / Area	120 m2
Стоимость дома / Price	118238 €
Наименование / Name	Цена / Price
Проекты, техн.контроль, разрешение на строительство / Project	3000
Подготовка территории / Preparing work	10585
Камин / fireplace	3000
Дымоход / flue	800
полки сауны / sauna equipment	300
Сантехника / Plumbing	1000
Мебелировка / Furniture	4000
Канализационная система / Water carriage	4500
Вентиляционная система / Ventilation	2500
Электрoфикация / Electricity	7000
Отопление / Firing	3000
Стены наружные / External walls	13330
Стены внутренние / Internal walls	4268
Фундамент / Foundation	10400
Нижнее перекрытие (пол) / Ceiling floor	8080
Крыша / Roof	17706
Окна / Windows	4261
Двери наружные / Entrance doors	1576
Двери внутренние / Inner doors	2067
Отделка / Decking	16864

Figure 3.4 The table for the calculation of the total cost

This table listed all elements included in the house. Also this table made reference to the two previous tables and contained the values of costs from them. It was possible to recalculate the total cost of the house in subjection to the area. This table was the prototype of the future program on PHP.

These three tables gave a possibility to specify the mathematical functions of the program and to see the total process of calculation.

3.4 PHP+MySQL

PHP is a widely used, general-purpose scripting language that was originally designed for web development to produce dynamic web pages [Wikipedia, PHP].

PHP is one of the most popular computer languages such as C or JAVA. PHP can be used together with MySQL system. MySQL is a relational database management system, which is used for saving, selection and outputting data base of the site. Using of PHP and MySQL can give good results for creating simple web projects. PHP is progressing fast. Actual information about PHP functions can be found out on official sites [MySQL et al.].

3.5 Summary of preliminary works

During the preliminary period a lot of important issues were done. There were confirming of language, development of program algorithm and preparatory programs. This phase took a lot of time, but also saved time in the future.

After the preliminary period a culmination phase started. The culmination phase consisted of program writing and filing of database. For program writing special computer literature was used. For creation of database it was necessary to use Finnish cost lists such as Rakennusosien kustannuksia 2009.

4 CONSTRUCTION COSTS

Finnish construction price lists for the definition of costs are used by most Finnish building companies on the building market. One of Finnish construction price lists is a handbook *Rakennusosien kustannuksia 2009*. This book is published every year and includes actual construction costs.

Using *Rakennusosien kustannuksia 2009* is not principal for the company Uhtuatalo Oy. The company defines actual construction costs not only with *Rakennusosien kustannuksia 2009*, but also using other price lists and analyzing today's situation on the building market.

During thesis writing, the handbook *Rakennusosien kustannuksia 2009* was used. At that moment it was not out of date, but the cost of each element was required to be checked.

4.1 Rakennusosien kustannuksia 2009 in brief

Rakennusosien kustannuksia 2009 is a big construction price list. This price list includes costs of materials, costs of work and labour inputs. Extra information about e.g. weight of elements, their acoustic opacity and fire resistance can be also found out.

The book includes all elements, which are used in low-rise houses. There are:

- internal walls
- external walls
- floors
- foundations
- roofs
- windows
- doors
- stairs and others.

If the element has several layers (for example, walls), the cost of each layer and total cost of elements can be found out. At the end of the book authors presented some examples of preliminary calculations for one-and-half storey and two-storey houses.

4.2 Using Rakennusosien kustannuksia 2009 in the program

Rakennusosien kustannuksia 2009 was one of the most useful books in this work. It influenced the structure of the program, especially the input form. Figure 4.1 presents the output form of the cost for each element. It was decided to use the same structure, which would include material costs, labor costs and extra costs.

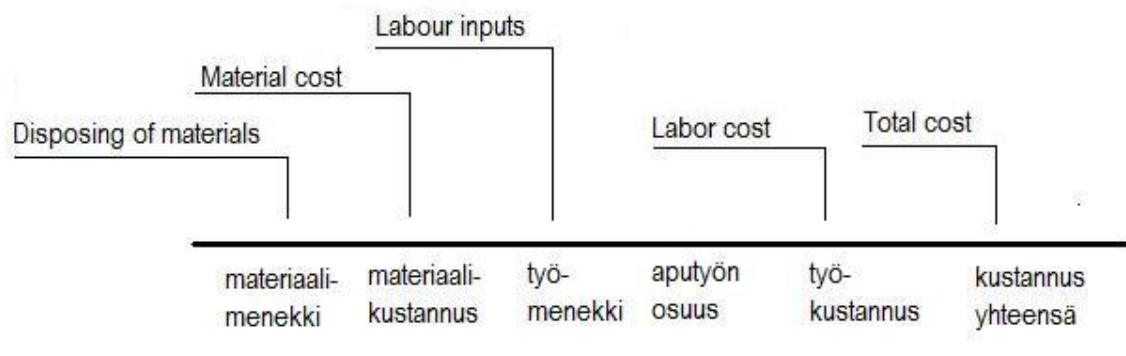


Figure 4.1 Output form of cost

As shown in Figure 4.1, the output form of costs in Rakennusosien kustannuksia 2009 includes the following items: disposing of materials, material cost, labour inputs, labor cost and total cost. The output form of costs in the program includes only material cost, labor cost, extra costs, quantity of elements and total cost.

The calculation of the total cost in Rakennusosien kustannuksia 2009 is divided into two parts. The first part is the calculation of finishing and the second part is the calculation of elements. Finishing is the most revised parameter. The program will be easy-to-use when the user has an ability to change finishing

without changing structural elements. Therefore it was decided to use the same structure in the program.

5 USAGE OF THE FINAL PROGRAM

The final program has two versions: inner and user versions. The user version is used by visitors on the web site of the company. This version can calculate the preliminary price of the house for customers. If the visitor is interested in a detailed calculation, he can call the company. The detailed calculation of the house will be done by the company management in concordance with wishes of the client. The inner version of the program will be used for the detailed calculation.

Appendix 1 includes information about functions and structure of the program. This manual was made on 29th March 2010. All updates of the program after this date are not included in Appendix 1.

5.1 Main principles of the program

The final program includes two versions: inner and user versions. The inner version is used for calculating the costs of the house inside the company. The user version is used on the web site for primary introduction of visitors with prices in the company. Both versions contain similar houses, but the inner version contains more detailed calculation than the user version. The inner version contains information about special factors, which raise the total cost of the house and give benefits to the company.

The inner version contains information about the cost of each element: cost of materials, cost of works, extra costs, special factor and total cost. Positions as cost of materials, cost of works and extra costs are formed on the basis of Rakennusosien kustannuksia 2009 and the experience of the company. The formation of costs is a process where a ready value of the cost is checked in concordance with the real cost on this element at that moment.

The values of cost of materials, cost of works and extra costs are inputted without additional benefits for the company. The company benefits by regulation of a special factor. The total price of elements for customers is calculated as the

total cost of elements for the company multiplied by special factor. If a special factor is less than unity, the total price of the element for customers will be less than the total cost of the element for the company and the company will suffer losses in this case. Special factors are regulated by the company for each element. It makes it possible to regulate the benefits of the house separately by each element.

5.2 Inner version

The main advantage of the program is a possibility to calculate the cost of the house in details. It is possible to input the costs of readymade composite structures or costs of each component. The final specification can be very detailed. In this case the specification can be used in the capacity of a real estimate of the house.

All components of the house are structured in parent groups, and all parent groups are structured in parent objects. It was done for the improvement of program usability. Main parent objects are:

- frame
- foundation
- roof
- finishing
- extra.

The program has a possibility to create new parent objects, if needed.

Every calculation of the house starts from design. In the project, the types of elements and geometry of the house: areas, perimeters and ceiling height in each room were exactly known. Exactness of the project corresponds to the exactness of calculation.

The process of calculation starts from the program element «Rooms» (the parent object of this element is «Finishing»). At first it is necessary to input house rooms with their geometry: areas, perimeters and ceiling heights. Every

room has the inner finishing of the floor, walls and the ceiling. It is necessary to input each kind of the finishing in the specification.

Formulas 5.1 – 5.10 show how to calculate the finishing of internal surfaces.

$$\text{Total floor finishing (cost for the company)} = (m + w + e) * a * f \quad (5.1)$$

$$\text{Total floor finishing (price for customers)} = (m + w + e) * a \quad (5.2)$$

$$\text{Total border floor (cost for the company)} = (m + w + e) * p * f \quad (5.3)$$

$$\text{Total border floor (price for customers)} = (m + w + e) * p \quad (5.4)$$

$$\text{Total walls finishing (cost for the company)} = (m + w + e) * p * c * f \quad (5.5)$$

$$\text{Total walls finishing (price for customers)} = (m + w + e) * p * c \quad (5.6)$$

$$\text{Total ceiling finishing (cost for the company)} = (m + w + e) * a * f \quad (5.7)$$

$$\text{Total ceiling finishing (price for customers)} = (m + w + e) * a \quad (5.8)$$

$$\text{Total border ceiling (cost for the company)} = (m + w + e) * p * f \quad (5.9)$$

$$\text{Total border ceiling (price for customers)} = (m + w + e) * p \quad (5.10)$$

In formulas 5.1 – 5.10 the following marks were used: m - cost of material, w - cost of works, e - extra cost, a - area of the room, f - special factor, p – perimeter of the room, c – ceiling height of the room. The special factor is the value, which can regulate the total cost of the element according to conditions. The total area of the house is calculated automatically as the summary area of rooms included in the house.

When the input of finishing is completed, it is possible to input other elements of the house. It is important to understand if the element depends on the area. If the element depends on the area, it is necessary to input the cost of the element per square meter of the house. If the element does not depend on the area, it is necessary to input the quantity of elements and a cost per unit.

Formulas 5.11 and 5.12 show the calculation of the total cost and total price, if the element does not depend on the area.

$$\text{Total element cost} = (m + w + e) * a \quad (5.11)$$

$$\text{Total element price} = (m + w + e) * a * f \quad (5.12)$$

Formulas 5.13 and 5.14 show the calculation of the total cost and total price, if the element depends on the area.

$$\text{Total element cost} = (m + w + e) * q \quad (5.13)$$

$$\text{Total element price} = (m + w + e) * q * f \quad (5.14)$$

In formulas 5.11 - 5.14 the following marks were used: m - cost of material, w - cost of works, e - extra cost, a - area of the room, f – special factor, q – quantity of units. The special factor is the value, which can regulate the total cost of the element according to conditions. The total cost of the house is calculated automatically as the summary cost of elements included in the house. Also the total price of the house is calculated as the summary price of elements included in the house.

5.3 Testing

For testing the program a typical house was chosen. It was a one-storey house including typical elements. The drawings of this house can be seen in Appendix 2. These drawings consist of facades, section and plan of the house. Following the drawings, all components were input in the program. The result of calculation was the specification of the elements and their costs. This specification can be seen in Appendix 3. The specification consists of five blocks: finishing, frame, foundation, roof and extra. Each block is the parent object in the program. Each block includes its own components with their costs: cost of material, cost of works, extra costs. The total costs of the block are found after each block. The list of blocks finishes by total results of calculation: area, total cost and square meter cost of the house.

This full specification was a base for the user specification, where it was possible to change an area and monitor the cost of the house. Appendix 4

contains a complete user specification. The user specification consists of block names with costs. This specification is the short version of the full specification.

The total cost of the house in the user specification is 134595 €. It is less than the total cost in the full specification (136191 €). The difference is 1.17 %. The reason is the inaccuracy of rounding in the program.

A change of the area makes it possible to monitor costs of the house. The Chart 5.1 shows a graph of total cost versus area for this house. This diagram was draw point by point. The values of the total cost and area were received from the user version of the program. This dependence (Total cost - Area) is a direct proportion.

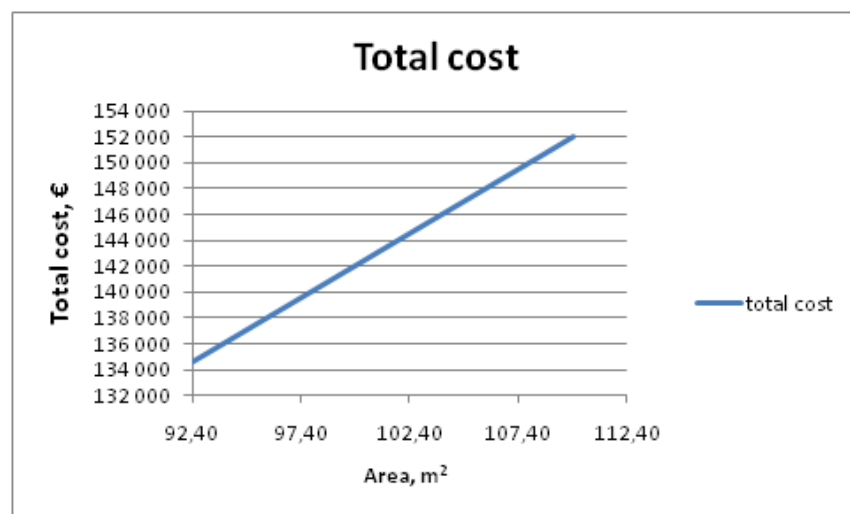


Chart 5.1 Graph of total cost versus area

The values of the area change in the range from 92.4 to 109.9 m². The graph is valid only for this diapason, because if the house has the greater area, extra elements such as extra windows, doors need to be included. These extra elements should be taken into account. Formula 5.8 describes the graph of total cost versus area.

$$y = k \cdot x + b \quad (5.8)$$

In formula 5.8 the following marks were used:

y – the total cost of the house;

- k – the sum of total costs of all elements, depending on the area;
- b – the sum of total costs of all elements, not depending on the area;
- x – the area.

By analogy with the diagram of total cost versus area, it is possible to draw a diagram of total cost per square meter versus area. Chart 5.2 shows a graph of total cost per square meter versus area.

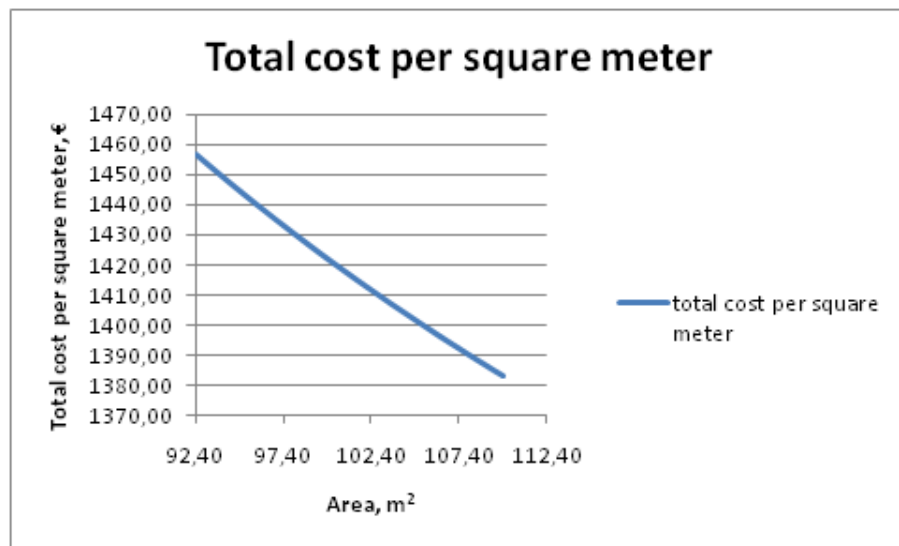


Chart 5.2 Graph of total cost per square meter versus area

The graph on the chart 5.2 is the hyperbolic curve and it can be described by formula 5.9.

$$y = b/x + k \quad (5.9)$$

In formula 5.9 the following marks were used:

- y – the total cost per square meter;
- k – the sum of total costs per square meter of all elements, depending on the area;
- b – the sum of total costs of all elements, not depending on the area;
- x – the area.

It is possible to draw a graph for each type of house. They will differ only in a number exponent, but types of diagrams will be the same as on charts 4.1 and 4.2. The main conclusions are as follows:

- the total cost of the house increases in direct proportion to the area;
- the total cost per square meter decreases in hyperbolic proportion to the area.

5.4 Future plans

At the present time the company Uhtuatalo Oy is satisfied with the program, because each starting idea was realized. But during program writing new ideas appeared, which were not realized in the final version. Life prompts the best variants of updates and this program is not an exception.

Probably future updates will be as follows:

- calculation of costs of separate works without links to the full object (for example, only finishing or foundation works);
- calculation of the total cost of public or industrial buildings;
- creation of price list of the company's own services.

6 COMPARISON OF WEB CALCULATORS

The price calculating program (calculator) is not a prime program of the company. The company Uhtuatalo Oy has an experience in the development and usage of its own applications, used on different stages of building. Because of this, the company has an advantage in competition on the building market. Not only the company Uhtuatalo Oy, but also other companies in Finland and abroad use their own applications as web calculators. It is possible to compare this version of calculator with others. Of course, comparison is possible for public versions (only in our case for the user version).

6.1 Calculator of the price from the company PolarSIP

The company PolarSIP designs and manufactures fast-erecting houses by Canadian technology in Russia and abroad. The company PolarSIP offers for the following calculator on the Internet (can be seen on figure 6.1).

Калькулятор стоимости (расчет индивидуального дома) - Омега

http://www.polarsip.ru/prices/calc.php

Строителям > Продажа панелей со склада По Специальным Ценам*

Представителям > Развиваем региональную сеть Узнайте Условия*

Клиентам > Полный цикл строительства (дома под ключ)*

Возможности

- Кодирование
- Индивидуальное проектирование
- Производство в регионе
- Логистика
- Строительство

Статьи

Пенополиурол и здоровье

Основные принципы планировки оптимального загородного дома

События

Проект "Мелочеве семья"

В мае 2009 года компания «PolarSIP» впервые начала строительство коттеджа, участвуя в целевой программе для молодых семей.

PolarSIP открывает новый офис

В городе Москва 12 мая 2009 года открылся новый офис Петербургской строительной компании «PolarSIP».

В Москве прошла выставка Mosbuild-2009

С 31 марта по 3 апреля в г. Москва состоялась Международная строительная выставка Mosbuild. Как сообщает организаторы, на протяжении 15 лет выставка Mosbuild — крупнейшее в Москве событие среды профессиональных выставок строительной и интерьерной отрасли.

Где строить? Что строить? Из чего строить?

20 августа 2008 года в Москве в

Калькулятор стоимости (расчет индивидуального дома)

Площадь 1-го этажа м² 1st floor area

Площадь 2-го этажа м² 2nd floor area

Высота потолков м Ceiling height

Сложная архитектура крыши Roof architecture

Стоимость изготовления комплекта дома руб. Price of materials

Стоимость монтажа комплекта дома руб. Price of works

Итого руб. Total price

Figure 6.1 Calculator from the company PolarSIP. Red text in red frame is a translation in English

The calculator is very clear and simple. It makes it possible to calculate the price of the house very fast. The visitor should choose areas of 1st and 2nd floors, ceiling height and architecture of the roof. The final result of calculation consists of total price of materials, total price of works and total price of the house.

Also this calculator has several disadvantages:

- It is unknown which positions will be included in «price of material» or «price of works»
- It is unknown how extra costs (for example, delivery) are taken into account
- Option «Roof architecture» is unclear: visitor can only confirm or cancel this option.

6.2 Calculator of the price from the company Stroitel

The company Stroitel builds log houses in Moscow and nearest regions. Figure 6.2 shows a screenshot from the web site of the calculator.

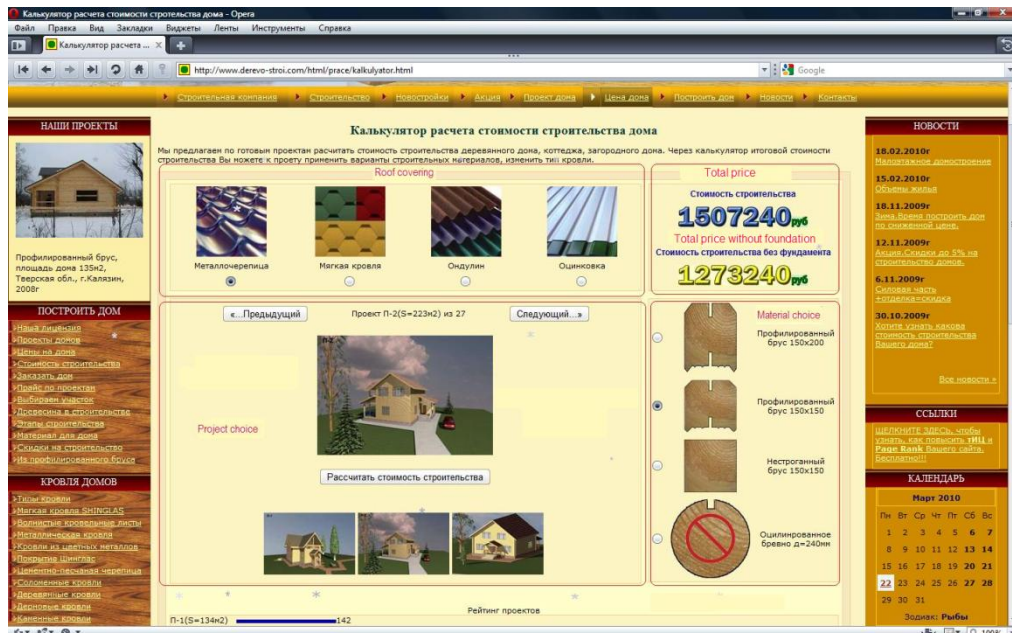


Figure 6.2 Calculator from the company Stroitel. Red text in red frame is a translation in English

The calculator on Figure 6.2 can help to choose roof material, type of logs and typical project of the house. The final result of calculation consists of total price of the house and total price of the house without price of foundation. This calculator is a very easy-to-use program and has a simple interface, but also it has one disadvantage: it is impossible to choose the area of the house.

6.3 Calculator of the price from the web site <http://www.rakentaja.fi/>

The calculator on the web site <http://www.rakentaja.fi/> stands out against a background of other analogs. The screenshot of this calculator can be seen on Figure 6.3. This calculator is distinct from others in the quantity of selected options.

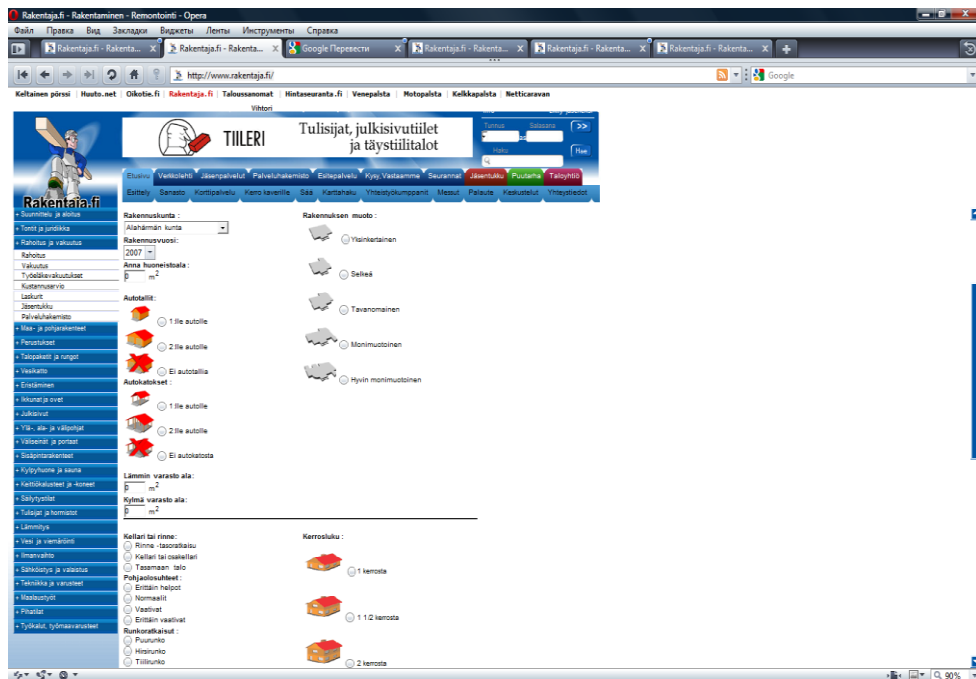


Figure 6.3 Calculator from the web site <http://www.rakentaja.fi/>

The calculator in Figure 6.3 calculates a preliminary price of the house after choosing following parameters:

- area
- quantity of storeys
- roofing system
- availability of a garage
- material of walls
- materials of finishing and others.

If a client wants to get an exact result, he must buy a full version of the calculator. That system orients only to the sales of the program, not to building.

6.4 User version of the Uhtuatalo Oy program

The user version of the Uhtuatalo Oy program is a calculator of the prices of houses. This calculator was realized in two languages: Russian and English. The screenshot of the calculator can be seen in Figure 6.4.



Figure 6.4 My program calculator

This calculator can help to choose frame material (timber or brick), quantity of storeys (one-storey house, one-and-half storey house or two-storey house) and the area of the house. At the present time a visitor has a possibility to choose one of the six types of houses. Types of houses are:

- timber, one-storey
- timber, one-and-half storey
- timber, two-storey
- brick, one-storey
- brick, one-and-half storey
- brick, two-storey.

After choosing, a client will receive the total price and the total price per square meter. Also the client will receive a small specification of elements with their prices. The screenshot of this specification can be seen in Figure 6.5.

Total price 142151 €				
Square meter price 1422 €				
Name	Price of works, €	Price of materials, €	Extra costs, €	Total price, €
<i>Frame</i>	5500	5500	2500	13500
<i>Foundation</i>	8000	6000	2000	16000
<i>Roof</i>	10000	4000	1000	15000
<i>Finishing</i>				
Floor finishing	1241.34	1329.55	620.89	3191.78
Floor border	859.31	859.31	620.89	2339.5
Wall finishing	5956.71	6411.26	5161.26	17529.23
Ceiling finishing	1129.87	676.95	217.42	2024.24
Ceiling border	2027.06	633.55	171.86	2832.47
<i>Extra</i>				
puualumiini-ikkuna, MSE/AL, 6x6, valk. maalatu	19.31	188	10	217.31
puualumiini-ikkuna, MSE/AL, 15x14, valk. maalatu	161.1	1735	50	1946.1
puualumiini-ikkuna, MSE/AL, 6x12, valk. maalatu	19.31	227	10	256.31
puualumiini-ikkuna, MSE/AL, 12x12, valk. maalatu	18.55	281	10	309.55
ulko-ovi, 10x21, valkoinen, 1 lasiaukko	69.86	1080	20	1169.86
Sisäovi, palo-ovi, 10x21, puu	130.98	1344	60	1534.98
Project, technical control	3000	0	0	3000
Preparing building territory	10500	0	0	10500
Fireplace	3000	0	0	3000
Flue	1000	200	0	1200
sauna brench	50	250	0	300
Plumbing	300	1000	0	1300
Furniture	0	4000	0	4000
Water carriage system	500	4000	0	4500
Ventilation system	500	2000	0	2500
Electricity	2000	5000	0	7000
Firing	5000	25000	0	30000

Figure 6.5 Specification of elements

This specification is a mirror of a full specification in the inner version of the program. It is possible to update each specification on the web site using the inner version of the program.

7 SUMMARY

Using computer applications is an integral part of modern building. Computer applications save not only time, but also money. The development and using of the company's own computer programs make it possible to improve the building process and offer advantages in competition for the company. A lot of building companies in Finland and abroad understand this fact and order their own programs (for example, the company Honka).

The development of programs is a process, which requires not only knowledge in programming, but also knowledge in the area of program activity. In the absence of needed knowledge, the development of the program can last a long time. Success of the work also depends on the correct task planning.

During the thesis writing several goals were achieved:

- Calculation program of the price of houses was developed and tested in real life
- New system of working with clients was developed (joint use of the inner and user versions)
- Work promoted systematization of inner special information in the company (prices of materials, services).

One of the most important stages in the creation of program is testing. Testing of the program in real life showed several disadvantages, which would be corrected in the future:

- program design
- required education before usage (only for the inner version)
- an added insurance against hacker fraud.

The inner version of the program was intended for the calculation of the final cost of houses. It calculates the cost of the house as the summary cost of components. This version can be used for the calculation of any types of houses. It depends on the wishes of a user. The manual of this version in

Appendix 1 contains information about the inner functions and features of the program. Each part of the manual consists of screenshots with description.

The development of the program was a very difficult process for me. The development took a lot of time, but also gave me new work experience. I acquainted with Finnish norms and features of building.

FIGURES

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Figure 3.1 Three-level system of elements, p. 9

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Figure 2.1. Program screenshot. [Visited 29th March 2010]. Available <http://www.uhtuatalo.ru/build-house.html>

Figure 6.1. Calculator from the company PolarSIP on web site. [Visited 29th March 2010]. Available <http://www.polarsip.ru/prices/calc.php>

Figure 6.2 Calculator from the company Stroitel on web site. [Visited 29th March 2010]. Available <http://www.polarsip.ru/prices/calc.php>

Figure 6.3 Calculator from the web site <http://www.rakentaja.fi/>. [Visited 29th March 2010]. Available <http://www.rakentaja.fi/>

Figure 6.4. My program calculator. [Visited 29th March 2010]. Available http://calcdom.ru/user_calculator_site/user_page.php

Figure 6.5. Specification of elements. [Visited 29th March 2010]. Available http://calcdom.ru/user_calculator_site/user_page.php

Appendix 1 Manual of the program for calculation cost of houses

1 INTRODUCTION

The program was intended for the calculation of final costs of houses. The program calculates cost of the house as a summary cost of components. It is possible to use an inner reference book for calculation of cost of component, or input own components. This program can be used for calculation of any types of houses. It depends on wishes of a user. The manual of the program for calculation housing cost contents information about inner functions and features of the program. Each part of the manual consists of screenshots with description.

2 STARTING PAGE

Figure 2.1 shows starting page of the program.

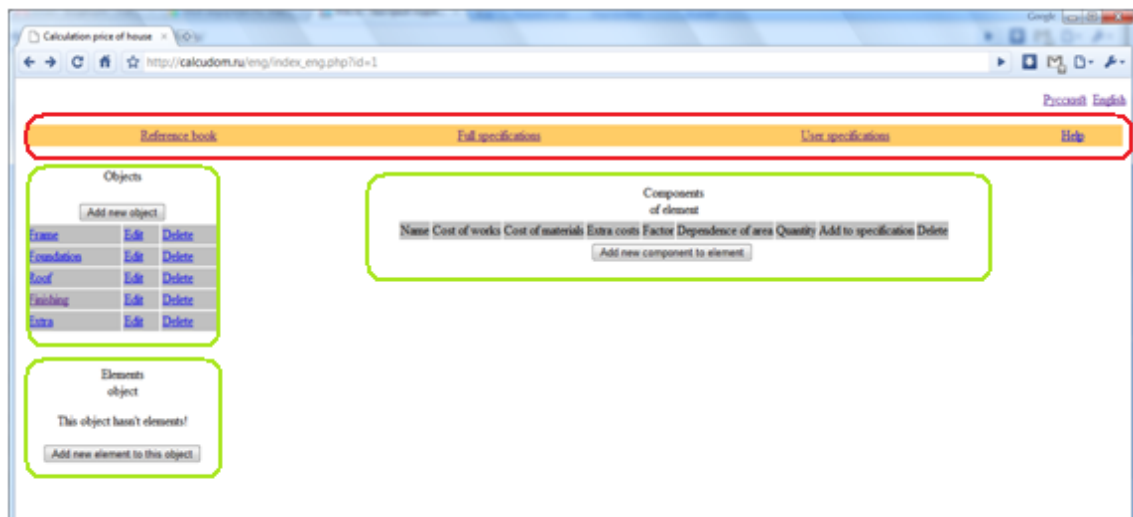


Figure 2.1 Starting page of the program

At the top of this page a main menu of the program can be seen (in red frame on figure 2.1). A base field of the page can be seen below the main menu. The base field was divided into three blocks: objects, elements of the object and

components of the element (in green frames on figure 2.1). Each menu item and block of the base field will be described separately.

3 MENU ITEM «REFERENCE BOOK»

Figure 3.1 shows the page after click on the link «Reference book».

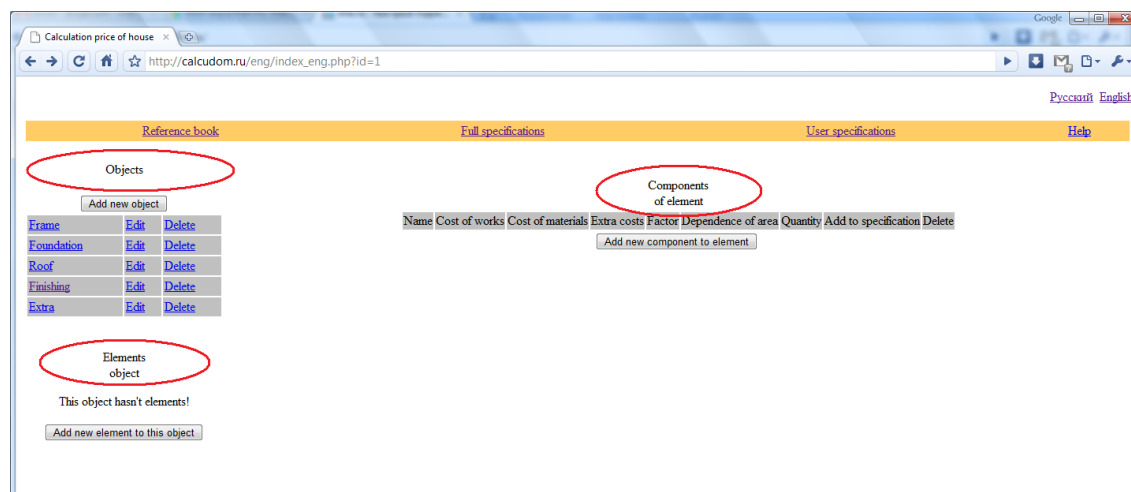


Figure 3.1 The page after click on the link «Reference book»

In the body of page three separate blocks can be seen: objects, elements of the objects and components of the element (every block is marked by red color on figure 3.1). Three blocks depend on each other. High level of the «reference book» is objects; middle level is elements of the object and lower level – components of the element. How it can be noticed from names: elements belong to objects and components belong to elements. This structure was defined in the chapter of thesis «Description of the program». In our example (on figure 3.1) only block of objects was opened. Phrase “This object hasn’t elements!” means that chosen object has not elements or no object was chosen.

3.1 The block «Objects»

Figure 3.2 shows the block «Objects».



Figure 3.2 The block «Objects»

This block consists of the button «Add new object» and a small table with three columns. The first column contains name of each object: for example, Frame, Foundation, Roof, Finishing and Extra; the second column contains a link «Edit» and the third column contains a link «Delete». The link «Edit» can transfer on the page, where editing of a name of the object is possible. The link «Delete» can transfer on the page, where deletion of the object is possible.

3.1.1 The button «Add new object»

Figure 3.3 shows the page after click on the button «Add new object».

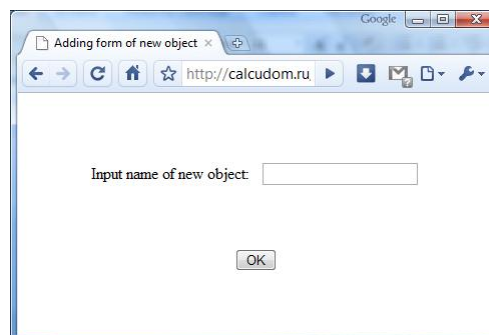


Figure 3.3 The page of creation of a new object

This page consists of a text field and the button «OK». The text field is used for input of a name of a new object. The button «OK» is used for entry approval

and should be clicked after input of a name. After click, the program will transfer to the starting page.

3.1.2 The block «Objects»: data output

This chapter describes a small table under the button «Add new object». The first column of the table contains names of objects. After click on the name all elements of this object will output in the block «Elements». For example, after click on the link «Frame», elements of this object (intermediate floor, internal walls and external walls) will be output (figure 3.4).

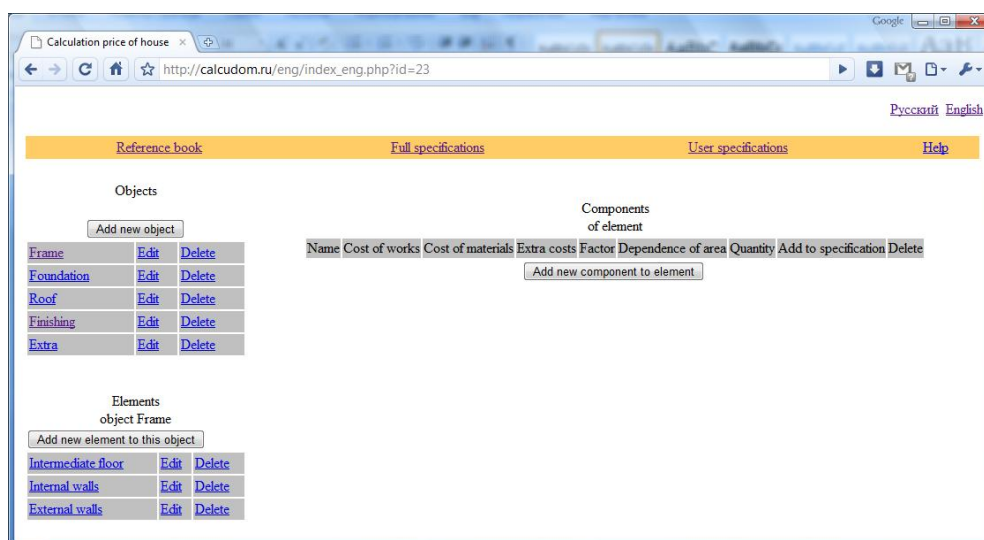


Figure 3.4 The page after click on the object name «Frame»

Figure 3.4 is a screenshot of the page after click on the object name «Frame». The block «Objects» consists of the button «Add new element to this object» and a small table with elements. The link «Edit» can transfer on the page, where editing of a name of the object is possible (see figure 3.5).

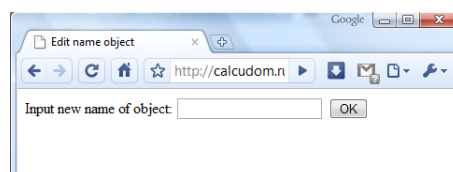
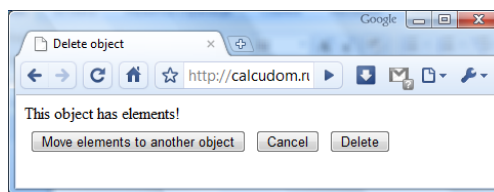


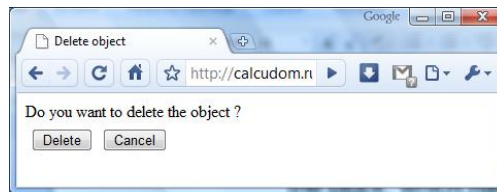
Figure 3.5 The page of editing

This page consists of a text field and the button «OK». The text field is used for input of a new name of the object. The button «OK» is used for entry approval and should be pressed after input of a name. After click, the program will transfer to the starting page.

The link «Delete» can transfer on the page, where deletion of the object is possible. But the page of deletion can have two types: the first one, when the object has elements (figure 3.6 a), and the second one, when the object has not elements (figure 3.6 b).



a) If the object has elements



b) If the object has not elements

Figure 3.6 The page of deletion

When the object has not elements (figure 3.6 b), it is possible to confirm deletion by click on the button «Delete» or cancel by click on the button «Cancel».

When the object has elements (figure 3.6 a), it is possible to confirm deletion by click on the button «Delete» or cancel by click on the button «Cancel». It is important to know that after click on the button «Delete», not only the object will be deleted, but also its elements will be deleted. If it is necessary to delete only the object and save elements in the database, the option «Move elements to

another object» should be used. After click on the button «Move elements to another object» the program will transfer on the page like on figure 3.7.

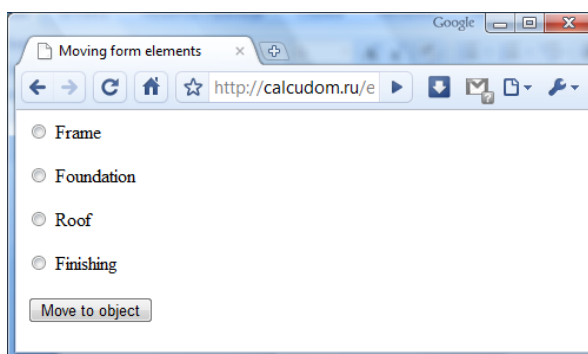


Figure 3.7 The page of remove

On this page it is required to choose the object, on which elements will be removed. The button «Move to object» is used for entry approval and should be pressed after choosing of the object.

3.2 The block «Elements»

Figure 3.8 shows the block «Elements».

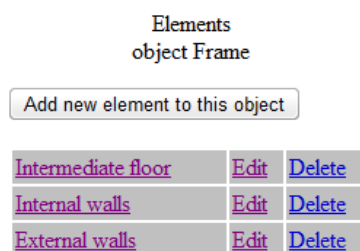


Figure 3.8 The block «Elements»

This block consists of the button « Add new element to this object» and a small table with three columns. The first column contains name of each element: for example, intermediate floor, internal walls, external walls; the second column contains a link «Edit» and the third column contains a link «Delete». The link «Edit» can transfer on the page, where editing of a name of the element is

possible. The link «Delete» can transfer on the page, where deletion of the element is possible.

3.2.1 The button «Add new element to this object»

Figure 3.9 shows the page after click on the button «Add new element to this object».

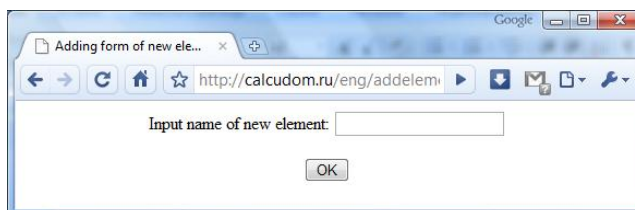


Figure 3.9 The page of creation of a new element

This page consists of a text field and the button «OK». The text field is used for input of a name of a new element. The button «OK» is used for entry approval and should be clicked after input of a name. After click, the program will transfer to the starting page.

3.2.2 The block «Elements»: data output

This chapter describes a small table under the button «Add new element to this object». The first column of the table contains names of elements. After click on the name all components of this element will be output in the block «Components». For example, after click on the link «Windows», components of this element («puualumiini-ikkuna, MSE/AL, 6x6, valk. Maalatu», «puualumiini-ikkuna, MSE/AL, 15x14, valk. maalatu» and others) will be output (figure 3.10).

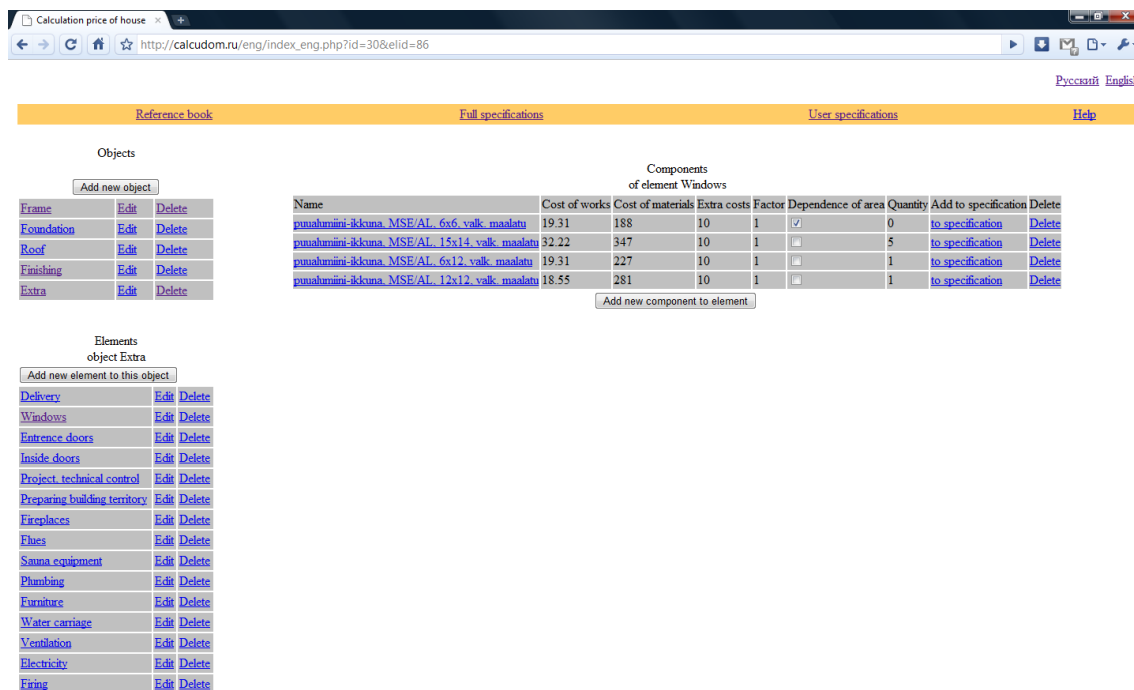


Figure 3.10 The page after click on the element name «Windows»

Figure 3.10 is a screenshot of the page after click on the element name «Windows». The block «Elements» consists of the button «Add new element to this object» and a small table with elements. The link «Edit» can transfer on the page, where editing of a name of the element is possible (see figure 3.11).

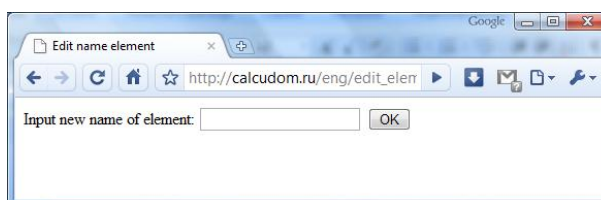
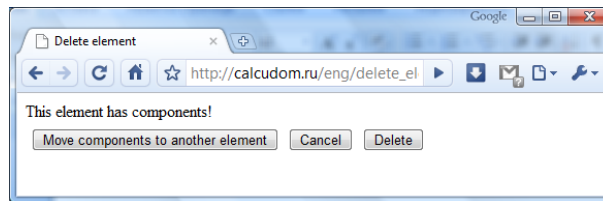


Figure 3.11 The page of editing

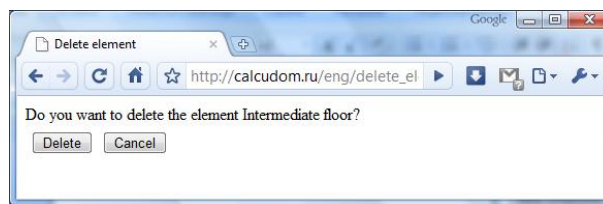
This page consists of a text field and the button «OK». The text field is used for input of a new name of the element. The button «OK» is used for entry approval and should be pressed after input of a name. After click, the program will transfer to the starting page.

The link «Delete» can transfer on the page, where deletion of the element is possible. But the page of deletion can have two types: the first one, when the

element has components (figure 3.12 a), and the second one, when the element has not components (figure 3.12 b).



a) If the element has components



b) If the element has not components

Figure 3.12 The page of deletion

When the element has not components (figure 3.12 b), it is possible to confirm deletion by click on the button «Delete» or cancel by click on the button «Cancel».

When the element has components (figure 3.12 a), it is possible to confirm deletion by click on the button «Delete» or cancel by click on the button «Cancel». It is important to know that after click on the button «Delete», not only the element will be deleted, but also its components will be deleted. If it is necessary to delete only the element and save components in the database, the option « Move components to another element » should be used. After click on the button « Move components to another element » the program will transfer on the page like on figure 3.13.

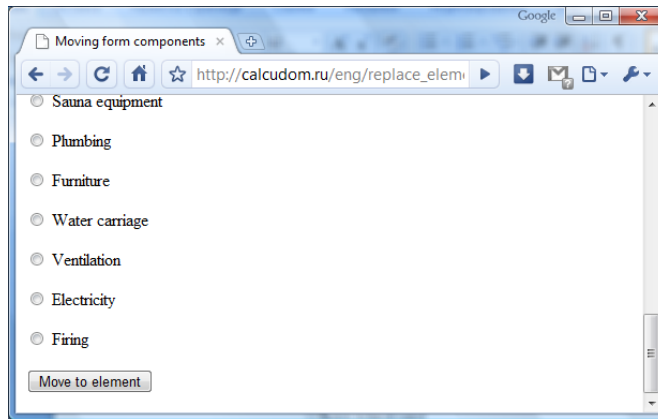


Figure 3.13 The page of remove

On this page it is required to choose the element, on which components will remove. The button «Move to element» is used for entry approval and should be pressed after choosing of the element.

3.3 The block «Components»

Figure 3.14 shows the block «Components».

Components
of element Windows

Name	Cost of works	Cost of materials	Extra costs	Factor	Dependence of area	Quantity	Add to specification	Delete
puualumiini-ikkuna_MSE/AL_6x6_valk_maalatu	19.31	188	10	1	<input type="checkbox"/>	3	to specification	Delete
puualumiini-ikkuna_MSE/AL_15x14_valk_maalatu	32.22	347	10	1	<input type="checkbox"/>	5	to specification	Delete
puualumiini-ikkuna_MSE/AL_6x12_valk_maalatu	19.31	227	10	1	<input type="checkbox"/>	1	to specification	Delete
puualumiini-ikkuna_MSE/AL_12x12_valk_maalatu	18.55	281	10	1	<input type="checkbox"/>	1	to specification	Delete

Add new component to element

Figure 3.14 The block «Components»

This block consists of the button «Add new component to element» and a small table.

3.3.1 The button «Add new component to element»

Figure 3.15 shows the page after click on the button «Add new component to element».

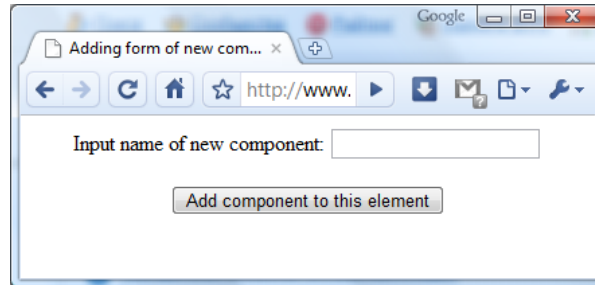


Figure 3.15 The page of creation of a new component

This page consists of a text field and the button «OK». The text field is used for input of a name of a new component. The button «OK» is used for entry approval and should be clicked after input of a name. After click, the program will transfer to the starting page.

3.3.2 The block «Components»: data output

This chapter describes a small table above the button «Add new component to element». The table can have two types: the first one, like on figure 3.14, the second one, like on figure 3.16.

Components
of element !!!Rooms!!!

Send to full specification	Name of room	Area, m ²	Ceiling height, m	Perimeter, m	Specification	Delete
to specification	Bedroom	25	2	18	(Don't use in specification)	Delete
to specification	Kitchen	17	2.7	21	Use in specification Example	Delete
to specification	WC	45	3	16	(Don't use in specification)	Delete
to specification	Tupa	33.2	3	49.8	Use in specification One-storey house	Delete
to specification	Makuuhuone 1	13.3	5	16	Use in specification One-storey house	Delete
to specification	Makuuhuone 2	16.1	3	21	Use in specification One-storey house	Delete
to specification	WC	2.7	3	7	Use in specification One-storey house	Delete
to specification	PH	3.8	3	9	Use in specification One-storey house	Delete
to specification	Sauna	2.9	3	7	Use in specification One-storey house	Delete
to specification	KHH	6	3	15	Use in specification One-storey house	Delete
to specification	TK	3.7	3	9	Use in specification One-storey house	Delete
to specification	ET	10.7	3	25	Use in specification One-storey house	Delete

[Add new component to element](#)

Name of finishing	Name of material	Cost of materials	Cost of working	Extra costs	Factor	Delete
to specification	Bedroom	area 25m ² ; ceiling height 2m; perimetr 18m				Delete
Floor finishing	ili	5	15	6	1.2	Erase
Floor border	base 1	25	15	30	1.5	Erase
Walls	Wallpaper	656	56	65	6	Erase
Ceiling finishing	maalaus	10	15	2	1.2	Erase
Ceiling border	Ceiling cornice 2	54	45	54	2	Erase

Figure 3.16 The second type of structure

The first type of structure is used for components, which do not enter in the element «Rooms», and the second type of structure is used for components belonging to the element «Rooms».

3.3.2.1 The first type of the structure

Figure 3.14 shows the first type of the structure. The table has following columns: Name, Cost of works, Cost of materials, Extra costs, Factor, Dependence on area, Quantity, Add to specification, Delete. Only columns Name, Add to specification and Delete have link. After click on the name, the program shows input form of this component (figure 3.17).

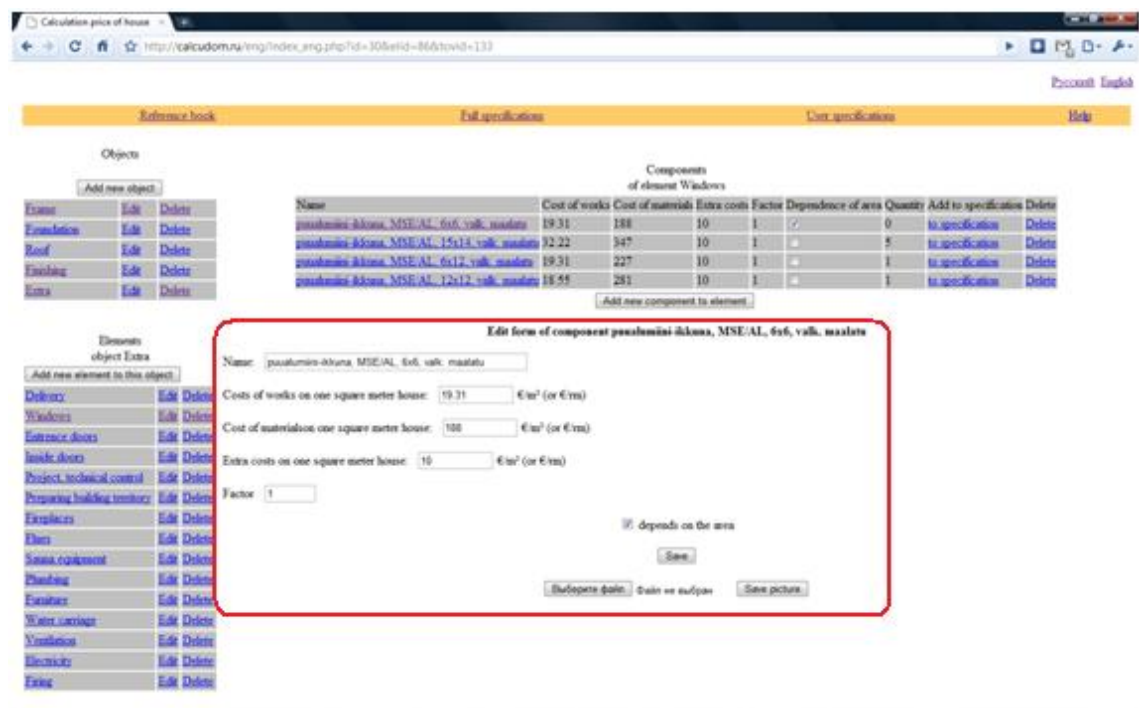


Figure 3.17 The page after click on the name of component

Before input it is necessary to know about dependence of this component on an area of house. If the component will depend on the area, it is necessary to check off «Dependence of area» and click the button «Save». This step is very important, because if it was not done, it would not be able to input all cost information about this component. If the component depends on the area, an

input form will be like form shown on figure 3.18 a, else – like on the figure 3.18 b.

Edit form of component puualumiini-ikkuna, MSE/AL, 6x6, valk. maalatu

Name:

Costs of works on one square meter house: €/m² (or €/rm)

Cost of materialson one square meter house: €/m² (or €/rm)

Extra costs on one square meter house: €/m² (or €/rm)

Factor

depends on the area

a) If the component depends on the area

Edit form of component puualumiini-ikkuna, MSE/AL, 6x6, valk. maalatu

Name:

Cost of works on one component: €

Cost of materials on one component: €

Extra costs on one component: €

Factor

Quantity of components

depends on area

b) If the component does not depend on the area

Figure 3.18 Edit form of a component

The main difference between these forms is availability of a string «Quantity of components». This string sets quantity of components, used in calculation. For saving of entry it is required to click the button «Save».

3.3.2.2 The second type of the structure

The second type of the structure is used for components belonging to the element «Rooms». Figure 3.19 shows this type of the structure.

Name of finishing	Name of material	Cost of materials	Cost of working	Extra costs	Factor	Delete
to specification	Makuuhuone 1	area 13.3m ² ; ceiling height 5m; perimetr 16m				Delete
Floor finishing	tammiparketti 2	15	10	5	1.2	Erase
Floor border	maku1 (base)	5	5	1	1.2	Erase
Walls	maalau2	10	10	10	1.2	Erase
Ceiling finishing	maalau4	5	10	2	1.2	Erase
Ceiling border	maku1(Ceiling cornice)	4	7	1	1.2	Erase

Figure 3.19 The second type of the structure

Each room has not only geometry dimensions, but also finishing of inner surfaces. The first string contains the name of the room (for example, Makuhuone 1) and geometry dimensions of the room. After click on the name, the program shows input form of this component (figure 3.20).

Edit form of component Makuuhuone 1

Name:

Area: m²

Ceiling height: m

Perimetr: m

Figure 3.20 Edit form of a component

The last column contains a link «Delete». Click on this link will delete the room and its materials of finishing from the reference book.

After the first string 5 strings with the name of finishing follow: floor finishing, floor border, walls, ceiling finishing and ceiling border. The cost of finishing will be taken into account only in borders of geometry dimensions of the room. If it is necessary to input a new material of finishing in the table, it is required to click on the name of finishing. After click the program will transfer on the page with required components. For example, after click on the name «Ceiling border», the program will transfer to the page with components of the element «Ceiling border» (figure 3.21).

Components
of element Ceiling border

Name	Cost of works	Cost of materials	Extra costs	Factor	Add to room	Delete
Ceiling cornice 1	9	10	2	1.4	to room	Delete
Ceiling cornice 2	45	54	54	2	to room	Delete
Ceiling cornice in wc	5	1	1	1.3	to room	Delete
tupa(Ceiling cornice)	7	3	1	1.2	to room	Delete
maku1(Ceiling cornice)	7	4	1	1.2	to room	Delete
maku2 (Ceiling cornice)	7	4	1	1.2	to room	Delete
wc (Ceiling cornice)	7	4	1	1.2	to room	Delete
ph (Ceiling cornice)	7	4	1	1.2	to room	Delete
sauna (Ceiling cornice)	7	4	1	1.2	to room	Delete
khh (Ceiling cornice)	7	4	1	1.2	to room	Delete
Ceiling cornice 3	7	4	1	1.2	to room	Delete
Ceiling cornice 4	7	4	1	1.2	to room	Delete
Ceiling cornice 5	5	8	9	1	to room	Delete

Figure 3.21 The page with materials of finishing

It is possible to choose required material from the list or input a new component. After click on the link «to room» (in red oval on figure 3.21), the component will be added to the room.

4 MENU ITEM «FULL SPECIFICATIONS»

Figure 4.1 shows the page after click on the link «Full specifications».



Figure 4.1 The page after click on the link «Full specifications»

At the top of this page a main menu of the program can be seen (in red frame on figure 4.1). A base field of the page can be seen below the main menu. The base field was divided into two blocks: specifications (left part of the base field) and the block of output (right part of the base field). In our example (on figure 4.1 the block of output contains phrase «Didn't choose a specification!»).

4.1 The block «Specifications»

Figure 4.2 shows the block «Specifications».

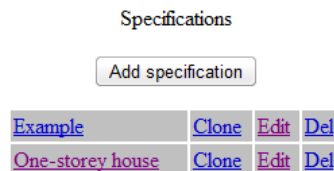


Figure 4.2 The block «Specifications»

The block consists of the button «Add specification» and the output table.

4.1.1 The button «Add specification»

Figure 4.3 shows the page after click on the button «Add specification».

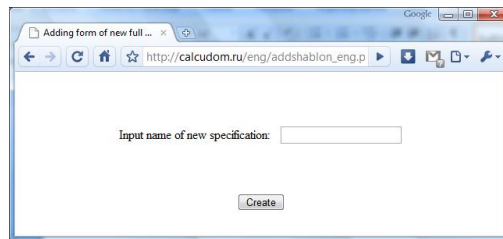


Figure 4.3 The page of creation of a new specification

This page consists of a text field and the button «OK». The text field is used for input of a name of a new specification. The button «OK» is used for entry approval and should be clicked after input of a name. After click, the program will transfer to the starting page.

4.1.2 The output table

The output table consists of 4 columns: the name of the specification, a link «Clone», a link «Edit» and a link «Del».

After click on the name, the program will output the full specification in the block of output (right block of the base field). The specification includes all components, which were added in this specification (figure 4.4).

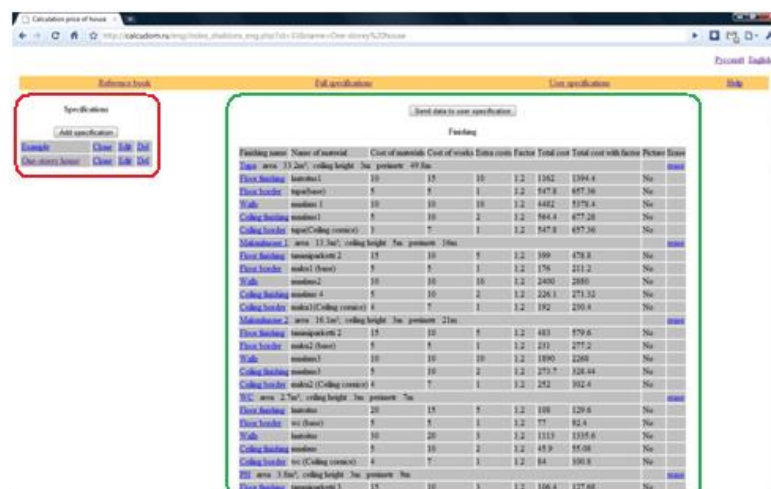


Figure 4.4 The page after click on the name of the specification

On figure 4.4 a red frame contains the block «Specifications», a green frame contains the block of output. The link «Clone» is used for creation a copy of the specification. After click on the link «Clone», the program will transfer on the page like on figure 4.5.

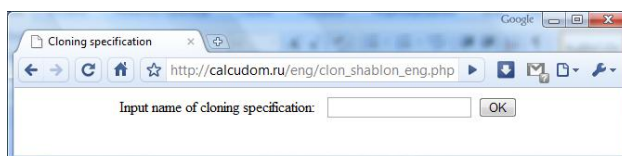


Figure 4.5 The page after click on the link «Clone»

This page consists of a text field and the button «OK». The text field is used for input of a name of a new specification. The button «OK» is used for entry approval and should be clicked after input of a name. The link «Edit» can transfer on the page, where editing of a name of the specification is possible. The link «Delete» can transfer on the page, where deletion of the specification is possible.

4.2 The block of output

The block is available after click on the name of the specification. The specification includes all components, which were added in this specification. Components will be output by groups: the name of the group is the name of the object. At the end of every group, results of calculation will be output (figure 4.6).

Frame										
Name	Cost of works	Cost of materials	Extra costs	Factor	Dependence on the area	Quantity	Total cost	Total cost with factor	Picture	Erase
external wall	40	40	20	1	<input checked="" type="checkbox"/>	0	9240	9240	No	erase
internal wall	15	15	5	1	<input checked="" type="checkbox"/>	0	3234	3234	No	erase
Total frame cost: 12474 € Total frame cost with factor: 12474 €										
Foundation										
Name	Cost of works	Cost of materials	Extra costs	Factor	Dependence on the area	Quantity	Total cost	Total cost with factor	Picture	Erase
Wall footing 2	40	40	10	1	<input checked="" type="checkbox"/>	0	8316	8316	No	erase
Ground floor	40	20	10	1	<input checked="" type="checkbox"/>	0	6468	6468	No	erase
Total foundation cost: 14784 € Total foundation cost with factor: 14784 €										

Figure 4.6 Results of calculation

Results include following values: a total cost of the group and a total cost of the group with factor. Also, at the end of the specification full results will be output (figure 4.7).

Name	Cost of works	Cost of materials	Extra costs	Factor	Dependence of area	Quantity	Total cost	Total cost with factor	Picture	Erase
puuallumiini-ikkuna_MSE/AL_6x6_valk_maalatu	19.31	188	10	1	<input checked="" type="checkbox"/>	0	20079.444	20079.444	No	erase
puuallumiini-ikkuna_MSE/AL_15x14_valk_maalatu	32.22	347	10	1	<input type="checkbox"/>	5	1946.1	1946.1	No	erase
puuallumiini-ikkuna_MSE/AL_6x12_valk_maalatu	19.31	227	10	1	<input type="checkbox"/>	1	256.31	256.31	No	erase
puuallumiini-ikkuna_MSE/AL_12x12_valk_maalatu	18.55	281	10	1	<input type="checkbox"/>	1	309.55	309.55	No	erase
ulko-ovi_10x21_valkoinen_1_lasiakko	34.93	540	10	1	<input type="checkbox"/>	2	1169.86	1169.86	No	erase
Sisäovi_palo-ovi_10x21_puu	21.83	224	10	1	<input type="checkbox"/>	6	1534.98	1534.98	No	erase
Project_technical_control	3000	0	0	1	<input type="checkbox"/>	1	3000	3000	No	erase
Preparing_buiding_territory	10500	0	0	1	<input type="checkbox"/>	1	10500	10500	No	erase
Fireplace	3000	0	0	1	<input type="checkbox"/>	1	3000	3000	Yes	erase
Elae	1000	200	0	1	<input type="checkbox"/>	1	1200	1200	No	erase
sauna_brench	50	250	0	1	<input type="checkbox"/>	1	300	300	No	erase
Phumbing	300	1000	0	1	<input type="checkbox"/>	1	1300	1300	No	erase
Furniture	0	4000	0	1	<input type="checkbox"/>	1	4000	4000	No	erase
Water_carriage_system	500	4000	0	1	<input type="checkbox"/>	1	4500	4500	No	erase
Ventilation_system	500	2000	0	1	<input type="checkbox"/>	1	2500	2500	No	erase
Electricity	2000	5000	0	1	<input type="checkbox"/>	1	7000	7000	No	erase
Firing	50	250	0	1	<input checked="" type="checkbox"/>	0	27720	27720	No	erase

Total extra cost: 90316.244 €
 Total extra cost with factor: 90316.244 €

Area: 92.4 m²
 Total house cost: 156053.444 €
 Total house cost with factor: 160977.284 €
 Square meter cost: 1688.89 €
 Square meter cost with factor: 1742.18 €

Figure 4.7 Full results of calculation

Full results include following values: an area, a total cost of the house, a total cost of the house with factor, square meter cost and square meter cost with factor.

Each component (except all components of the object «Finishing») can be added to the specification by click on the link «to specification» (figure 4.8).

Components
of element Windows

Name	Cost of works	Cost of materials	Extra costs	Factor	Dependence of area	Quantity	Add to specification	Delete
puuallumiini-ikkuna_MSE/AL_6x6_valk_maalatu	19.31	188	10	1	<input checked="" type="checkbox"/>	0	to specification	Delete
puuallumiini-ikkuna_MSE/AL_15x14_valk_maalatu	32.22	347	10	1	<input type="checkbox"/>	5	to specification	Delete
puuallumiini-ikkuna_MSE/AL_6x12_valk_maalatu	19.31	227	10	1	<input type="checkbox"/>	1	to specification	Delete
puuallumiini-ikkuna_MSE/AL_12x12_valk_maalatu	18.55	281	10	1	<input type="checkbox"/>	1	to specification	Delete

Add new component to element

Figure 4.8 The link «to specification» in an output table of components

After click on the link «to specification», the program will transfer on the page like on figure 4.9.

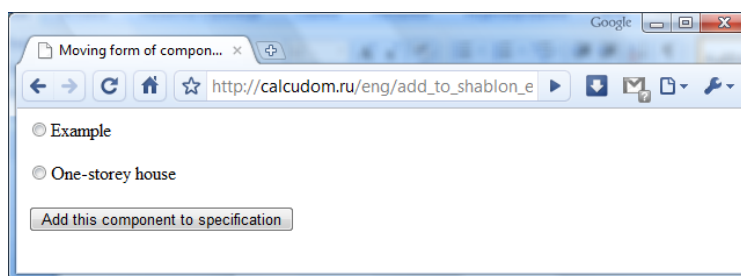


Figure 4.9 The page after click on the link «to specification»

On this page it is required to choose the specification, in which the component will be added. The button «Add this component to specification» is used for entry approval and should be clicked after choice of the specification.

From components of the object «Finishing» it is possible to add to the specification only components of the element «Rooms». Each component can be added to the specification by click on the link «to specification» (figure 4.10).

Name of finishing	Name of material	Cost of materials	Cost of working	Extra costs	Factor	Delete
to specification	Makuuhuone 2	area 16.1m ² ; ceiling height 3m; perimetr 21m				Delete
Floor finishing	tammiparketti 2	15	10	5	1.2	Erase
Floor border	maku2 (base)	5	5	1	1.2	Erase
Walls	maalau3	10	10	10	1.2	Erase
Ceiling finishing	maalau3	5	10	2	1.2	Erase
Ceiling border	maku2 (Ceiling cornice)	4	7	1	1.2	Erase

Figure 4.10 The link «to specification» in an output table of components of the element «Rooms»

When all components of the house were added, the program would calculate cost and output results of this calculation. If it is required to know a cost of the house, differed in an area, it is necessary to create a user specification on basis of a full specification. It can be done in menu item «User specifications»

5 MENU ITEM «USER SPECIFICATIONS»

Figure 5.1 shows the page after click on the link «User specifications».

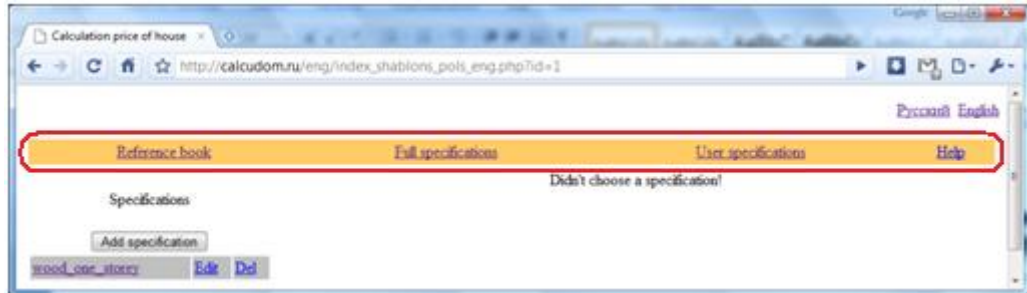


Figure 5.1 The page after click on the link «User specifications»

At the top of this page a main menu of the program can be seen (in red frame on figure 5.1). A base field of the page can be seen below the main menu. The base field was divided into two blocks: specifications (left part of the base field) and the block of output (right part of the base field). In our example (on figure 5.1 the block of output contains phrase «Didn't choose a specification!»).

5.1 The block «Specifications»

You can see this block on the figure 5.2.

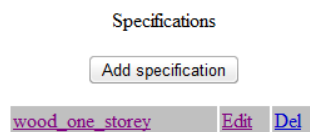


Figure 5.2 The block «Specifications»

This block consists of the button «Add specification» and output table.

5.1.1 The button «Add specification»

Figure 5.3 shows the page after click on the button «Add specification».

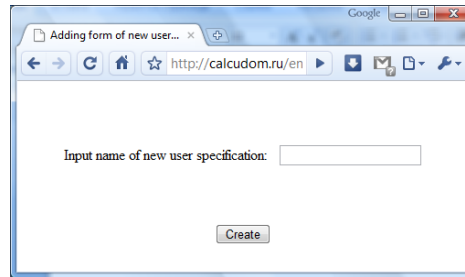


Figure 5.3 The page of creation of a new user specification

This page consists of a text field and the button «OK». The text field is used for input of a name of a new user specification. The button «OK» is used for entry approval and should be clicked after input of a name. After click, the program will transfer to the starting page.

5.1.2 The output table

The output table consists of 3 columns: the name of the specification, a link «Edit» and a link «Del». After click on the name, the program will output the full specification in the block of output (right block of the base field). The specification includes all components, which were added in this specification (figure 5.4).

Name	Cost of works, €	Cost of materials, €	Extra costs, €	Total cost, €
Frame	1500	1500	500	2500
Foundation	8000	6000	2000	16000
Roof	10000	4000	1000	15000
Finishing				
Floor finishing	1489.81	1595.45	745.07	3830.13
Floor border	1031.17	1031.17	745.07	2807.41
Wall finishing	7148.08	7693.51	6193.51	21035.07
Ceiling finishing	1155.84	812.34	260.01	2429.09
Ceiling border	2432.47	760.26	206.23	3398.96
Extra				
penohmitin-ikkuna, MSE(AL, 6r6, valk. maastala	1931	18800	1000	21731
penohmitin-ikkuna, MSE(AL, 15x14, valk. maastala	161.1	1715	90	1946.1
penohmitin-ikkuna, MSE(AL, 6x12, valk. maastala	19.31	227	10	256.31
penohmitin-ikkuna, MSE(AL, 12x12, valk. maastala	18.55	281	10	309.55
ilko-ovi, 10x21, valkoinen, 1 lasialikko	69.86	1080	20	1169.86
Sisäovi, palo-ovi, 10x21, pun	150.98	1344	60	1534.98
Project, technical control	3000	0	0	3000
Preparing building territory	10500	0	0	10500
Fireplace	3000	0	0	3000

Figure 5.4 The page after click on the name of the specification

The link «Edit» can transfer on the page, where editing of a name of the specification is possible. The link «Delete» can transfer on the page, where deletion of the specification is possible.

5.2 The block of output

The block of output contains a specification which is a short version of a full specification. But a short version can recalculate a cost of the house in dependence on an area of the house (see figure 5.5).

Name	Cost of works, €	Cost of materials, €	Extra costs, €	Total cost, €
Frame	1500	1500	500	2500
Foundation	8000	6000	2000	16000
Roof	10000	4000	1000	15000
Finishing				
Floor finishing	1489.61	1595.45	745.07	3830.13
Floor border	1031.17	1031.17	745.07	2807.41
Wall finishing	7148.05	7693.51	6193.51	21035.07
Ceiling finishing	1355.84	812.34	260.91	2429.09
Ceiling border	2432.47	760.26	206.23	3398.96
Extra				
panahimi-ikkuna, MSE/AL, 6x6, valk. maalatu	1931	18800	1000	21731
panahimi-ikkuna, MSE/AL, 15x14, valk. maalatu	161.1	1735	50	1946.1
panahimi-ikkuna, MSE/AL, 6x12, valk. maalatu	19.31	227	10	256.31
panahimi-ikkuna, MSE/AL, 12x12, valk. maalatu	18.55	281	10	309.55
ulko-ovi, 10x21, valkoinen, 1 lasimätkko	69.86	1080	20	1169.86
Sisäovi, palo-ovi, 10x21, puu	130.98	1344	60	1534.98
Project, technical control	3000	0	0	3000
Preparing building territory	10500	0	0	10500
Fireplace	3000	0	0	3000

Figure 5.5 The block of recalculation

Red frame on figure 5.5 contains the block of recalculation. For recalculation, it is necessary to input required area and click the button «Calculate».

For creation a new user specification, at first, it is necessary to create a new empty user specification. After creation a new empty user specification, it is necessary to send data from the full specification to this empty user specification. This action can be realized by click on the button «Send data to user specification» (figure 5.6).

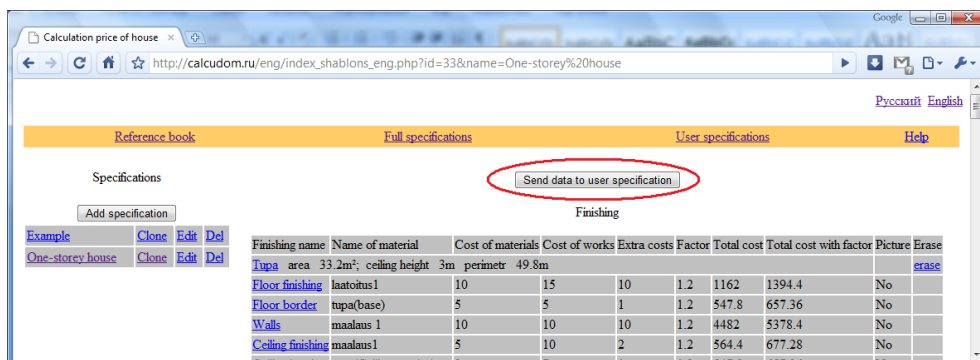


Figure 5.6 The button «Send data to user specification»

This button is located on the page «Full specifications» in the block of output before body of a specification.

FIGURES

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Figure 5.1 The page after click on the link «User specifications», p. 49

Figure 5.2 The block «Specifications», p. 49

Figure 5.3 The page of creation of a new user specification, p. 50

Figure 5.4 The page after click on the name of the specification, p. 50

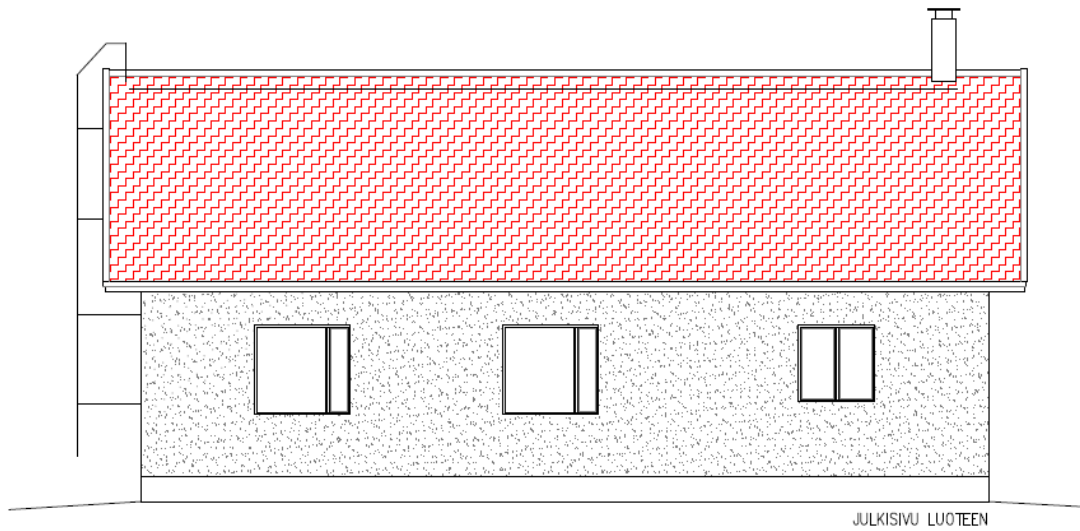
Figure 5.5 The block of recalculation, p. 51

Figure 5.6 The button «Send data to user specification», p. 52

Appendix 2 Drawings of the tested house

1(3)

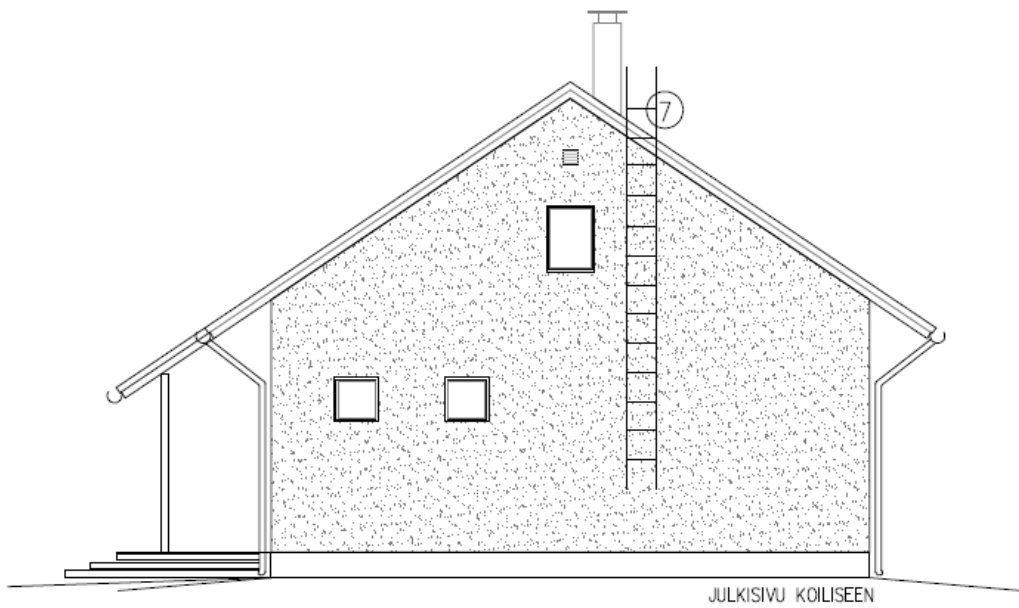
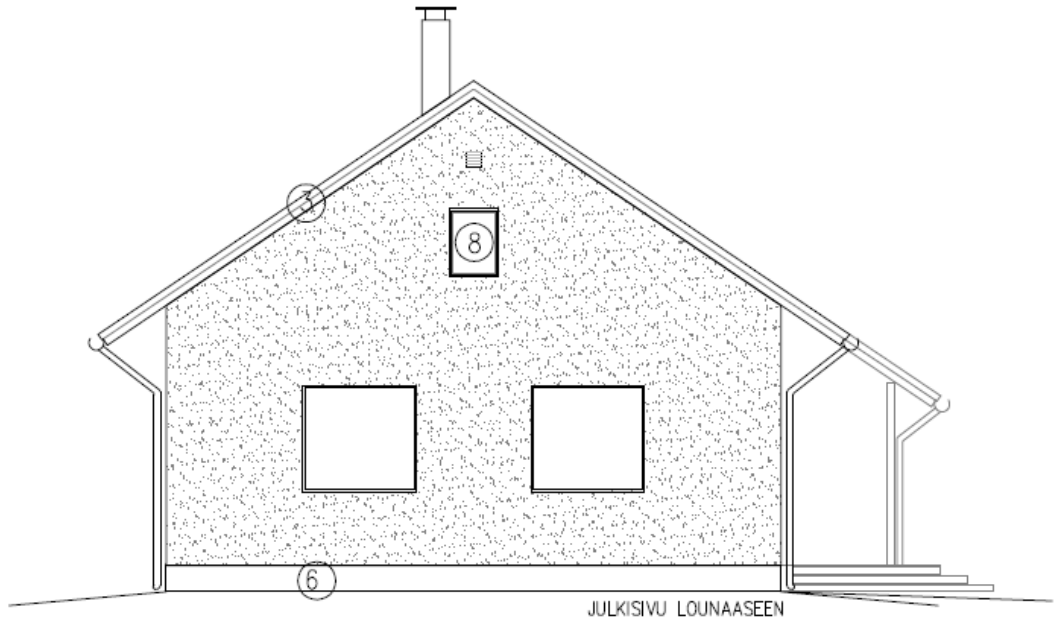
Facade drawings



Appendix 2 Drawings of the tested house

2(3)

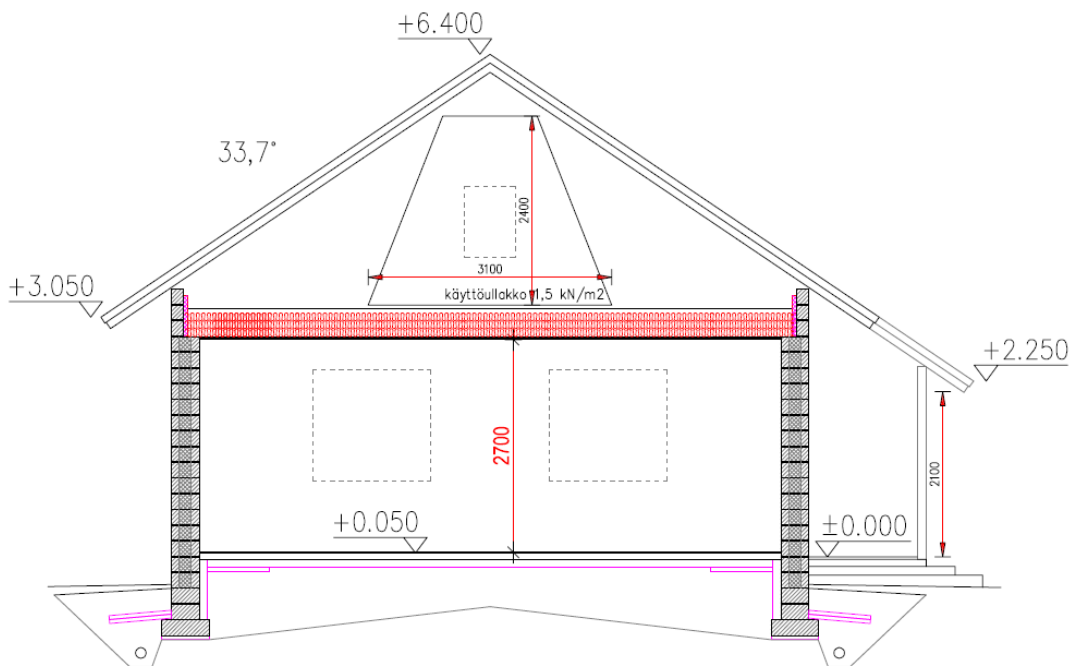
Facade drawings



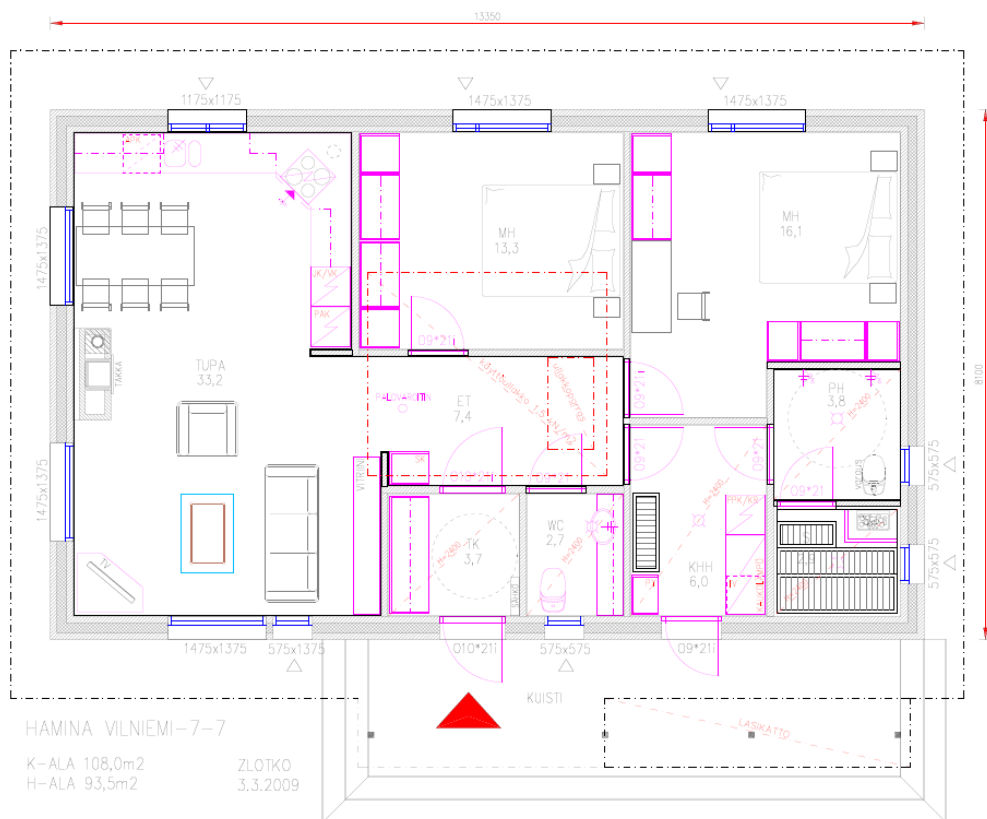
Appendix 2 Drawings of the tested house

3(3)

Section of the house



Plan of the house



Appendix 3 Full specification of the tested house

1(1)

Finishing							
Finishing name	Name of material	Cost of materials	Cost of works	Extra costs	Factor	Total cost	Total cost with factor
	Tupa area 33.2m², ceiling height 3m, perimetr 49.8m						
Floor finishing	laatoitus1	10	15	10	1	1162	1162
Floor border	tupa(base)	5	5	1	1	547.8	547.8
Walls	maalaus 1	10	10	10	1	4482	4482
Ceiling finishing	maalaus1	5	10	2	1	564.4	564.4
Ceiling border	tupa(Ceiling cornice)	3	7	1	1	547.8	547.8
	Makuuhuone 1 area 13.3m², ceiling height 5m, perimetr 16m						
Floor finishing	tammiparketti 2	15	10	5	1	399	399
Floor border	maku1 (base)	5	5	1	1	176	176
Walls	maalaus2	10	10	10	1	2400	2400
Ceiling finishing	maalaus 4	5	10	2	1	226.1	226.1
Ceiling border	maku1(Ceiling cornice)	4	7	1	1	192	192
	Makuuhuone 2 area 16.1m², ceiling height 3m, perimetr 21m						
Floor finishing	tammiparketti 2	15	10	5	1	483	483
Floor border	maku2 (base)	5	5	1	1	231	231
Walls	maalaus3	10	10	10	1	1890	1890
Ceiling finishing	maalaus3	5	10	2	1	273.7	273.7
Ceiling border	maku2 (Ceiling cornice)	4	7	1	1	252	252
	WC area 2.7m², ceiling height 3m, perimetr 7m						
Floor finishing	laatoitus	20	15	5	1	108	108
Floor border	wc (base)	5	5	1	1	77	77
Walls	laatoitus	30	20	3	1	1113	1113
Ceiling finishing	maalaus	5	10	2	1	45.9	45.9
Ceiling border	wc (Ceiling cornice)	4	7	1	1	84	84
	PH area 3.8m², ceiling height 3m, perimetr 9m						
Floor finishing	tammiparketti 3	15	10	3	1	106.4	106.4
Floor border	ph (base)	5	5	1	1	99	99
Walls	maalaus 4	10	10	10	1	810	810
Ceiling finishing	maalaus	10	15	2	1	102.6	102.6
Ceiling border	ph (Ceiling cornice)	4	7	1	1	108	108
	Sauna area 2.9m², ceiling height 3m, perimetr 7m						
Floor finishing	laatoitus, kuivat tilat	30	25	10	1	188.5	188.5
Floor border	sauna (base)	5	5	1	1	77	77
Walls	paneeli+saunasuoja	30	20	2	1	1092	1092
Ceiling finishing	paneeli+saunasuoja	30	20	5	1	159.5	159.5
Ceiling border	sauna (Ceiling cornice)	4	7	1	1	84	84
	KHH area 6m², ceiling height 3m, perimetr 15m						
Floor finishing	muovimatto	10	10	2	1	132	132
Floor border	kh (base)	5	5	1	1	165	165
Walls	maalaus	10	10	10	1	1350	1350
Ceiling finishing	maalaus	5	10	2	1	102	102
Ceiling border	kh (Ceiling cornice)	4	7	1	1	180	180
	TK area 3.7m², ceiling height 3m, perimetr 9m						
Floor finishing	muovimatto	10	10	2	1	81.4	81.4
Floor border	tk(base)	5	5	1	1	99	99
Walls	maalaus	10	10	10	1	810	810
Ceiling finishing	maalaus	10	15	4	1	107.3	107.3
Ceiling border	Ceiling cornice 3	4	7	1	1	108	108
	ET area 10.7m², ceiling height 3m, perimetr 25m						
Floor finishing	tammiparketti	15	10	2	1	288.9	288.9
Floor border	base 3	5	5	1	1	275	275
Walls	maalaus	10	10	10	1	2250	2250
Ceiling finishing	maalaus	10	15	2	1	288.9	288.9
Ceiling border	Ceiling cornice 4	4	7	1	1	300	300
Total finishing cost: 24619.2 €							
Total finishing cost with factor: 24619.2 €							
Frame							
Name	Cost of works	Cost of materials	Extra costs	Factor	Total cost	Total cost with factor	
external wall	40	40	20	1	9240	9240	
internal wall	15	15	5	1	3234	3234	
Total frame cost: 12474 €							
Total frame cost with factor: 12474 €							
Foundation							
Name	Cost of works	Cost of materials	Extra costs	Factor	Total cost	Total cost with factor	
Wall footing 2	40	40	10	1	8316	8316	
Ground floor	40	20	10	1	6468	6468	
Total foundation cost: 14784 €							
Total foundation cost with factor: 14784 €							
Roof							
Name	Cost of works	Cost of materials	Extra costs	Factor	Total cost	Total cost with factor	
Roof structure 2	100	40	10	1	13860	13860	
Total roof cost: 13860 €							
Total roof cost with factor: 13860 €							
Extra							
Name	Cost of works	Cost of materials	Extra costs	Factor	Quantity	Total cost	Total cost with factor
puualumiini-ikkuna_MSE/AL_6x6_valk_maalatu	19.31	188	10	1	1	20079.444	20079.444
puualumiini-ikkuna_MSE/AL_15x14_valk_maalatu	32.22	347	10	1	5	1946.1	1946.1
puualumiini-ikkuna_MSE/AL_6x12_valk_maalatu	19.31	227	10	1	1	256.31	256.31
puualumiini-ikkuna_MSE/AL_12x12_valk_maalatu	18.55	281	10	1	1	309.55	309.55
ulko-ovi_10x21_valkoinen_1_lasiaukko	34.93	540	10	1	2	1169.86	1169.86
Sisäovi_palo-ovi_10x21_puu	21.83	224	10	1	6	1534.98	1534.98
Project_technical_control	3000	0	0	1	1	3000	3000
Preparing_building_territory	10500	0	0	1	1	10500	10500
Fireplace	3000	0	0	1	1	3000	3000
Flue	1000	200	0	1	1	1200	1200
sauna_brench	50	250	0	1	1	300	300
Plumbing	300	1000	0	1	1	1300	1300
Furniture	0	4000	0	1	1	4000	4000
Water_carriage_system	500	4000	0	1	1	4500	4500
Ventilation_system	500	2000	0	1	1	2500	2500
Electricity	2000	5000	0	1	1	7000	7000
Firing	50	250	0	1	0	27720	27720
Total extra cost: 70454.11 €							
Total extra cost with factor: 70454.11 €							
Area: 92.4 m²							
Total house cost: 136191.31 €							
Total house cost with factor: 136191.31 €							
Square meter cost: 1473.93 €							
Square meter cost with factor: 1473.93 €							

Appendix 4 User specification of the tested house

1(1)

Total cost 134595.62 €				
Square meter cost 1456.66 €				
Name	Cost of works, €	Cost of materials, €	Extra costs, €	Total cost, €
Frame	5082	5082	2310	9702
Foundation	7392	5544	1848	14784
Roof	9240	3696	924	13860
Finishing				
Floor finishing	1147	1228.5	573.7	2949.2
Floor border	794	794	573.7	2161.7
Wall finishing	5504	5924	4769	16197.01
Ceiling finishing	1044	625.5	200.9	1870.4
Ceiling border	1873	585.4	158.8	2617.2
Extra				
<i>puualumiini-ikkuna, MSE/AL, 6x6, valk. maalatu</i>	19.31	188	10	217.31
<i>puualumiini-ikkuna, MSE/AL, 15x14, valk. maalatu</i>	161.1	1735	50	1946.1
<i>puualumiini-ikkuna, MSE/AL, 6x12, valk. maalatu</i>	19.31	227	10	256.31
<i>puualumiini-ikkuna, MSE/AL, 12x12, valk. maalatu</i>	18.55	281	10	309.55
<i>ulko-ovi, 10x21, valkoinen, 1 lasiaukko</i>	69.86	1080	20	1169.86
<i>Sisäovi, palo-ovi, 10x21, puu</i>	130.98	1344	60	1534.98
<i>Project, technical control</i>	3000	0	0	3000
<i>Preparing building territory</i>	10500	0	0	10500
<i>Fireplace</i>	3000	0	0	3000
<i>Flue</i>	1000	200	0	1200
<i>sauna brench</i>	50	250	0	300
<i>Plumbing</i>	300	1000	0	1300
<i>Furniture</i>	0	4000	0	4000
<i>Water carriage system</i>	500	4000	0	4500
<i>Ventilation system</i>	500	2000	0	2500
<i>Electricity</i>	2000	5000	0	7000
<i>Firing</i>	4620	23100	0	27720