VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

FACULTY OF CIVIL ENGINEERING

DEPARTMENT OF CONSTRUCTION ECONOMICS AND PROPERTY MANAGEMENT

Oana Maria Cãtanã

HEALTHY HOUSE AND VIRTUAL HOUSE INTELLIGENT SYSTEM. APPLIED TO PHYSIOLOGICAL REQUIREMENTS

Master‘s degree Thesis

Real Estate Management study programme, state code 621N20013

Real Estate Management specialization

Management studies

Vilnius, 2014

UNIVERSIDAD POLITÉCNICA DE VALENCIA

ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA DE EDIFICACIÓN

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Master en Gestión de Edificación

Curso 2013/2014

Tutor (UPV): Mª del Carmen Llinares Millán
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Vilnius, 2014

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OBJECTIVES FOR MASTER THESIS

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Vilnius

For student ..... Oana Maria Cãtanã.....….....….....….....
(Name, Surname)

Master Thesis title: HEALTHY HOUSE AND VIRTUAL HOUSE INTELLIGENT SYSTEM. APPLIED TO PHYSIOLOGICAL REQUIREMENTS

Approved on…… , 201... by Dean‘s decree No. .....
(day, Month) (year)

The Final work has to be completed by ..... , 201.....
(Day, Month) (Year)

THE OBJECTIVES:

Study Housing Health and Safety Decision Support System and analyze four of the hazards (damp and mould, excess cold, excess heat and radiation) that can exist or appear in a dwelling.
Also, give recommendations for the presented hazards with the purpose to avoid the appearance of them or if the problems already exist to eliminate them.
Create an interactive tool: Virtual House Intelligent System which will help the user to see all the hazards, to understand them. From the virtual tour the user can acess the recommendation system.…….....
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Consultants of the Master Thesis:
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Academic Supervisor..... Prof. PhD. DSc. Arturas Kaklauskas
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Objectives accepted as a quidance for my Master Thesis

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VILNIUS GEDIMINAS TECHNICAL UNIVERSITY
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REVIEW
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REVIEW

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HEALTHY HOUSE AND VIRTUAL HOUSE INTELLIGENT SYSTEM. APPLIED TO PHYSIOLOGICAL REQUIREMENTS

Master Thesis of Real State and Property VGTU (Lithuania): Oana Maria Cãtanã
Supervisor VGTU (Lithuania): Arturas Kaklauskas
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Actual submission date: 17/01/2014

VILNIUS GEDIMINAS TECHNICAL UNIVERSITY
FACULTY OF CIVIL ENGINEERING
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REVIEW

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Contents

Chapter I. Introduction

1.1. Description and justification of the work

For each of us the word "home" can have different meanings. Some think about their home, others about their workplace. For others it is simply a space, however, for architects and engineers, a new project to realize.

It is clear that a building, be it our home, work office, shopping center, university, college, etc. is the space where we spend most of our time, so we should pay close attention to all its care: construction, maintenance, cleaning.

The interior of a house and its surroundings have to be comfortable and healthy. Over time, experts have searched the best solutions to achieve these goals. In the U.S.A and in the UK there are several books that give advice on how to have and maintain a healthy home, given the number of diseases that occur because of bad construction, lack of maintenance and cleaning. One of the first books appeared, published in 1976 by the “Disease Control Center” was used for many decades, and its principle is that "the quality of a home is the key to public health".

Although there are no manuals, instructions, each occupant of a dwelling must be responsable for the quality of it, to ensure their own health, to maintein their home. But there are problems that we are not aware about and that need a detailed study.

This paper presents a study of four of the problems that may occur in a dwelling: mold and damp, excess cold, excess heat and radon. These are part of the group of physiological requirments. The study made by the British Government, includes this group with other three: psychological requirments, protection against infection and protection against accidents. Each existing problem in the house influences the health of the inhabitants, as has been analyzed.

Mold and moisture threaten the physical mental health and social welfare. A long exposure will give not only allergies, rhinitis, conjunctival, eczema, asthma cough but also can lead to death. Cardiovascular and respiratory diseases can also be caused by an excess of cold or excessive heat. As important fact, note that radon is the next cause after tobacco, which causes lung cancer.

Paying more attention to these causes, many dangers and risks that affect the health of the population could be avoided.

This work is carried out within the Erasmus Program, in collaboration with the research project of Vilnius Gediminas Technical University on Healthy House and Safety Decision Support System with Augmented Reality.

In collaboration with the host university a virtual tour of a dwelling is developed, in which the problems under study (mould and damp, excess cold, excess heat and radon) will be integrated through pictures, and also recommendations where all the information needed to solve the problem is obtained.

The ultimate goal is to create the interactive tool "Virtual Tour" in which will be included the recommendations program, being provided access to this information to all users.

The recommendations will have technical / constructive character but also devoted to the regular user, to the actions that he should do to improve the quality of the house.

A healthy home, a free from disease and comfortable medium will be achieved. It will reduce or eliminate sources of diseases caused by housing problems. Not only the quality of housing will be improved, also the users life, yielding improved productivity and an increased potential for the development of activities.

1.2. General aspects

Since the beginning of the world a lot of diseases appeared and affect human health, sometimes causing death.

The relationship between space and health dates back to Hippocrates, who stated that "airs, waters, places" all played significant roles impacting human health and history [28]. A classic piece of research in health geography was done in 1854 as a cholera outbreak gripped a neighborhood in London. Death tolls rang around the clock and the people feared that they were being infected by vapors coming from the ground. John Snow thought that if he could locate the source of the disease, it could be contained. He drew maps showing the homes of people who had died of cholera and the locations of water pumps. He found that one pump, the public pump on Broad Street, was central to most of the victims. He figured that infected

water from the pump was the culprit. He instructed the authorities to remove the handle to the pump, making it unusable. After that the number of new cholera cases decreased [28].

In time, many articles about housing health were published, and nowdays with the internet access it is easier to find information regarding this aspect.

Looking for articles of interest about "Healthy House and Safety Rating System" (HHSRS) we can see in table 1.1 and in figure 1.1 the evolution of the articles dedicated to this aspect:

Period	Results HHSRS
1999-2000	1
2000-2001	5
2001-2002	16
2002-2003	18
2003-2004	21
2004-2005	41
2005-2006	61
2006-2007	79
2007-2008	87
2008-2009	77
2009-2010	80
2010-2011	99
2011-2012	96
2012-2013	85
2013-2014	46

Table 1.1 with the results for "HHSRS"

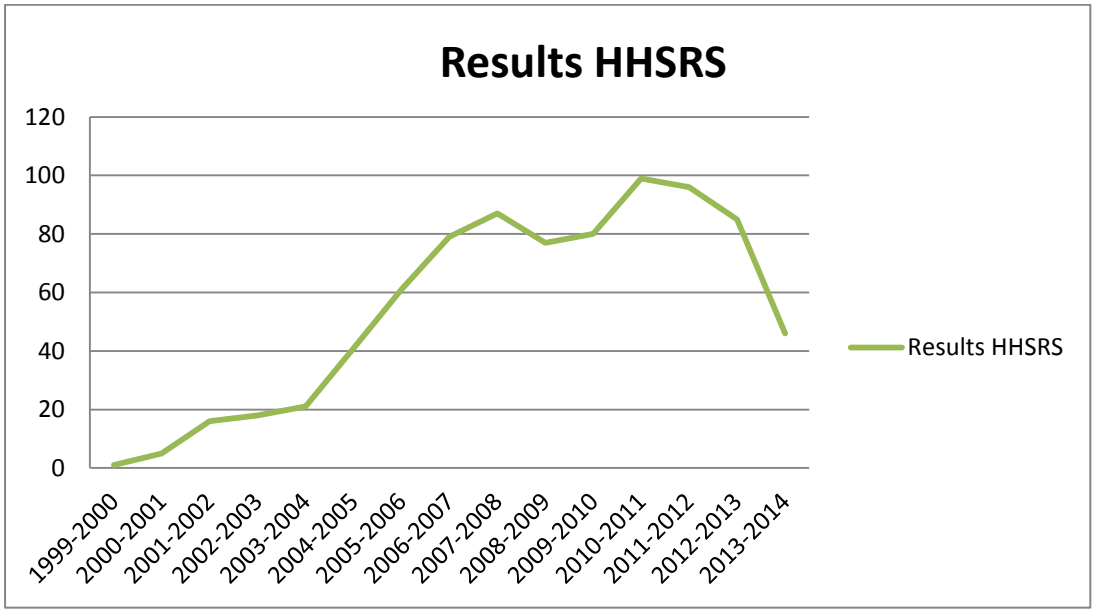


Fig.1.1. Graphic with the results for "HHSRS"

Housing Health and Safety Rating System (HHSRS) is a new risk assesement tool used to access potential risks to the health and safety of occupants in residential properties in England and Wales.

The legislation came into affect in England in 2006. HHSRS replaces the Housing Fitness Standard, which was set out in the Housing Act 1985 [23].

This action affects all owners and landlords, including social landlords. The private sector contains some of the worst housing conditions and owners and landlords should be aware that any future inspections of their property will be made using HHSRS. Private landlords and managing agents are advised to assess their property to determine whether there are serious hazards that may cause a health and safety risk to tenants. They should then carry out improvements to reduce the risks [25].

In United States, Department of Housing and Urban Development developed the program called "Healthy Home Rating System (HHRS)" whick is based upon the successful "Housinf Healthy and Safety Rating System (HHSRS)" developed for the United Kingdom (UK) [25].

The original Basic Housing Inspection manual was published in 1976 by the Center for Disease Control (now known as the Centers for Disease Control and Prevention). Its foreword stated:

"The growing numbers of new families and the increasing population in the United States have created a pressing demand for additional housing that is conducive to healthful living. These demands are increased by the continuing loss of existing housing through deterioration resulting from age and poor maintenance. Large numbers of communities in the past few years have adopted housing codes and initiated code enforcement programs to prevent further deterioration of existing housing units. This growth in housing activities has caused a serious problem for communities in obtaining qualified personnel to provide the array of housing service needed, such as information, counseling, technical advice, inspections, and enforcement. As a result many agencies throughout the country are conducting comprehensive housing inspection training courses. This publication has been designed to be an integral part of these training sessions."

The original Basic Housing Inspection manual has been successfully used for several decades by public health and housing personnel across the United States. Although much has changed in the field of housing construction and maintenance, and health and safety issues have expanded, the manual continues to have value, especially as it relates to older housing.

The revised *Basic Housing Inspection* manual, renamed the *Healthy Housing Reference Manual*, responds to the enormous changes that have occurred in housing construction methods and materials and to new knowledge related to the impact of housing on health and safety [6].

Also, there are many associations which are treating the aspect of the health, like "American Lung Association", "World Health Organization", "Warwick Institute of Health" which developes the program "Safe and Healthy Housing Unit".

1.3. Research methodology

In the present work are developed aspects about healthy and safety house. It is composed of five chapters as following:

Chapter I, "Introduction", is structured in three parts and presents the description and justification of the work, where is explained why will be developed this subject, the importance of it. Here are introduced the terms "healthy house", is presented the evolution of the articles of interest about "healthy house and safety rating system" and also the new approach of the U.Ks Government regarding this.

Chapter II, "Healthy House and Safety Model", gives details about what is a health and a safety house, which are the problems that were found, in time, by specialists, and how the U.K.'s Government divide all the 29 hazards in four main groups. All this information, is wanted to be set in virtual applications that are developed by projects as LARGE (Learning Augmented Reality Global Environment). With graphics, audio, video, 3D objects and other enhancements, this project combines the virtual reality with the real one. As part of this project is one called "Development of National Housing Health and Safety Certification Model" and with this tool is supposed that will be improved the public healthcare services and the management of residential environmental health risk factor.

Healthy House Model is divided in six stages, the first is the determination of the system criteria, the second is a comparative description about healthy and safety house in different countries, the third and the fourth are about recommendations and the last is about multiple criteria analysis of the composite parts of a housing health and safety.

In the present work will be described three of the six stages. In the first stage are described two criterias, excess cold and excess heat (description, potential for harm health

effects, causes, relevant matters affecting likelihood and harm outcome, hazard assessment) and in the next stage described will be given recommendations for these two hazards.

In the last stage are described two of the methods that are part of the "Healthy House System". With the first method is determinated the weight of the criteria and with the second one is made a determination of significance, priority and utility degree of alternatives.

In Chapter III, "Decision Support System" is described the database (which can be accesed with internet) with the 29 criterias (hazards) and each criteria is divided in other subcriterias. All of these give information about the investigated problem, using pictures, comparative alternatives, calculations, etc. As an example are presented other two hazards, damp and mould and radiation. In model base it is shown how appear the forth investigated problems (damp and mould, radiation, excess cold and excess heat) as criterias.

For all these problems exist calculators which will help the user to measure the hazards.

In Chapter IV, "Case study – Virtual Tour" is presented a virtual flat, as an entertaining tool, which helps the user to see all the problems, to realize how big the hazard is, the risks that are threatening its life. In this part, first is presented how the virtual tour is created, which method is used to take the pictures, after that which are the programs where the panoramic view can be created and the virtual space, how can be added pictures, links to the internet pages. After these, the virtual tour is created and the user can "walk" on it and identify hazards. By specific figures, the hazard can be noticed, a representative picture appears and near it are the information points which will send the user to the recommendation system.

Chapter V, "Manual for the user", presents the two recommendations systems, "Health and Safe Recommendation System" and "National Health Recommendation Certification Model Advisory System" how can be used, the meaning of it. Also is presented how the user can create an account for adding more information to the system.

Chapter II. Housing Health and Safety Model

2.1. Housing Health and Safety Rating System

The health of the people always represents a serious aspect which needs all the attention. People spend indoors a very enormous part of their life, this means that the environment, the place were we spend has to be a health and a safety one.

During the time specialists made serious investigations about the problems that can appear in a dwelling, problems that can appear because of a bad construction, the lack of maintenance and cleaning , which disease can appear; about all these they wrote books, guidances, give advices, recommendations so the dwelling holders can realize how important is to have a healthy house.

American Lung Association of the Upper Midwest and UK Government pay during the time a lot of attention to all the problems that we can confront, to all the diseases that can affect our the health.

Certain groups of patients included in American Lung Association‘s study are those such as asthmatics, atopic patients, patients with emphysema and bronchitis, heart and stroke patients, people with diabetes, pregnant women, and the elderly and children who are especially sensitive to the health effects of outdoor air toxicants [2]. It is estimated that about 20% of the USA’s population suffers from asthma, emphysema, bronchitis, diabetes or cardiovascular diseases and are thus especially susceptible to outdoor air pollution [2]. Outdoor air quality plays an important role in maintaining good human health. Air pollution causes large increases in medical expenses, morbidity and is estimated to cause about 800,000 annual premature deaths worldwide [7]. Much research [3, 4, 22], digital maps and standards [9, 12, 27] on the health effects (respiratory effects, cardiovascular effects, cancer, reproductive and developmental effects, neurological effects, mortality, infection and other health effects) of outdoor air pollution, a premise’s microclimate, and dwelling valuation, has been published in the last decade. The above-mentioned and other problems are related to a built environment’s air pollution, the premise’s microclimate, health effects, and real estate market value, etc.

The housing health and safesty rating system (HHSRS) is a risk-based evaluation tool to help local authorities identify and protect against potential risks and hazards to health and safety from any deficiencies identified in dwellings. It was produced under the "Housing Act 2004" and applies to residential properties in England and Wales [11].

This program is developed by the Department for Communities and Local Government of UK and the policies are providing housing support for older and vulnerable people and improving the rented housing sector,

On the official internet page of the UK's Government there are posted four documents: "Housing health and safety rating system (HHSRS) enforcement guidance: housing conditions", "Housing health and safety rating system (HHSRS): guidance for landlords and property-related professionals", "Reducing the risks: the housing health and safety rating system (HHSRS)" and "Housing health and safety rating system (HHSRS) enforcement guidance: housing inspections and assessment of hazards" [11].

There are 29 hazards in dwellings. These are arranged in four main groups reflecting the basic health requirements. The four groups are sub-divided according to the nature of the hazards [19] *(*Fig. 2.1.*)*:

- Physiological Requirements, including – Hygrothermal conditions and Pollutants (non-microbial).

- Psychological Requirements, including – Space, Security, Light, and Noise.

- Protection against Infection, including – Hygiene, Sanitation, and Water supply.

- Protection against Accidents, including – Falls, Electric shock, Burns and Scalds, and Building related Collisions.

One of the priorities of the Europe 2020 Strategy - smart growth is driven by complex interactions between technical, social, economic, and human factors. The project - Learning Augmented Reality Global Environment (LARGE) - is designed to create a new type of learning environment that support the educational/training institutions in delivering their curriculum in the most attractive and effective for the learners way. Aim of the LARGE is to build a global environment, based on this technology, simplifying the process of augmented reality content creation, allowing all educational/training institutions to benefit from its undoubted advantages. This Global Environment consists of a platform, serving as a basis for the system and an integrated content development tool, which will allow the creation of appropriate educational/training AR content by the target groups. An AR system generates a composite view for the user which combines the real scene and the virtual scene generated by

the computer that then augments the scene with additional information. The Learning Augmented Reality Global Environment superimposes graphics, audio, video, 3D objects and other enhancements from computers screens to real time environments expanding users" knowledge, skills and experience.

The main aim of project "Development of National Housing Health and Safety Certification Model" is to improve the quality of public healthcare services and to improve the management of residential environmental health risk factor. The goal of mentioned project was to create the tools of residential environmental health risk factor management [14].

A. PHYSIOLOGICAL REQUIREMENTS

1. Damp & Mould growth
2. Excess of cold
3. Excess of heat
4. Asbestos and MMF
5. Biocides
6. Carbon monoxide and fuel combustion products
7. Lead
8. Radiation
9. Uncombusted fuel gas
10. Volatile organic compounds

Hygrothermal Conditions

Pollutants (non-microbial)

B. PSYCHOLOGICAL REQUIREMENTS

11. Crowding and space
12. Entry by intruders
13. Lighting
14. Noise

Space, security, light and noise

C. PROTECTION AGAINST INFECTION

15. Domestic hygiene, pests and refuse
16. Food safety
17. Personal hygiene, sanitation and drainage
18. Water suply

→ **Hygiene, sanitation and water supply**

D. PROTECTION AGAINST ACCIDENTS

19. Falls associated with baths
20. Falling on level surface
21. Falling on stairs
22. Falling between levels

→ **Falls**

23. Electrical hazards
24. Fire
25. Flames, hot surfaces

→ **Electric shocks, fires, burns and scalds**

26. Collision and entrapment
27. Explosions
28. Position and operability of amenities
29. Structural collapse and falling elements

→ **Collisions, cuts and strains**

Fig.2.1. 29 hazards arraged in four main groups and divided according to the nature of the hazard

These problems are developed in various internet programs, one of them can be find on VGTU database (Fig. 2.2.).

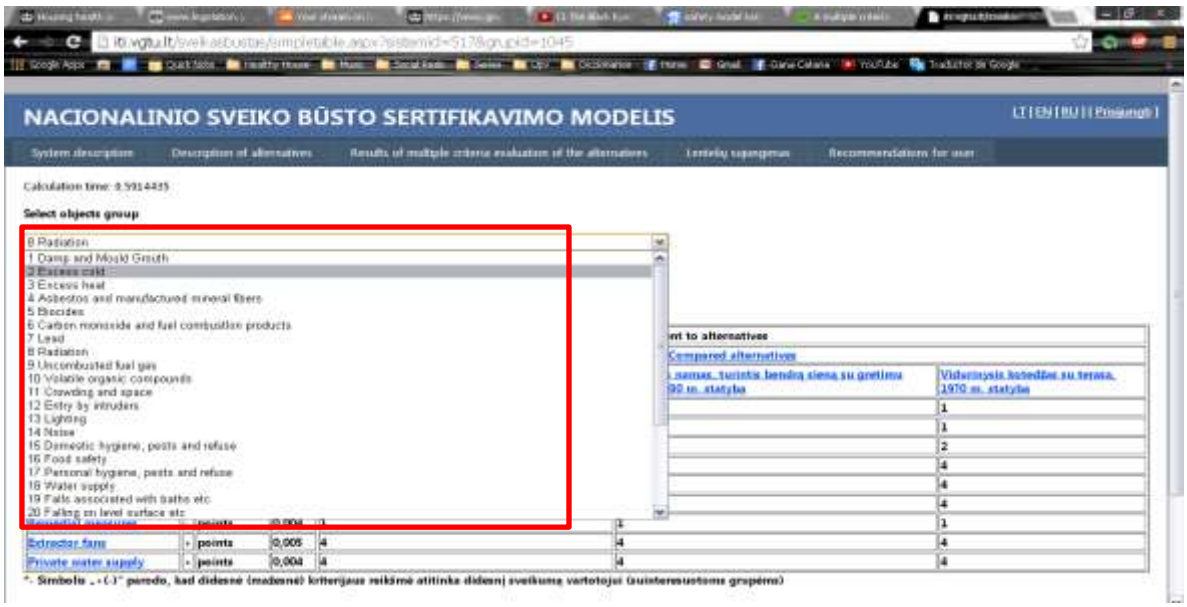
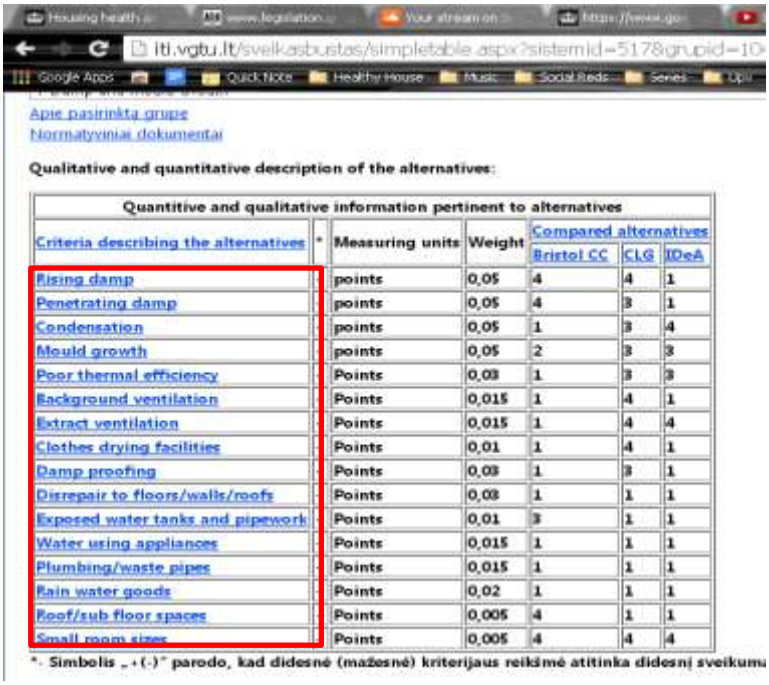


Fig. 2.2. 29 criterias described in "National Healthy Housing Certification Model" program system

Each criteria (hazard) can be divided in subcriterias, resulting more or less 420 criterias.

For example, damp and mould hazard has the following subcriterias (Fig.2.3.):

1. Rising damp
2. Penetrating damp
3. Condensation
4. Mould growth
5. Poor thermal efficiency
6. Background ventilation
7. Extract ventilation
8. Clothes drying facilities
9. Damp proofing
10. Disrepair to floors/walls/roofs
11. Exposed water tanks and pipework
12. Water using appliences
13. Plumbing/waste pipes
14. Rain water goods
15. Roof/sub floor spaces
16. Small room sizes



Apie pasirinktą grupę
Normatyviniai dokumentai

Qualitative and quantitative description of the alternatives:

Quantitive and qualitative information pertinent to alternatives						
Criteria describing the alternatives	*	Measuring units	Weight	Compared alternatives		
				Bristol CC	CLG	IDeA
Rising damp		points	0,05	4	4	1
Penetrating damp		points	0,05	4	3	1
Condensation		points	0,05	1	3	4
Mould growth		points	0,05	2	3	3
Poor thermal efficiency		Points	0,03	1	3	3
Background ventilation		Points	0,015	1	4	1
Extract ventilation		Points	0,015	1	4	4
Clothes drying facilities		Points	0,01	1	4	1
Damp proofing		Points	0,03	1	3	1
Disrepair to floors/walls/roofs		Points	0,03	1	1	1
Exposed water tanks and pipework		Points	0,01	3	1	1
Water using appliances		Points	0,015	1	1	1
Plumbing/waste pipes		Points	0,015	1	1	1
Rain water goods		Points	0,02	1	1	1
Roof/sub floor spaces		Points	0,005	4	1	1
Small room sizes		Points	0,005	4	4	4

*- Simbolis „+(-)" parodo, kad didesnė (mažesnė) kriterijaus reikšmė atitinka didesnį sveikumą

Fig. 2.3. "Damp and mould" subcriterias described in "National Healthy Housing Certification Model" program system

2.2. The model

The Housing health and safety model for quantitative and qualitative analyses was developed with the goal of integrating the health, safety, technical, technological, economic, legal/regulatory, innovative, microclimatic, social, cultural, ethical, psychological, religious, ethnic and other aspects of the process over the life of the housing.

Healthy House model is developed in six stages, but in the present work are developed only three of them:

Stage I. Determining a system of criteria characterizing the efficiency of a housing health and safety by employing relevant literature and expert methods;

Stage II. Comparative description of the housing health and safety in different countries (by health, safety, economic, legal/regulatory, technical, technological. organizational, managerial, quality of life, thermic, indoor quality, social, cultural, political, ethical and other aspects

Stage III. Development of certain general recommendations on how to improve the knowledge levels of stakeholders.

Stage IV. Submission of certain recommendations to stakeholders including several particular alternatives for each general recommendation proposed.

Stage V. A multiple criteria analysis of the composite parts of a housing health and safety, henceforth interlinking the received compatible and rational composite parts of a housing health and safety into a full housing health and safety project.

2.3. Criteria system

As was mentioned in the part 2.1., Healthy House and Safety Rating System is about 29 hazards which were identified in dwellings.

As example, were choosed 2 of the hazards, in this case “Excess of cold” and “Excess of heat” and were described as in the “Operating Guidance - Housing Act 2004 - Guidance about inspections and assessment of hazards”. To the information provided by the UK Government were added photos and more recommendation.

2.3.1. Excess of cold

Excess of cold represent a serious hazard for the structure of building, for the ambient, for the health of the people. If is not resolved in time can attack people health.

As can be seen in the following images (Fig.2.4.) one of the measures to resolve this problem is to isolate the building, it has to be protected from the freezing of the roof, dotated with heater.

Fig.2.4. Representative images for "Excess of cold" problems

2.3.1.1. Description of the hazard

This category covers the threats to health from sub-optimal indoor temperatures [19].

2.3.1.2. Potential for harm

The most vulnerable age group is all persons 65 years or over [19].

2.3.1.3. Health effects

A healthy indoor temperature is around 21°C, although cold is not generally perceived until the temperature drops below 18°C. A small risk of adverse health effects begins once the temperature falls below 19°C. Serious health risks occur below 16°C with a substantially increased risk of respiratory and cardiovascular conditions. Below 10°C the risk of hypothermia becomes appreciable, especially for the elderly [19].

There are approximately 40,000 more deaths between December and March than expected from the death rates in other months of the year. This seasonal fluctuation, excess

winter deaths, is greater in Britain than in most other countries of continental Europe and Scandinavia [19].

Cardiovascular conditions (e.g. heart attacks and stroke) account for half the excess winter deaths, and respiratory diseases (e.g. influenza, pneumonia and bronchitis), account for another third. The increase in deaths from heart attacks occurs about 2 days following the onset of a cold spell, the delay is about 5 days for deaths from stroke, and about 12 days for respiratory deaths [19].

Although there is some excess winter deaths in all age groups, it becomes significant for those in the 45+ age group. The risk increases with age in a roughly linear pattern up to the 85+ age group, after which there is a marked increased risk [19].

The main causal factor for excess winter deaths appears to be changes in ambient (outdoor) temperature, but seasonal infections, and changes in behavioural patterns, air pollution levels and micronutrient intake may also account for some of the seasonal patter [19].

The extent to which housing contributes is not clearly known, but the indication is that people living in dwellings that are poorly heated are at significantly greater risk. There is less evidence on the relationship between housing characteristics and health other than mortality. However, it is very probable that the findings in relation to cold-related mortality can be extended in broad terms to cardio-respiratory morbidity and health related quality of life [19].

Low temperatures can impair the thermoregulatory system of the elderly, and the very young whose thermoregulatory system is immature. Both these groups may spend a greater time indoors in cold weather and both will not move about as much as other groups in the cold [19].

Cold air streams may affect the respiratory tract and can slow the heart temporarily, increasing cardiovascular strain. When the whole body is cooled, blood pressure increases. The effect of cold air on the bronchial lining and immune system can reduce resistance to infection. Thus, sleeping in cold bedrooms has been shown to substantially increase the health risk [19].

The symptoms of rheumatoid arthritis can be worsened by cold. Low temperatures also aggravate sickle cell anaemia and the related thalassaemia, and can affect the healing of leg skin ulcers [19].

2.3.1.4. Causes

The percentage rise in deaths in winter is greater in dwellings with low energy efficiency ratings. There is a gradient of risk with age of the property, the risk being greatest in dwellings built before 1850, and lowest in the more energy efficient dwellings built after 1980. Absence of central heating and dissatisfaction with the heating system also show some association with increased risk of excess winter death [19].

Cold related illness is in part determined by the characteristics of the dwelling and in part by occupation factors. For example, under-occupation can mean either excessive heating costs or low indoor temperatures [19].

The energy efficiency of a dwelling depends on the thermal insulation of the structure, on the fuel type, and the size and design of the means of heating and ventilation. Any disrepair or dampness to the dwelling and any disrepair to the heating system may affect their efficiency. The exposure and orientation of the dwelling are also relevant [19].

Some forms of insulating material, such as glass fibre, will settle over a period and become less effective as a result. As water readily conducts heat, excess moisture content (dampness) of the structure will reduce the thermal insulation provided. The effectiveness of some forms of insulating material can become compromised by moisture. Dampness will also affect the thermal insulation of bedding, increasing the risk [19].

Excess ventilation wastes heat and reduces air temperatures. It also causes draughts and discomfort. Excess ventilation may be caused by too large or inappropriately sited permanent openings, or large openable windows. Draughts can also be caused by illfitting butt-jointed floor boarding or ill-fitting doors or windows [19].

2.3.1.5. Relevant matters affecting likelihood and harm outcome

Matters relevant to the likelihood of an occurrence and the severity of the outcomes include:

a) Thermal insulation – inadequate insulation of the external envelope of the dwelling, including the presence of cold bridges.

b) Dampness – in such a position, and sufficiently extensive and persistent as to reduce the effectiveness of the thermal insulating material and/or the structure.

c) Settling of insulation – compression of the thermal insulating material reducing its effectiveness.

d) Type of heating provision – inappropriate or inefficient systems and appliances.

e) Size of heating system – systems and appliances inadequate for the size of dwelling.

f) Installation and maintenance of heating system – inadequately installed or maintained systems.

g) Controls to heating system – inadequate or inappropriate controls to the system or appliance.

h) Amount of ventilation – inadequate, excessive, or inappropriate provision for thorough ventilation.

i) Ventilation controls – inadequate means of controlling the ventilation.

j) Disrepair to ventilation – to the system or controls.

k) Draughts – uncontrollable draughts and those situated to cause discomfort [19].

2.3.1.6. Hazard assessment

Indoor temperature is a function both of dwelling characteristics and of the occupying household. For the HHSRS assessment it is the dwelling characteristics, energy efficiency and the effectiveness of the heating system, which are considered, assuming occupation by the vulnerable age group. Simple measurement of indoor temperature is inappropriate [19].

The assessment should take account of the adequacy of the heating, insulation and ventilation. This may involve assessing the dwelling energy rating (using SAP34), and any other factors which might affect the indoor temperature, such as dampness, or disrepair to the structure or to the space or water heating system [19].

The energy efficiency of cooking facilities, lighting, and other energy using installations and appliances, should not be included in the HHSRS assessment [19].

2.3.2. Excess heat

Not only the excess of cold can be dangerous but also the excess of heat. The orientation of the building respect the sun has a very big influence, also the type of the windows as can be seen (Fig.2.5).

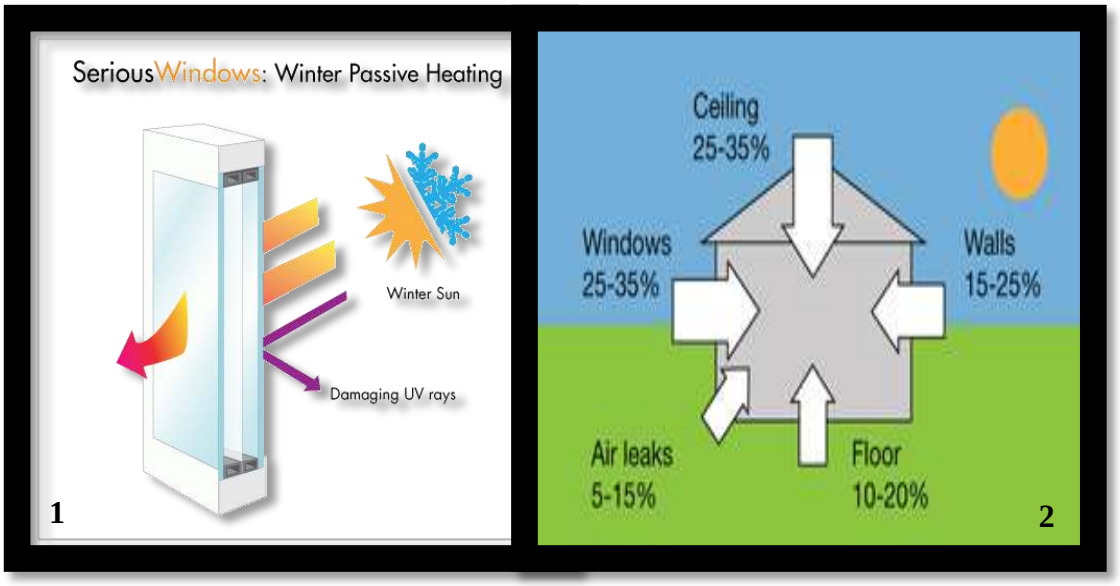


Fig. 2.5. Representative images for "Excess of heat"

2.3.2.1. Description of the hazard

This category includes threats from excessively high indoor air temperatures [19].

2.3.2.2. Potential for harm

The most vulnerable age group is all persons aged 65 years or over [10].

2.3.2.3. Health effects

As temperatures rise, thermal stress increases, initially triggering the body's defence mechanisms such as sweating. High temperatures can increase cardiovascular strain and trauma, and where temperatures exceed 25°C, mortality increases and there is an increase in strokes. Dehydration is a problem primarily for the elderly and the very young [19].

Evidence from investigations about heat waves and morbidity in other countries, shows that there is an increase in genitourinary diseases and as ozone levels rise during heat waves, an increase in respiratory conditions. Also, heat waves have been linked with excess mortality due to mental disorders [19].

The elderly, especially those with pre-existing cardiovascular disease, and the very young (infants) are more vulnerable than other groups [19].

2.3.2.4. Causes

In the UK it has been unusual for risks from over-heating of a dwelling, heat waves are forecast to become more common. It is possible, therefore, that there will be an increase in mortality and morbidity rates from excess heat associated with the inability to maintain a healthy temperature within dwellings [19].

The major dwelling factors are solar heat gain, ventilation rates, and thermal capacity and insulation of the structure. Smaller, more compact dwellings, and particularly attic flats, are more prone to overheating than are large dwellings [19].

Solar heat gain is influenced by the area and orientation of glazing, the amount of external shading, and the thermal capacity and insulation of the structure. Ventilation and/or the provision of air-conditioning influence the ability to control the indoor air temperature.

Of particular importance to the risk to health of occupants is the ability to dissipate heat at night. This is influenced by the thermal mass of the structure, the position of insulation in the structure (i.e. whether the insulation is external, in the cavity, or internal, and the night time ventilation rate) [19].

Defects to a heating system, or the inability to control the dwelling's heating system, can also be a cause of excessive heat in dwellings [19].

Dwellings in multi-occupied buildings are more likely to be affected by excessively high indoor temperatures. Particularly those located immediately beneath an uninsulated roof, those with only a south facing elevation, and those with district heating systems not controllable by the occupier [19].

2.3.2.5. Relevant matters affecting likelihood and harm outcome

Matters relevant to the likelihood of an occurrence and the severity of the outcomes include:

a) Thermal insulation – inadequate provision for thermal insulation particularly in attic flats.

b) Orientation of glazing – large areas of south facing glazing in inappropriately designed dwellings.

c) Heating controls – faulty, inappropriately designed, or inadequate controls to the heating system.

d) Ventilation provision – inadequate or inappropriate provision for ventilation.

e) Ventilation control – inadequate means of controlling the ventilation.

f) Disrepair to ventilation – to the system or devices [19].

2.3.2.6. Hazard assessment

The assessment should take account of the provision for ventilation, particularly night time ventilation, and the provision and condition of any mechanical ventilation or air conditioning system. Also relevant will be the thermal capacity of the structure and the amount and position of thermal insulation, the extent and orientation of glazing, and the condition of and controls for the heating system [19].

2.4. Development of certain general recommendations

For each hazard the Government of UK, in the Guidances offered by them for Healthy House and Safety Rating System give recommendations. To that recommendations were added other recommendations that people all over the world is using and all of these will be added to the database of VGTU.

The following recommendations will be found also in Appendix II and are translated in Spanish and Romanian language.

Recommendations for excess of cold and excess of heat

In multi-occupied buildings provision for space heating may be centrally controlled. Such systems should be operated to ensure that occupants are not exposed to cold indoor temperatures and should be provided with controls to allow the occupants to regulate the temperature within their dwelling [19].

There should be means for ensuring low level background ventilation without excessive heat loss or draughts. It should be controllable, properly installed and maintained, and appropriate to the particular part of the dwelling. There should be means for rapid ventilation at times of high moisture production in kitchens and bathrooms [19].

Heating should be controllable by the occupants, and safely and properly installed and maintained. It should be appropriate to the design, layout and construction, such that the whole of the dwelling can be adequately and efficiently heated [19].

Structural thermal insulation should be provided to minimise heat loss. The level of insulation necessary is in part dependent on geographical location and exposure, position in relation to other dwellings and buildings, and orientation. South facing glazing can be used to increase solar heat gain and so save energy [19].

The structure of the dwelling should provide or incorporate sufficient thermal insulation, having regard to its construction, its geographical location, its position in relation to other dwellings and buildings and its orientation [19].

Where there are large expanses of south facing glazing there should be appropriate shuttering or blinds to control solar heat gain in summer months [19].

There should be adequate controls to the heating system within the dwelling, particularly for district heating systems, enabling the occupier to control temperature [19].

There should be means for cooling during hot summer weather, either by natural ventilation or by air conditioning. The means should be controllable, properly installed and maintained, and appropriate, having regard to the particular part of the dwelling. While openable windows can provide ventilation, occupiers may be reluctant to use them for security reasons, or because of external noise levels, especially at night [19].

Others recommendations for EXCESS COLD

Access appropriate energy advice about improving the energy effciency of your home and staying warm in winter [17].

Protect water pipes from freezing if possible [17] .

Have all gas, solid fuel and oil burning appliances (boilers, heaters, cookers etc.) services by an appropriately registered engineer to present breakdown [17].

If you plan to use fireplace or wood stove for emergency heating, have your chimney or flue inspected each year [24].

If you will be using a fireplace, wood stove or kerosene heater, install a smoke detector and a battery-operated carbon monoxide detector near the area to be heated. Test them monthly [24].

Maintein regular contact with vulnerable people and neighbours you know to be at risk in cold weather [17].

Stay turned into the weather forecast and ensure you are stocked with food and medications in advance [17].

If you are likely to be restricted to one room during the winter period or during a cold spell, make sure that it can be kept at or above recommended temperatures [17].

Check ambient room temperatures-especially those rooms where disabled or vulnerable people spend most of their time [17].

Keep active [17].

Dress warmly, eat warm food, take warm drinks regulary [17].

Others recommendations for EXCESS HEAT

Reduce the humidity using air conditioning and dehumidiers, or reduce the sources of moisture [31].

Wear loosefitting, lightweight, light-colored clothing. Excess, dark or tight clothing holds in heat and doesn't let your body cool properly because it inhibits sweat evaporation [18].

Avoid sunburn. If you're going to be outdoors, wear a lightweight, wide-brimmed hat or use an umbrella to protect yourself from the sun, and apply sunscreen to any exposed skin. Having a sun burn reduces your body's ability to rid itself of heat [18].

Seek a cooler place. Being in an air-conditioned building, even for just a few hours, is one of the best ways to prevent heat exhaustion. If your home doesn't have an air conditioner, consider spending time at a library or shopping mall. At the least, find a well-shaded spot. [18].

Drink plenty of fluids. Staying hydrated will help your body sweat and maintain a normal body temperature. If your doctor has told you to limit fluids because of a health condition, be sure to check with him or her about how much extra you need to drink when the temperature rises. Avoid alcoholic beverages [18].

Take extra precautions with certain medications. Ask your doctor or pharmacist whether the medications you take make you more susceptible to heat exhaustion and, if so, what you can do to keep your body from overheating [18].

Avoid hot spots. On a hot day, the temperature in your parked car can rise 20 F (about 6.7 C) in just 10 minutes. Let your car cool off before you drive it. Never leave children or anyone else in a parked car in hot weather for any period of time [18].

Let your body acclimate to the heat. If you travel to somewhere hot, or the temperatures suddenly jump in your area, it can take several weeks for your body to get used

to the heat. You'll still need to take precautions, but working or exercising in heat should become more tolerable. If you're on vacation, you probably don't have several weeks to wait, but it's a good idea to wait at least a few days before attempting vigorous activity in the heat [18].

2.5. A multiple criteria analysis

The methods utilised for the development of Healthy House System are the same used for "The multiple criteria analysis of building refurbishments", "The intelligent Passive House design system", "Multiple criteria decision support on-line system for construction":

- Method of complex determination of the weight of the criteria taking into account their quantitative and qualitative characteristics (MEDICI);
- Method of multiple criteria complex proportional evaluation of the projects (COPRAS);
- Method of Defining the Utility degree and MArket value of a project (DUMA);
- Method of Multiple criteria Multivariant design of an Alternatives (MOMMA).

In this chapter, as an example, were developed the first two:

2.5.1. Method of complex determination of the weight of the criteria taking into account their quantitative and qualitative characteristics.

The results of the comparative analysis of healty house alternatives are presented here as a grouped decision making matrix where columns contain n alternatives, while all quantitative and conceptual information pertaining to them are found in Table 2.1.

Any alternative that has a criteria value worse than the required level was rejected.

Grouped decision making matrix of construction alternative's multiple criteria analysis										
Quantitative information relevant to construction alternatives										
Criteria describing the construction alternatives		[a]	Weights	Measuring units	Comparable construction alternatives					
					a_1	a_2	...	a_j	...	a_n
Quantitative criteria	X_1	z_1	q_1	m_1	x_{11}	x_{12}	...	x_{1j}	...	x_{1n}
	X_2	z_2	q_2	m_2	x_{21}	x_{22}	...	x_{2j}	...	x_{2n}
	...	...	...	...	...	...	...	...	...	...
	X_i	z_i	q_i	m_i	x_{i1}	x_{i2}	...	x_{ij}	...	x_{in}
	...	...	...	...	...	...	...	...	...	...
	X_t	z_t	q_t	m_t	x_{t1}	x_{t2}	...	x_{tj}	...	x_{tn}
Qualitative criteria	X_{t+1}	z_{t+1}	q_{t+1}	m_{t+1}	$x_{t+1\,1}$	$x_{t+1\,2}$	...	$x_{t+1\,j}$	...	$x_{t+1\,n}$
	X_{t+2}	z_{t+2}	q_{t+2}	m_{t+2}	$x_{t+2\,1}$	$x_{t+2\,2}$	...	$x_{t+2\,j}$	...	$x_{t+2\,n}$
	...	...	...	...	...	...	...	...	...	...
	X_s	z_s	q_s	m_s	x_{s1}	x_{s2}	...	x_{sj}	...	x_{sn}
	...	...	...	...	...	...	...	...	...	...
	X_m	z_m	q_m	m_m	x_{m1}	x_{m2}	...	x_{mj}	...	x_{mn}
Conceptual information relevant to alternatives (i.e. text, drawings, graphics, video tapes)										
C_f		C_z	C_q	C_m	C_1	C_2	...	C_j	...	C_n

[a]The sign z_i (±) indicates that a greater/lesser criteria value corresponds to a greater significance for interested parties.

Table 2.1. Grouped decision making matrix of construction alternative's multiple criteria analysis

In the case analysed by the authors, the Grouped Decision Making Matrix is designed for analysis of quantitative and conceptual information. Therefore, it is suitable only for database management system in this instance [16].

Taking into account their quantitative and qualitative characteristics, we developed a new method for the complex determination of the weight of the criteria. This method allows one to calculate and coordinate the weights of the quantitative and qualitative criteria according to their significance and values. The weights of quantitative criteria can be coordinated if the values of the quantitative criteria are expressed through an equivalent monetary unit (Stages 1–4) [16].

Having performed a strict mutual coordination of the quantitative criteria weights, the same coordination is done with the weights of the qualitative criteria (Stages 5–7) [16].

Stage 1: The determination of the sum of values for every quantitative criteria according to:

$$S_i = \sum_{j=1}^{n} x_{ij}, \quad i = \overline{1,t}; \quad j = \overline{1,n}, \tag{1}$$

where *xij* is the value of the i criteria in the j alternative of asolution; t is the number of quantitative criteria; and *n* is the number of the alternatives compared [16].

Stage 2: The total monetary expression of every quantitative criteria describing the investigated alternative is obtained by applying:

$$P_i = S_i p_i, \quad i = \overline{1,t}, \tag{2}$$

where *pi* is the initial weight of the i criteria. *pi* should be measured in such a way as, having been multiplied by a quantitative criteria value, an equivalent monetary expression can be obtained [16].

According to the quantitative criteria's effect on the efficiency of the alternative's life cycle, the quantitative criteria can be divided into:

1. Short-term factors, affecting the alternative only for a certain period of time;
2. Long-term factors, affecting the alternative throughout its life cycle.

The initial weights of long-term criteria, such as resources needed for the maintenance and environmental protection depends on the alternative's repayment time and on the evaluation, in financial terms, of a criteria's unit of measure and is

$$p_i = e f_i, \tag{3}$$

where *e* is repayment time of an alternative; and *fi* is monetary evaluation of a measure unit of the *i* criteria.

The initial weight of a single criteria comprising of, for example, the cost of an alternative, is equal in financial terms to the criteria's unit of measure and is

$$p_i = f_i. \tag{4}$$

The meaning of the initial weight of a quantitative criteria consists of multiplying the initial weight by the value of a quantitative criteria and its monetary expression is calculated over the whole period of the alternative's repayment (equivalent to former natural expression) [21].

Stage 3: The overall quantitative criteria magnitude's sum expressed in financial terms is determined by

$$V = \sum_{i=1}^{t} P_i, \quad i = \overline{1,t}. \tag{5}$$

Stage 4: The quantitative criteria weights describing the alternative, which can be expressed in financial terms, are determined as follows:

$$q_i = \frac{P_i}{V}, \quad i = \overline{1,t}. \tag{6}$$

When the above method is applied in the calculation of weights, the total sum of weights of the quantitative criteria is always equal to 1 [16]:

$$\sum_{i=1}^{t} q_i = 1. \tag{7}$$

Stage 5: In order to achieve full coordination between the weights of quantitative and qualitative criteria, a comparative standard of value (E) is set. E is equal to the sum of any selected weights of quantitative criteria. One of the main requirements for this comparative standard value is that according to the utility, E should be easily comparable to all the qualitative criteria. The weights of all the qualitative criteria are determined by the comparison of their utility with the standard value [16].

E is determined according to the following equation:

$$E = \sum_{z=1}^{g} q_z, \tag{8}$$

where g is the number of quantitative criteria and is included into the compared standard; qz is the weight of z quantitative criteria and is included into the compared standard [16].

Stage 6: The initial weight vi of qualitative criteria is determined by using expert methods that compare their relative significance to the significance E of the selected

compared standard. Relative weights of qualitative criteria should be expressed in percentages [16].

Stage 7: The weight of the i qualitative criteria is determined as follows:

$$q_i = \frac{v_i E}{100}, \quad i = t+1, \ldots, m. \tag{9}$$

The above method allows for the determination of weights of the criteria that are maximally interrelated and depend on qualitative and quantitative characteristics of all criteria [16].

Therefore, equivalence can be drawn between the notes of qualitative aspects and the costs of the quantitative aspects, after the establishment of the weight of each criteria [16].

2.5.2. Method of multiple criteria complex proportional assessment (COPRAS) of the alternatives.

The method of complex proportional assessment [33] assumes direct and proportional dependence of the significance and utility degree of the investigated versions in a system of criteria adequately describing the alternatives and of values and weights of the criteria. A decision maker by using the expert methods determines the system of criteria and calculates the values and initial weights of the qualitative criteria [16].

The determination of significance, priority and utility degree of alternatives is carried out in five stages.

Stage 1: The weighted normalized decision-making matrix D is formed at this stage. The purpose here is to receive dimensionless weighted values from comparative indexes. When the dimensionless values of the indexes are known then all criteria can be compared.

The following equation is used for this purpose:

$$d_{ij} = \frac{x_{ij} q_i}{\sum_{j=1}^{n} x_{ij}}, \quad i = \overline{1,m}; \quad j = \overline{1,n}, \tag{10}$$

where xij is the value of the i criteria in the j alternative; m is the number of criteria; n is the number of the alternatives compared; and qi is weight of i criteria.

The sum of dimensionless weighted index values dij of each criteria xi is always equal to the weight qi:

$$q_i = \sum_{j=1}^{n} d_{ij}, \quad i = \overline{1,m}; \quad j = \overline{1,n}. \tag{11}$$

In other words, the value of weight qi of the investigated criteria is proportionally distributed among all alternative versions aj according to their value xij [16].

Stage 2: The sums of weighted normalized indexes describing the jth version are calculated. The versions are described by minimizing indexes S-j and maximizing indexes S+j. The lower the value of the minimizing indexes such as the price of an alternative, the better the attainment of goals. Further, the greater the value of maximizing indexes such as quality, the better attainment of goals.

Sums are calculated according to

$$S_{+j} = \sum_{i=1}^{m} d_{+ij};$$
$$S_{-j} = \sum_{i=1}^{m} d_{-ij}, \quad i = \overline{1,m}; \quad j = \overline{1,n}. \tag{12}$$

The greater the value S+j then there is more satisfactionof the interested parties. The lower the value S_{+j} the better the attainment of goals of interested parties. S_{+j} and S_{-j} express the degree of goals attained by the interested parties in each alternative. In any case the sums of 'pluses' S_{+j} and 'minuses' S_{-j} of alternatives are always respectively equal to the sums of weights of maximizing and minimizing criteria:

$$S_{+} = \sum_{j=1}^{n} S_{+j} = \sum_{i=1}^{m} \sum_{j=1}^{n} d_{+ij},$$
$$S_{-} = \sum_{j=1}^{n} S_{-j} = \sum_{i=1}^{m} \sum_{j=1}^{n} d_{-ij}, \quad i = \overline{1,m}; \quad j = \overline{1,n}. \tag{13}$$

In this way, the calculations may be additionally checked [16].

Stage 3: The significance of comparative alternatives is determined on the basis of describing positive alternatives S_{+j} and negative alternatives S_{-j} characteristics [16].

Stage 4: Determination of alternative priorities. The greater Qj the higher is the priority of the alternative. Significance Qj of alternative aj indicates the satisfaction degree of demands and goals pursued by the interested parties. In this case, the significance Qmax of the most rational alternative will always be the highest. The significance of all remaining alternatives is lower compared to the most efficient alternative. Total demands and goals of interested parties will be satisfied to a smaller extent than in the case of the best alternative [16].

Relative significance Qj of each alternative aj is found according to

$$Q_j = S_{+j} + \frac{S_{-\min}\sum_{j=1}^{n} S_{-j}}{S_{-j}\sum_{j=1}^{n}(S_{-\min}/S_{-j})}, \quad j = \overline{1,n}. \tag{14}$$

It is assumed that people can measure values of various alternatives, in terms of the so-called utility. Each alternative has its consumer or other interested party's utility. In the proposed method, the utility of alternatives is measured quantitatively [16].

The degree of the alternative's utility is directly associated with the quantitative and conceptual information related to the alternative. If one alternative is characterized by the highest quality level and price indices, while other alternatives show better maintenance characteristics, having obtained the same significance values as a result of multiple criteria evaluation, then this means that their utility degree is also equal. With the increase/decrease of the significance of an analyzed alternative, it was found that, its degree of utility also increases/decreases. The degree of alternative utility is determined by comparing the analysed alternatives with the most efficient alternative. All the values of the utility degree related to the analyzed alternatives will range from 0% to 100% [16].

Stage 5: Utility degree Nj of alternative aj is calculated as

$$N_j = (Q_j : Q_{\max})\ 100\%, \tag{15}$$

where Qj and Qmax are the significance of alternatives obtained from Eq. (14).

In order to find what price will make an alternative of that which is being valuated, competitive on the market, a method for determining the market value of alternatives based on the complex analysis of all their benefits and drawbacks was suggested. According to this method the alternatives market value of an alternative that is being estimated are directly proportional to the system of the criteria that adequately describes them and the values and weights of these criteria. This method and its practical application have been described in several publications [16, 34].

Following the performed analysis of different multiple criteria decision making methods (TOPSIS, SAW, etc.) is it possible to make a conclusion that these methods do not show in what percent one alternative is better than another one. The suggested methods solve this problem. It is a task of the degree of utility. The degree of utility Nj of the alternative aj indicates the level of satisfying the needs of the parties interested in the project. The more goals are achieved and the more important they are, the higher is then degree of the project utility. Having calculated by what percent one alternative is better that another one, the developed new methods allow solving a lot of other problems. For example, it may be used as a basis for determining real estate market value (Table 2.2).

The application of a Multiple Criteria Decision Support On-Line System for Construction (OLSC) allows one to determine the strengths and weaknesses of the alternatives [16].

Calculations were made to find out by what degree one version is better than another and the reasons disclosed why it is so. Landmarks have been set for an increase in the efficiency of construction versions. All this was done argumentatively, based on indexes that were under investigation, on their values and weights and on conceptual information. This saved the users' time considerably by allowing them to increase both the efficiency and quality of construction alternatives analysis. The method for the presentation of recommendations, offered by the authors, is used for the analysis of alternatives and for the preparation of recommendations [16].

Alternative's multiple criteria analysis results

Criteria under evaluation	Measuring units	[a]	Weights	Comparable alternatives (matrix D)					
				1	2	...	j	...	n
X_1	m_1	z_1	q_1	d_{11}	d_{12}	...	d_{1j}	...	d_{1n}
X_2	m_2	z_2	q_2	d_{21}	d_{22}	...	d_{2j}	...	d_{2n}
...	...	...	...	...	...	...	...	...	...
X_i	m_i	z_i	q_i	d_{i1}	d_{i2}	...	d_{ij}	...	d_{in}
...	...	...	...	...	...	...	...	...	...
X_m	m_m	z_m	q_m	d_{m1}	d_{m2}	...	d_{mj}	...	d_{mn}
The sums of weighted normalized maximizing indices of the alternative				S_{+1}	S_{+2}	...	S_{+j}	...	S_{+n}
The sums of weighted normalized minimizing indices of the alternative				S_{-1}	S_{-2}	...	S_{-j}	...	S_{-n}
Significance of the alternative				Q_1	Q_2	...	Q_j	...	Q_n
Alternative's priorities				Pr_1	Pr_2	...	Pr_j	...	Pr_n
Alternative's utility degree (%)				N_1	N_2	...	N_j	...	N_n

[a]The sign z_i ($\pm$) indicates that a greater/lesser criteria value satisfies interested parties.

Table 2.2. Alternative's multiple criteria analysis results

Chapter III. Decision Support System

3.1. A housing health and safety multiple criteria decision support system

Based on the analysis of existing information, expert and decision support systems and in order to determine most efficient versions of housing health and safety a HHS system consisting of a database, database management system, model-base, model-base management system and user interface was developed (Fig. 3.1).

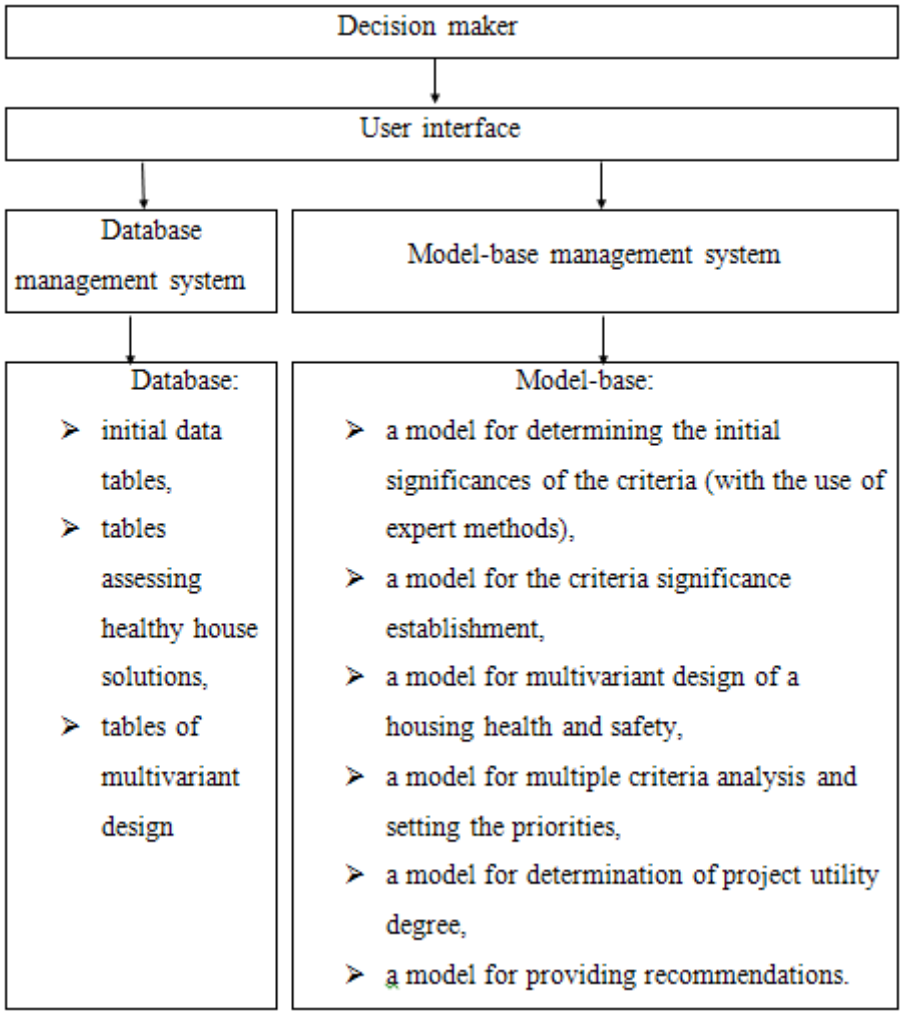


Fig. 3.1. The components of HHS system

According to the user's needs, various models may be provided by a model management system. When a certain model (i.e. search for construction alternatives) is used, the results obtained become the initial data for some other models (i.e. a model for multiple criteria analysis and setting the priorities). The results of the latter, in turn, can be taken as the initial data for some other models (i.e. determination of utility degree of market, suppliers, contractors, renovation of walls, windows and roof, etc.) [13, 16]

The management system of the model-base allows user to select desired additional models related to the existing models provided by a system [15, 16]

3.2. Datebase – 29 hazards

Housing health and safety involves a number of interested parties (i.e. clients, users, designers, contractors, suppliers, maintenance organisations, local authorities, government and its institutions, etc.) pursuing various goals as well as having different potentialities, educational level and experience. This leads to various approaches of the above parties to decision making in this field. In order to thoroughly analyze the alternatives available and obtain an efficient compromise solution it is often necessary to define them on the basis of health, safety economic, qualitative, legal, social, technical, technological and other type of information (Figure 3.5). This information should be provided in a most user-oriented way.

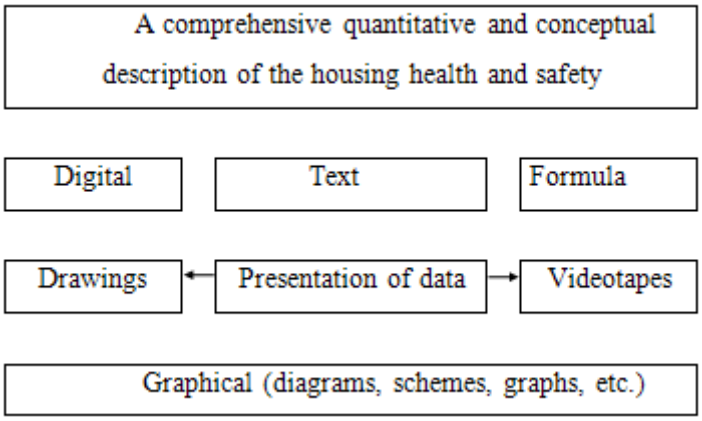


Fig. 3.2. A comprehensive quantitative and conceptual description of the housing health and safety

The presentation of information needed for decision making in HHS system may be in conceptual (digital (numerical), textual, graphical (diagrams, graphs, drawing, etc),

photographical, sound, visual (video)) and quantitative forms. Thus, quantitative information presentation involves criteria systems and subsystems, units of measurement, values and initial significances fully defining the variants provided. Conceptual information means a conceptual description of the alternative solutions, the criteria and ways of determining their values and significances, etc.

In this way, HHS system enables the decision maker to get various conceptual and quantitative information on housing health and safety from a database and a model-base allowing him to analyze the above factors and make an efficient solution.

The analysis of database structures in decision support systems according to the type of problem solved reveals their various utility. There are three basic types of database structures: hierarchical, network and relational. HHS system has a relational database structure when the information is stored in the form of tables. These tables contain quantitative and conceptual information. Each table is given a name and is saved in the computer external memory as a separate file. Logically linked parts of the table make a relational model. The following tables make HHS system database:

- **Initial data tables**. These contain general facts about the building considered and the information of its health and safety.
- **Tables assessing health and safety solutions**. They contain quantitative and conceptual information about alternative housing health and safety solutions.
- **Tables of multivariant design**. They provide quantitative and conceptual information on the interconnection of the elements to be design, their compatibility and possible combinations as well as data on complex multivariant design of a building.

The collection, processing and presentation of information for a database in the computer acceptable form is a complicated time-consuming process. The information collected in a database should be reliable, fully describing housing health and safety as well as enabling HHS system to perform an efficient multivariant refurbishment design and multiple criteria analysis.

To design the structure of a database and perform its completion, storage, editing, navigation, searching, browsing, etc. a database management system was used.

Tables of initial data contain information about the 29 hazards:

Damp & mould growth, excess of cold, excess of heat, asbestos and MMF, biocides, carbon monoxide and fuel combustion products, lead, radiation, uncombusted fuel gas,

volatile organic compounds, crowding and space, entry by intruders, lighting, noise, domestic hygiene, pests and refuse, food safety, personal hygiene, sanitation and drainage, water suply, falls associated with baths, falling on level surface, falling on stairs, falling between levels, electrical hazards, fire, Flames, hot surfaces, collision and entrapment, explosions, position and operability of amenities, structural collapse and falling elements.

The tables of variant assessment contain the variants available and their quantitative and conceptual description. Quantitative description of the alternatives deals with the systems and subsystems of criteria fully defining the variants as well as the units of measurement and values and initial significances. Conceptual description defines the alternatives available in a commonly used language giving the reasons and providing grounds for choosing a particular criterion, calculation its value, significance and the like. The process of drawing up the tables of refurbishing variant assessment consists of the following steps:

- collection and presentation of general information about the variants under consideration,
- establishment and conceptual description of the systems and subsystems of criteria,
- establishing of criteria for choosing the units of measurement,
- estimation of the values of the criteria with the description of the process of calculation and its presentation,
- determination of the initial significances of the criteria with the description of the process of calculation and its presentation.

Based on various sources of information the variants presenting some interest to the client as well as some general facts, a system of criteria, their types (quantitative and qualitative), units of measurement and the range of value estimation are determined. The wider the range of estimating the values and significances of the criteria the more accurate analysis may be done.

The values of the criteria used to describe the alternatives are obtained by analysing the projects as well as using the expert, statistical and other methods, analogies, available recommendations and documents. The accuracy of information about the alternatives presented is of paramount importance, the objective character of the choice of the most efficient variant being largely dependent on it. It should be noted that quantitative information is sufficiently objective. Actual projects have actual costs and maintenance expenditures. The values of the qualitative criteria are usually rather subjective though the

application of expert methods contributes to their objectivity. The initial significances of all criteria are obtained by using expert methods. In addition, based on various specifications and standards as well as expertise results and the client's requirements, some limitations on the criteria determining the rejection of the variants from further analysis in case the latter do not satisfy them can be established.

Uniform types of relational tables have been chosen to facilitate entering of appropriate data into the database. Such unified database also make it possible easily correct and introduce new information as well as efficiently carrying out computation.

The above tables are used as a basis for working out the matrices of decision making. These matrices, along with the use of a model-base and models, make it possible to perform multivariant design and multiple criteria evaluation of alternative building refurbishing projects resulting in the selection of most beneficial variants.

In order to design and realise an effective housing health and safety project the alternatives available should be analysed. Computer-aided multivariant design requires the availability of the tables containing the data on the interconnection of the elements to be renovated and the solutions made as well as their compatibility, possible combination and multivariant design.

Since the objectives and financial situations of HHS system users often vary the initial design data and, consequently, the results obtained will also be different. Therefore, the objectives and the financial situation of the clients are expressed quantitatively and provided as the initial data for calculations. These data should be related to the other information of the tables. Based on the above tables of multivariant building design possible refurbishment variants are being developed. When using a method of multivariant design suggested by the author until 100 000 000 alternative housing health and safety projects may be obtained. These project versions are checked for their capacity to meet various requirements. Those which can not satisfy these requirements raised are excluded from further consideration. In designing a number of variants of housing health and safety the problem of significance compatibility of the criteria arises. In this case, when a complex evaluation of the alternatives is carried out the value of criterion significance is dependent on the overall criteria being assessed as well as on their values and initial significances.

3.2.1. Database of the problem analysis

3.2.1.1. Analysis of Damp & Mould growth

Damp and mould is a problem that, most probably, every occupant of a dwelling found it. There are cases where it is a very enormous quantity and can be very dangerous for the people's health. Also is giving a very bad view where appers (fig. 3.3).

Fig.3.3. Representative pictures for "Damp and Mould" hazard

Description of the hazard

This category covers threats to health associated with increased prevalence of house dust mites and mould or fungal growths resulting from dampness and/or high humidities. It includes threats to mental health and social well-being which may be caused by living with the presence of damp, damp staining and/or mould growth [19].

Potential for harm

The most vulnerable age group is all persons aged 14 years or under [19].

Health effects

- *Physiological health effects*

Both the detritus from house dust mites and mould spores are potent airborne allergens. Exposure to high concentrations of these allergens over a prolonged period will cause sensitisation of atopic individuals (those with a predetermined genetic tendency to sensitisation), and may sensitise non-atopic individuals. Once a person is sensitised relatively low concentrations of the airborne allergen can trigger allergic symptoms such as rhinitis, conjunctivitis, eczema, cough and wheeze. For a sensitised person, repeated exposure can lead to asthma, and it appears that the severity of the asthma intensifies with increasing humidity, house dust mite and mould levels.

Deaths from all forms of asthma in the UK are around 1,500 a year, of which around 60% has been attributed to dust mite allergy. 20 to 30% of asthma sufferers are sensitised to mould spores. One in eight children suffer with asthma in the UK, compared with one in thirteen adults [19].

- *Dust mites*

Allergens associated with house dust mites (found in the mite faecal pellets) are the most common triggers of asthma, and are also implicated as a causal agent of the illness. Around 80% of atopic children who suffer from asthma are sensitised to house dust mites, and about a third of all children, whether asthmatic or not, display some evidence of allergy to them [19].

- *Mould growth*

Although less significant statistically in health terms, spores of many moulds and fungi (including timber attacking fungi) can be allergenic. The spores can also be carcinogenic, toxic and cause infections; the potential health effect varying with species.

Fungal infection, whilst not common, is usually associated with those vulnerable to infection (such as those on immuno-suppressant drugs). Some fungi, particularly when in very high concentrations, can also colonise the airways of susceptible individuals, particularly asthmatics. Toxins from some moulds (mycotoxins) can cause nausea and diarrhoea, can suppress the immune system, and have been implicated in cancers.

Although uncommon, these are serious if they occur [19].

- *Social and mental health effects*

The mental and social health effects of dampness and mould should not be underestimated.

Damage to decoration from mould or damp staining and the smells associated with damp and mould can cause depression and anxiety. Feelings of shame and embarrassment can lead to social isolation [19].

Causes

The indications are that house dust mite populations and indoor mould growth have increased over the last century. This is probably because of reduced ventilation levels, increased humidities, and warmer indoor temperatures in winter months caused by changes in dwelling design and adaptations introduced when houses are renovated [19].

Both house dust mites and moulds flourish in damp or humid conditions, and their growth is also influenced by temperature. Where relative humidities are within the optimum range, increasing temperatures results in reduction in dust mite populations [19].

However, where there are high humidities, outside the optimum range, increasing temperatures can result in increased mite populations and mould growth. Moulds can grow when the indoor relative humidity persistently exceeds 70% [19].

Moisture production is influenced by the design, construction and repair of the dwelling, and on occupant density and activity. Moisture is produced by occupants through their normal biological and domestic activities. Relatively low levels of moisture are generated through breathing and are spread out over the twenty-four hours [19].

However, there are higher levels produced in peaks from cooking, clothes drying and bathing (or showering). Vapour pressure will equalize humidities throughout a dwelling, so that damp in one part will have an impact on relative humidities in other parts [19].

There should be continuous low-level of background ventilation. Small reductions in the ventilation rate below 0.5 air changes per hour can greatly increase the mite population [19].

Increasing the rate to above 0.7 air changes per hour can also lead to an increase in the mite population in a dwelling which is not adequately heated. Use of mechanical heat recovery ventilation (MHRV) systems can allow an increased air change rate (around 0.9 per hour) without the same heat loss. Dwellings which can be expected to have high occupant density and small room sizes may require increased ventilation and heating/insulation to prevent problems [19].

Hygrothermal conditions are considered the most important limiting factor in house dust mite population growth. However, furnishing, especially the age and type of mattresses, and mode of housekeeping, can also have some influence [19].

Relevant matters affecting likelihood and harm outcome

Matters relevant to the likelihood of an occurrence and the severity of the outcomes include:

a) Energy efficiency – inadequate heating and insulation of the dwelling.

b) Background ventilation – lack of controllable background ventilation.

c) Extract ventilation – lack of safe and accessible means for the extraction of moisture laden air during cooking, bathing or showering.

d) Clothes drying facilities – lack of facilities ventilated to the external air.

e) Damp proofing – in disrepair or otherwise inadequate, resulting in rising or penetrating dampness.

f) Disrepair – floors, walls or roofs allowing water penetration.

g) Exposed water tanks and pipework – inadequate frost protection.

h) Water using appliances – inadequately installed and sealed facilities, such as baths, showers, wash hand basins and wc basins which may permit splashing.

i) Plumbing and waste pipes – inadequately installed, or disrepair to, waste pipes or plumbing serving water using appliances (such as baths, showers, wash hand basins, bidets and sinks).

j) Rain water goods – inadequate or defective.

k) Roof and sub-floor spaces – inadequate ventilation.

l) Small rooms sizes – may result in high occupant density [19].

Hazard assessment

The many variables mean that, perhaps more so than for other hazards, the assessment is one of professional judgement rather than measurement. Consideration should be given to the design, condition and state of repair of the dwelling. The location, extent and duration of any dampness identified are important determinants of the effect it may have on dust mite populations and mould growth, and the consequent potential for harm [19].

The immediate local climate and exposure should also be taken into account. Areas of high rainfall will influence penetrating dampness. Altitude and wind exposure will affect the thermal efficiency and associated condensation/high relative humidities [19].

Prevailing weather conditions should be taken into account. While a temporary spell of good weather may result in dry conditions when an inspection is undertaken, the assessment is for a twelve month period. Penetrating and rising dampness may be less prevalent during dry weather. Condensation is less likely outside cold and winter months. Damage to decoration, mould growth, and/or structural deficiencies are indicative of potential problems [19].

Dwelling size is a relevant factor, a small dwelling can cope with less moisture than a larger dwelling. The location of the damp and/or mould is also relevant, the threat to health being influenced by the number and intended use of the affected room(s). Damp affected bedrooms are probably more important since mattresses tend to support larger dust mite populations than other furniture and furnishings. Also the most vulnerable age group normally spend a large proportion of the day in their bedrooms, both because that group typically require 9 to 14 hours sleep per day and because bedrooms are often also used for homework [19].

The cause of the dampness is also relevant to the assessment. Condensation is a symptom of high humidities, while other types of dampness are potential causes of high humidities, rather than being a symptom [19].

Measurement of background ventilation rates and of thermal efficiency may be appropriate in some circumstances. Thermal efficiency is usually assessed using the Government's Standard Assessment Procedure [19].

For dwellings where rooms are occupied for both living and sleeping, such as bedsits and small flats in multi-occupied buildings, then the presence of dampness may be more significant as occupants can be expected to spend a greater proportion of time exposed. This can be compounded if the room is also used for cooking [19].

Recommendations

The following recommendations will be found also in Appendix I and are translated in Spanish and Romanian language.

A mould appears because of the poorly ventilated rooms, where warm air and humidity is circulating and frequently because of not enough cleaned houses [20].

You need to fight with a mould instantly in several ways: first of all you need to remove reasons, which lead to formation of mould, then eliminate already existing moulds. The humidity in house accumulates from wide variety of phenomena like from watered flowers, cooked food, washed and dried clothes and etc. Rising water vapour gathers on the walls and in such way creates good conditions for the moulds to grow. A mould can appear for many reasons, starting with poor ventilation of the rooms and ending with building spoilage [20].

However, nevertheless, there is a big impact on how carefully cleaning of premises is made. First step - at least few times a day ventilate rooms well. Most of us make a huge mistake: leave slightly jammed window, but house does not ventilate in that way. The best ventilation method is to open the windows wide for several minutes. If an amount of humidity in the house is very big, one of the effective ways is to acquire dehumidifiers [20].

Sometimes foundation, which does not have waterproofing, is responsible due to excessive amount of humidity. Mostly it is common for the old houses, however in this case nor wall restoration, nor isolation of foundation does not help. If foundation is really responsible, expensive special system, which is capable of stopping rise of humidity, needs to be used [20].

First of all mould focus has to be neutralized – in order to prevent mould from spreading in its removal process. Mould needs to be scraped from the surface well. Since mould gathers not only on surface, but penetrates to the walls too, therefore it needs to try to exterminate it from inside. For that baking soda and washing powder solution can be used(add 100 grams of baking soda and a tablespoon of washing powder to the 10 litres hot water). With this solution damaged wall spots are washed. It is not enough to disinfect with mould removal preparations [20].

Next step in mould extermination process is examination of adjacent zones and disinfection. For this step special equipment needs to be used, which helps to identify whether mould infected the surrounding surfaces, because as it is known, in his early stages mould cannot be seen with a naked eye. It is very important stage, because after cleaning only the clearly visible hot spots without disinfecting surrounding areas, provides a possibility of formation of a new mould or generally, mould problem renewal in house [20].

Formation of condensate

The reason why windows dew is simple - humidity is in premises. The warmer air, the more it stimulates emergence of moisture. The coldest spot in windows is glass package. Warm indoor air contacts with cooler glass surface and becomes water. This problem often arises in winter time, when air temperature is very low outside. Although condensate may occurs in summer. In winter, condensate appears from the inside, on the surface of glass, in summer - from outside. If it happens in summer - it is only esthetical problem, but in winter condensate (or even icing) can damage the same windows and window opening. Window less isolates indoors from cold than insulated wall, no matter what kind of glass would be in use in glass unit. If unfavourable conditions arise, condensate can appear on plastic or wooden window and on all kind of glass. However, if vapour or condensate arises inside of glass package, it means, that it is not hermetic. Then window's glass package has to be replaced by the new one. If condensate or ice arises from room side, it means, that room window is too moist. Within the perimeter of the glass unit there is remote aluminium frame, therefore a corner of window's glass package is the coolest (of course, if temperature outside is lower than inside). When weather is too moist, then water vapour in air condensates in direction of coolest window part and if temperature outside is very low, water on window freezes. Later on ice melts and water leaks on windowsill. The reason, why condensate

appears on one window and on other does not, is that level of moist in different rooms is various [10].

It is very important to avoid condensate and ice creation on glass. New, modern window main advantage “airtightness” in this case became a little deficiency. Therefore indoors need to be ventilated by opening a window. It is required to ventilate premises few times per day. Short ventilation is enough in order to fill room with fresh air, while temperature do not decrease much [1].

If there is possibility, maintain internal glass temperature as high as possible. If there is radiator under a window, try not to cover it with wide windowsill or mill the holes in a sill. Long curtains or louvers, which prevent air circulation, should not be in premises. Do not cover radiator, do not dry clothes on radiator, do not cook food or grow big amount of plants, because that way creation of moisture is promoted and it does not allow air circulate normally [1].

The structure and finishes of a dwelling should be maintained free from rising, penetrating and traumatic dampness, or persistent condensation [19].

Dwellings should be warm, dry and well-ventilated. Indoor relative humidity should be between 40% and 60%, except for short periods of fluctuation. This range is the optimum to limit the growth of house dust mite populations and mould growth. It is also the recognized comfort zone [19].

Rising and penetrating dampness should be prevented by proper and adequate dampproofing including damp proof courses and membranes and detailing around door and window openings. The external fabric should be kept in repair to prevent rain penetration. Preventative measures including frost protection, will help avoid traumatic problems such as burst pipes and tanks [19].

All facilities which involve the use of water (for example, baths, wash hand basins, sinks, showers, and wc basins) should be properly installed to prevent or at least minimise the risk of dampness from splashing during normal use. Such facilities should be properly connected to a waste pipe capable of safely carrying waste water to a drainage inlet outside the dwelling [19].

There should be properly installed rain water goods, including eaves gutters and rainwater fall pipes, capable of safely collecting rainwater discharged from the roof and carrying it safely away from the dwelling either into a drainage inlet or other proper means of disposal [19].

Roof and underfloor spaces should be properly ventilated to ensure timber remains airdry to minimize the chance of fungal infection [19].

The dwelling should be able to cope with normal occupant moisture producing activities without persistently high relative humidities. There should be provision for the safe removal of moisture-laden air during peak production. This should include extraction during cooking or bathing, either by mechanical means, or passive stack ventilation and direct venting of clothes drying facilities (whether tumble driers or drying cabinets) to the exterior [19].

There should be sufficient and appropriate means of ventilation to deal with moisture generated by normal domestic activities without the need to open windows. Opening windows can result in heat loss, noise, and may be a security risk. There may be no need for additional background ventilation where windows are ill-fitting, no draughtstripping, and/or where there are open chimney flues. Where there is draught-stripping, or tight fitting windows, provision for background ventilation may be necessary via trickle vents in replacement windows, insertion of high-level airbricks, or by a passive stack or a MHRV system [19].

If moisture levels are controlled, through adequate ventilation, dust mite populations can be significantly reduced by raising indoor temperatures. To achieve this, there should be adequate structural thermal insulation, and appropriate means of space heating [19].

Damp and mould brochure recommends:

In Europe, an estimated 10-50% of the indoor environments where human beings live, work and play are damp. Too much moisture makes a home stuffy and gives it a faint odour. Humid walls create a coldness that makes more heating necessary and increases energy bills [32].

Occupants of damp or mouldy buildings are at increased risk of experiencing health problems such as symptoms, respiratory infections, allergic rhinitis and asthma [32].

The problem of Excessive Moisture can take the form of: DAMP AIR, CONDENSATION ON SURFACES and INCREASED HUMIDITY levels in materials [32].

If you have concerns about a health problem that may be related to humidity in your home, always contact your general practitioner [32].

Practical tips on getting rid of damp and mould

Measures to prevent or reduce moisture are the main way to limit the development of mould (and any microbial) growth: WITHOUT WATER - NO MOULD!!!

1. Detecting and locating the source of the moisture problem

Moulds only grow when there is sufficient moisture. When mould appears, the first task is to establish where the moisture is coming from [32].

Major causes for excessive moisture are [32] :

- Leaking pipes, wastes or owerflows;
- Rain seeping through the roof where a tile or slate is missing, spiling from a blocked gutter, penetrating around window frames, or leaking through a cracked pipe;
- Rising damp due to a defective damp course or because there is no damp-course.

These causes of damp leave a "tidemark" and you should have the necessary repairs carried out to remove the source of damp [32].

If your house is newly-built it may be damp because the water used during its construction is still drying out [32].

If your home is damp for any if these reasons, it may take weeks of heating and ventilating to dry out. Hiring a dehumidifier may also help [32].

When the source of moisture does not appear to be related to structural faults, leaks or rising damp or the newness of the property, it is probably due to condensation [32].

2. Removing the mould

After indentifying and reducing /removing the moisture sources, the next step is to decide whether removing the mould from the affected areas is something that can be managed without professional help [32].

When the cause of the mould is related to building faults (leakages etc.) and/or the mould is also present in the building structure and material, it is recommended to get professional help [32].

In this case, it may be useful to consult a national or local source of information to guide you in your selection of a suitable contractor.

If mould growth is due to condensation and the mould area is less than 1 m2 (i.e., 1 metre high by 1 metre wide or roughly 3 feet high by 3 feet wide) and is not caused by

sewage or other contaminated water, you can probably manage the job yourself following these guidelines or some of those listed in the references, such as the guidelines of the US Environment Protection Agency (EPA). Many national institutes have also published guidance documents in national languages [32].

Whether the job is undertaken by a contractor or yourself, care has to be taken to avoid personal exposure to microscopic mould spores and the spread of spores within the building. If you yourself are undertaking the task of the mould removal, use a protective mask which covers your nose and mouth, wear goggles (without ventilation holes) to avoid getting mould or mould spores in your eyes, and protect your hands by wearing rubber gloves, preferably long ones [32].

Chemical desinfection and the use of biocides are not recommended as a routine practice for mould control as it may be toxic for the occupants. The application of disinfecting substances also does not solve the cause of the problem, and therefore may provide more health risks than benefits [32].

Removal of mould-contaminated materiales [32]:

a) Have a big bag ready to take away mildewed clothes, curtanins, rugs and carpets for cleaning. Consider replacing a mattress or soft toy that smells and feels damp.

b) The process of cleaning will release mould spores into the air. Open any windows but close doors tightly to help prevent the spores being spread to other areas of the house. Leave the windows open during and after the clean up activity.

c) Prepare a bucket of water, some mild detergent, such as washing up liquid or a soap used for hand washing clothes, and some rags that can be thrown away after removing the mould.

d) Carefully wipe the mould off the wall surface with the soapy rag. Take a dry rag to wipe down and remove the moisture following the cleaning process. Put the rags in a plastic prior to disposal.

e) After mould removal, allsurfaces in the room should be thoroughly cleaned either by wet wiping or by vacuum cleaning, preferably with a HEPA filter to remove spores that have spread during mould removal.

Once the work of removing the mould is completed, your energies should turn to preventing it from reappearing. The following section provides advice on preventing dampness and condensation [32].

3. Taking action to control excessive moisture and condensation

If your problem is not from a leak or a faulty or non-existent damp-course, it is probably caused by condensation [32].

Three factors contribute to the condensation of water on building surfaces: high humidity of indoor air, low temperature of the walls/surfaces and poor ventilation [32]:

1) Humidity of indoor air: condensation appears when the indoor air in a room cannot hold the level of moisture than cold air. For example, running a bath causes steam. As the air in the bathroom fills up with water vapour, it can no longer hold all the moisture that it contains. As a result, tiny drops of water appear, and develop first on cold surfaces such as mirrors and window sills.

2) Low tenperature: Condensation can be worse when it is cold. The humid air comes into contact with cold indoor surfaces, transforms into surfaces mist and then into water that runs down the window causing wooden frames to rot and wallpaper and painted walls to blister. The tell-tale signs of dampness are often found on north-facing walls, the cooler sie of any home, and especially in corners of rooms.

3) Poor ventilation: Humidity of indoor air can be reduces by ventilation. If air exchange is inadequate, then humidity accumulates indoors and leads to increased condensation. In addition, walls remain cool when a lack of free movement of indoor air prevents warm air from reaching them. Mould may therefore form where there is little movement of air, for example, in a windowless basement, or behind wardrobes and cupboards. In places where low ventilation comes together with cold surfaces, they become the priority risk areas for mould growth.

After cleaning up mould due to condensation, stopping the dampness from coming back means understanding and dealing with each other of the causes of condensation [32].

How to prevent condensation

a. Produce less moiusture: 1.put a lid on saucepans to keep the steam inside 2. Do not leave kettles boiling 3. Dry washing outside if possible. Otherwise, hang it up in the bathroom, close the dooe and have the window open or a fan working continuosly while it dries 4.Try to avoid usig paraffin or bottled-gas heaters that do not have an exhaust pipe to the outside. Burning paraffin or gas produces considerables amounts of water [32].

b. Ventilate to remove moisture: 1. ventilate all the rooms at the regular intervals to remove humid air. Note that tight buildings require more active ventilation! 2. Mechanical ventilation systems should not be stopped 3. Cooking, bathing and showering all produce steam. Open the window or put on the fan and close the door to prevent the damp air circulating into other rooms. 4. At other times, leave all the doors to different rooms open to allow the air to circulate 5. To avoid condensation in bedrooms, open the window for 15 minutes each morning. Human breathing puts considerable moisture into the indoor air 6. Move items of furniture away from the wall slightly so that air can pass behind them. Leave the doors of cupbroads open from time to time to air them 7. Do not ventilate cold basements when the outside temperature exceeds the inside temperature because the humidity of the warm air will condensate on the cold surfaces. In summer, only ventilate basements at night when outdoor temperatures have dropped [32].

c. Insulate your building or heat your home a little more: 1. Thermal comfort ranges are very subjective. When at home, the ideal temperature usually ranges between 19-22 degrees Celsius in the living room, including the kitchen and bathroom, and 16-20 degrees Celsius in the bedrooms 2. When away from home, the temperature in the rooms should not drop under 15 degrees Celsius to avoit condensation and increased humidity levels 3. Do not heat up cold bedrooms in the evening by opening the door to heated rooms. The warm air and humid air will condensate on the cold walls on the bedroom 4. Good insulation on the building helps preventing mould growth due to higher temperature of the walls. Again: note that tight windows and buildings require more active ventilation [32]!

If the problem persist!!! Some households will find that despite taking steps to reduce the condensation, humidity remains a problem. It may then be worth considering: 1.covering cold surfaces, such as cold water pipes, with insulation 2. installing ventilation flaps or grills in windows 3. using electric fans and forces ventilation systems 4. contracting a professional building inspector for a thermal insulation assessment 5. insulating the loft or wall cavity, and draught-proofing windows and doors [32].

3.2.1.2. Analysis of Radiation

Radiation can cause lung cancer, and that is why needs to receive a very close attention. Specialists developed this subject, studied the way of how radon could enter in a house (fig.3.6.).

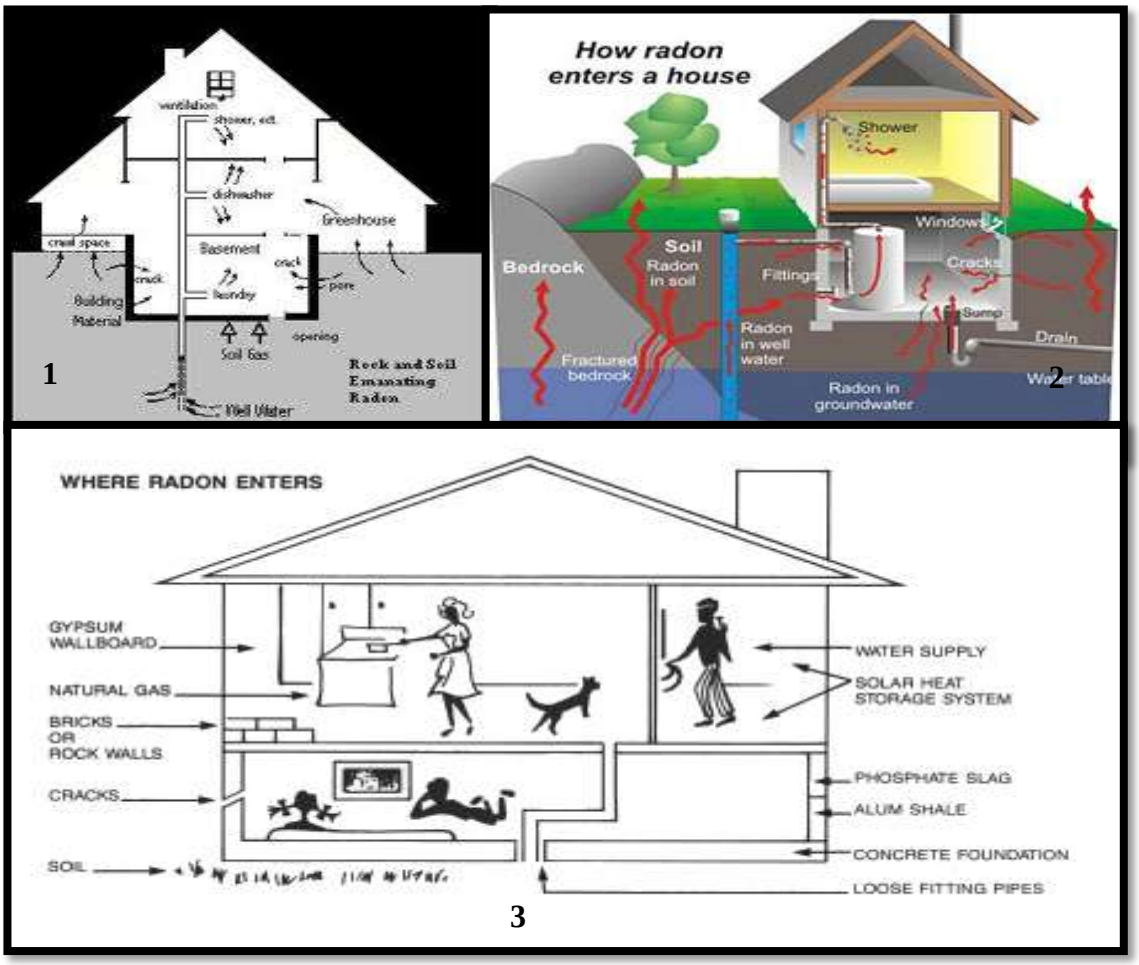


Fig.3.4. "Radon" hazard

Description of the hazard

This category covers the threats to health from radon gas and its daughters, primarily airborne, but also radon dissolved in water [19].

Concern has been expressed about the possible health effects of electromagnetic fields (EMFs). Low frequency fields are produced whenever an electric current is flowing and can be found in the vicinity of power lines, electricity sub-stations and electrical appliances. High frequency fields are produced by mobile telephones and their masts, television and radio transmitters, microwave ovens and radar. At present, there is no

clear evidence of a risk to health from low level exposure to the EMFs normally found in the domestic environment [19].

Leakage from microwave ovens might also be considered under this hazard category where the oven is provided by a landlord in furnished accommodation. However, the incidence of significant microwave leakage is extremely rare [19].

Potential for harm

The most vulnerable age group is all persons aged between 60 and 64 years who have had lifetime exposure to radon [19].

Health effects

Radiation is the process of energy emission as waves or particles. There are two forms:

- **Ionising radiation**

which includes alpha (a) particlesresulting from the decay of radon, can pass through the tissues of the body and hassufficient energy to damage DNA and cause genetic mutation [19].

- **Non-ionising radiation**

such as ultraviolet radiation, microwave, and radio-frequency radiation, does not have sufficient energy to damage DNA directly [19].

Radon

Radon gas is the second most important cause of lung cancer after smoking, and most radon exposure occurs at home. Risk estimates suggest that up to one in 20 cases of lung cancer in the UK can be attributed to residential radon exposure, and this figure will be higher in some areas. This amounts to around 3,000 lung cancer deaths per year, of which 1,000 are in non-smokers [19].

The risk of lung cancer is attributable to the radon gas decay products, which are themselves radioactive. Radon decays rapidly and the resulting products can very quickly attach themselves to particles in the air. If these particles are inhaled, they can be deposited in the lungs where the process of radioactive decay continues. The a particles emitted can cause cells lining the lungs to be genetically mutated, and initiate cancer, or facilitate a process already initiated by other carcinogens. The risk related to radon increases with dose and duration of exposure [19].

There is strong epidemiological evidence that radon gas is a cause of lung cancer. Although weaker, there are indications that other organs may be targeted by radon through ingestion and skin contact. Malignancies resulting from these exposures may include leukaemia (acute lymphatic leukaemia in children) and skin cancer.
As radon is soluble in water, it can be ingested resulting in the organs of the gastro intestinal tract receiving the largest dose [19].

Since 1990 the UK government has set 200 Bq m-3 as the Action Level for radon gas in homes. This is the recommended limit for the annual average radon gas level in homes. The lifetime risk of lung cancer for smokers at the Action Level of 200 Bq m-3 is a 10 to 15%, compared to a 1 to 3% risk for non-smokers [19].

EMFs

The levels of non-ionising radiation, or EMFs, usually found within dwellings are insufficient to cause significant harm to health [19].

Causes

Natural sources account for 85% of the total exposure to ionising radiation of the UK population, the majority of which is from radon gas in buildings. Radon dissolved in water supplies is only found in significant quantities in private water supplies in areas where there are high levels of radon gas [19].

While there is no completely safe level of radon, the risk is small at low levels at the UK average level of 20 Bq m-3 for airborne radon in dwellings [19].

Radon gas is naturally occurring in the UK, but the amount varies from place to place. Concentrations tend to be highest in areas where the underlying rock is granite, but can occur in other areas. In the open air radon is diluted to very low concentrations, but in confined spaces, such as within a building, it can accumulate and reach concentrations hazardous to health [19].

Indoor levels depend on the concentration of radon in the ground, the design and state of repair of the house, and the way the house is heated and ventilated. Radon levels between similar houses, even those in the same street, can vary widely [19].

The gentle suction created by the normally lower atmospheric pressure within building draws radon gas in through holes, cracks and gaps in the floor. This will occur most readily with suspended timber floor, but any breaches of solid floors or damp proof

membranes will allow the gas to penetrate into the dwelling [19].

Upper floor ventilation, particularly with open chimney flues (whether used or unused), can create a stack effect, drawing radon-rich air from under the dwelling. Extractor fans can sometimes aggravate radon problems if a suitable air inlet is not provided, as they may draw soil gas into the house [19].

Problems with radon gas typically affect houses and dwellings in the lower storeys of a building. Flats located above ground floor level, and which are separated from the lower flats, by, for example, fire resisting construction, tend to be less affected.

Radon is not found in major public water supplies in concentrations which pose a threat to health. Private water supplies may have elevated levels of radon, particularly in areas where there are elevated levels of uranium and radon in the underlying rock and soil (typically Action Areas). However, less is known about the risks from radon in drinking water than that in air [19].

Relevant matters affecting likelihood and harm outcome

The primary relevant matter is whether the dwelling is sited in an Affected Area. If it is, then the following matters may increase the likelihood of an occurrence:

a) Timber ground floor – ground floor of suspended timber construction particularly if without adequate sub-floor ventilation.

b) Disrepair to solid floor – holed, cracked or other disrepair to a solid ground floor.

c) Lack of DPM – lack of or defective damp proof membrane to solid floor.

d) Sealing around services – inadequate sealing around service entry points, and similar disrepair.

e) Ventilation rates – high upper-level ventilation rates.

f) Open fires – use of open fires and solid-fuel-effect open fires, without additional through the wall ventilation.

g) Remedial measures – disrepair to any remedial measures, such as a radon sump or associated fan.

h) Extractor fans – continuous use of extractor fans in kitchens, bathrooms or wcs.

i) Private water supply – particularly if from a borehole or well [19].

Hazard assessment

Radon in the air

There is little if any need to consider radon as a hazard unless the dwelling is in an Affected Area [19].

If the dwelling is in an Affected Area, then the construction and condition of the ground floor and the presence of open chimney flues and the means of ventilation should be assessed. If present, the state of any remediation measures should be checked. However, the condition of these will only indicate that there could be a problem. And, as radon levels can vary widely between apparently identical dwellings, the only way to determine whether or not there is a threat to health is by measurement [15].

Radon in the water supply

As for radon gas, the only way to determine whether or not there is a high level in a *particular water supply is by measurement* [19].

Recommendations

The following recommendations will be found also in Appendix III and are translated in Spanish and Romanian language.

For existing dwellings one remedial technique is to provide a radon sump, a hollow under the floor with a low power fan to disperse the gas into the open air. Other, but less effective options include increased air flow under a timber floor, and installing a whole house positive pressurisation system [19].

All new dwellings should be constructed to achieve radon gas levels as low as is practicable. For existing dwellings in Affected Areas (ie, identified areas where radon emissions are likely to be above the Action Level) remedial measures should be adopted [19].

It is easier and much less expensive to design and construct a new building with radon-resistant and/or easy to mitigate features than to add these features after the building is completed and occupied [26].

There are three techniques that help us to prevent radon:

1. Install and active soil depressurization (ASD) system

2. Pressurize the building using the heating, ventilating and air conditioning (HVAC) system

3. Seal major radon entry routes [26]

Radon can enter in a building in different ways: from the soil gas through pressure driven transport, through difussion, well water and construction materials [26].

Pressure driven transport: A suction fan is used to produce a low-pressure field under the slab.This low-pressure field prevents radon entry by causing air to flow from the building into the soil [26].

Diffusion is the same mechanism that causes a drop of food coloring placed in a glass of water to sperad through the entire glass; is rarely met. Well water that is supplied directly to a building and that is in contact with radium-bearing formations can be a source of radon in a building. Radon can also emanate from building materials but is very rarely [26].

Soil Depressurization.: A suction fan is used to produce a low-pressure field under the slab.This low-pressure field prevents radon entry by causing air to flow from the building into the soil [26].

Steps

1.Place a clean layer of coarse aggregate of narrow particle size distribution (naturally occurring gravel or crushed bedrock) beneath the slab.

2. Eliminate all major barriers to extension of the subslab low pressure zone, such as interior subslab walls.

3.Install radon suction pit(s) beneath the slab in the aggregate (one radon suction pit for each area separated by subslab walls)

4.Install a vent stack from the radon suction pit(s) under the slab to the roof.

5.Install a suction fan on the vent stack. (The fan should be operated continuously, and the system should be equipped with a warning device to indicate loss of negative pressure through fan failure or other causes.)

6.Seal all major slab and foundation penetrations [26].

Building Pressurization. indoor/subslab pressure relationships are controlled to prevent radon entry. More outdoor air is supplied than exhausted so that the building is

slightly pressurized compared to both the exterior of the building and the subslab area [26].

Steps

1. In radon-prone areas, eliminate air supply and return ductwork located beneath a slab, in a basemen or in a crawl space.

2. Supply outdoor air.

3. Construct a “tight” building shell to facilitate achieving a slightly positive pressure in the building.

4. Seal slab, wall, and foundation entry points , especially in areas of the building planned to be under negative pressure by design (such as rest rooms, janitor’s closets, laboratories, torage closets, gymnasiums, shops, kitchen areas).

5. Ensure proper training and retraining of the HVAC system operators, together with an adequate budget, so that the system is properly operated and maintained. (This appears to be a major area of neglect in existing school buildings.)

6. In areas with large exhaust fans, supply more outdoor air than air exhaustedif possible [26].

Sealing Radon Entry Routes

Because the greatest source of indoor radon is almost always radon-containing soil gas that enters the building through cracks and openings in the slab and substructures, a good place to begin when building a radon-resistant building is to make the slab and substructure as radon-resistant as economically feasible [26].

Steps

Radon entry routes that should be sealed are:

- Floor/wall crack and other expansion joints. Where code permits, replace expansion joints with pour joints and/or control saw joints because they are more easily and effectively sealed.
- Areas around all piping systems that penetrate the slab or oundation walls below grade (utility trench, electrical conduits, plumbing penetrations, etc.).
- Masonry basement walls [26].

3.3. Model base

Since the efficiency of a housing health and safety variant is often determined taking into account health, safety, economic, aesthetic, technical, comfortability, legal, social and other factors a model-base of a decision support system should include models enabling a decision maker to do a comprehensive analysis of the variants available and make a proper choice. The following models of model-base are aimed to perform this function:

- a model for determining the initial significances of the criteria (with the use of expert methods),
- a model for the criteria significance establishment,
- a model for multivariant design of a housing health and safety,
- a model for multiple criteria analysis and setting the priorities (fig. 3.5, fig.3.6, fig.3.7)
- a model for determination of project utility degree (fig. 3.5, fig.3.6, fig.3.7)
- a model for providing recommendations.

Based on the above models, a HHS system can make until 100 000 000 housing health and safety alternative versions, performing their multiple criteria analysis, determining utility degree and selecting most beneficial variant without human interference.

According to the user's needs, various models may be provided by a model base management system. When a certain model (i.e. determining the initial significances of the criteria) is used the results of the calculations obtained become the initial data for some other models (i.e. a model for multivariant design of a housing health and safety, a model for multiple criteria analysis and setting the priorities), while the results of the latter, in turn, may be taken as the initial data for some other models (i.e. determining project utility degree, providing recommendations, etc.).

A management system of the HHS model base provides the user with a model base allowing him to modify the models available, eliminating those which are no longer needed and adding some new models linked with the existing ones.

In order to check the correctness of the suggested HHS system, the whole of its solution process has been more than once gone through manually. The results of manual and computer calculations matched. Besides, all separate working stages of the HHS system as

well as all complex calculations have been coordinated with experts in this field - i.e. the essence of the calculations has been found to be in conformity with their logical reasoning. Owing to suggestions of these experts, some useful changes have been introduced into the HHS system. The check-up by the experts is bound with the fact that universal decision making methods are not always suitable for specific tasks and can lead to gross errors or to bad results altogether.

The more alternative versions are investigated before making a final decision, the greater is the possibility to achieve a more rational end result. Basing oneself on possessed information and the HHS system it is possible to perform multiple criteria analysis of health and safety projects components and select the most efficient versions. After this, the received compatible and rational components are joined up into projects. Having performed multiple criteria analysis of projects made up in such a way, one can select the most efficient ones. Strong and weak sides of investigated projects are also given an analysis. Facts of why and by what degree one version is better than the other are also established. All this is done basing oneself on conceptual and quantitative information.

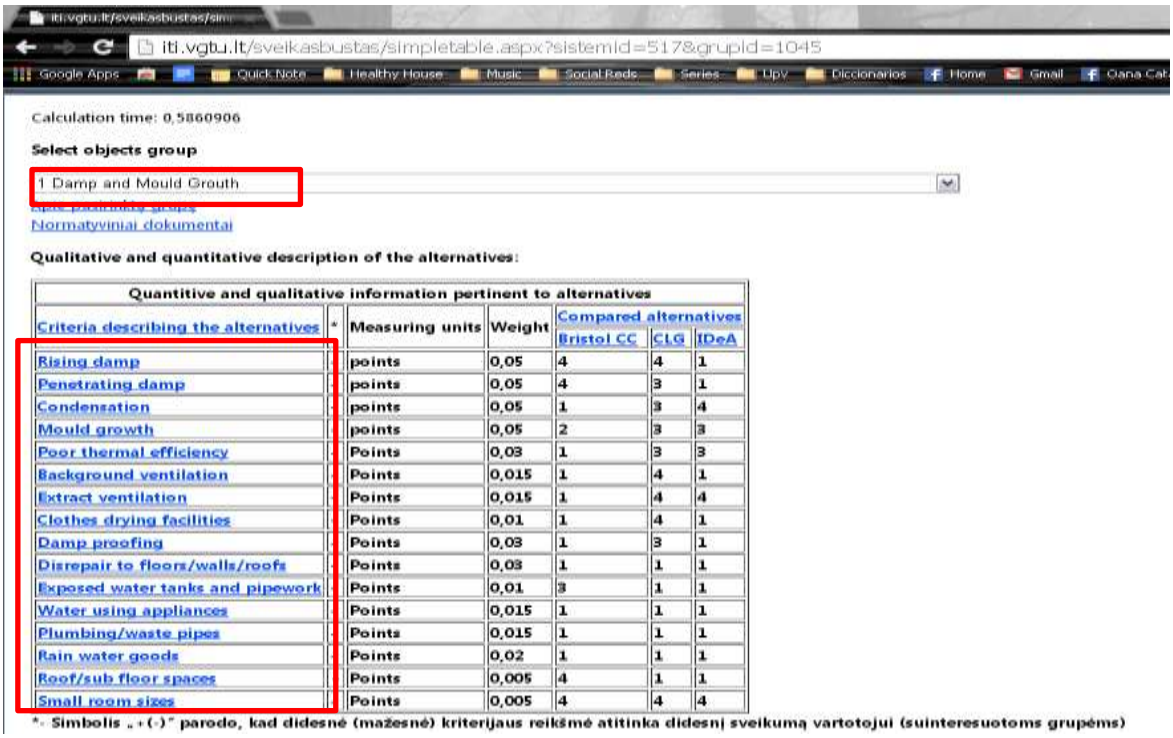


Fig.3.5. "Damp and mould " criteria and subcriterias

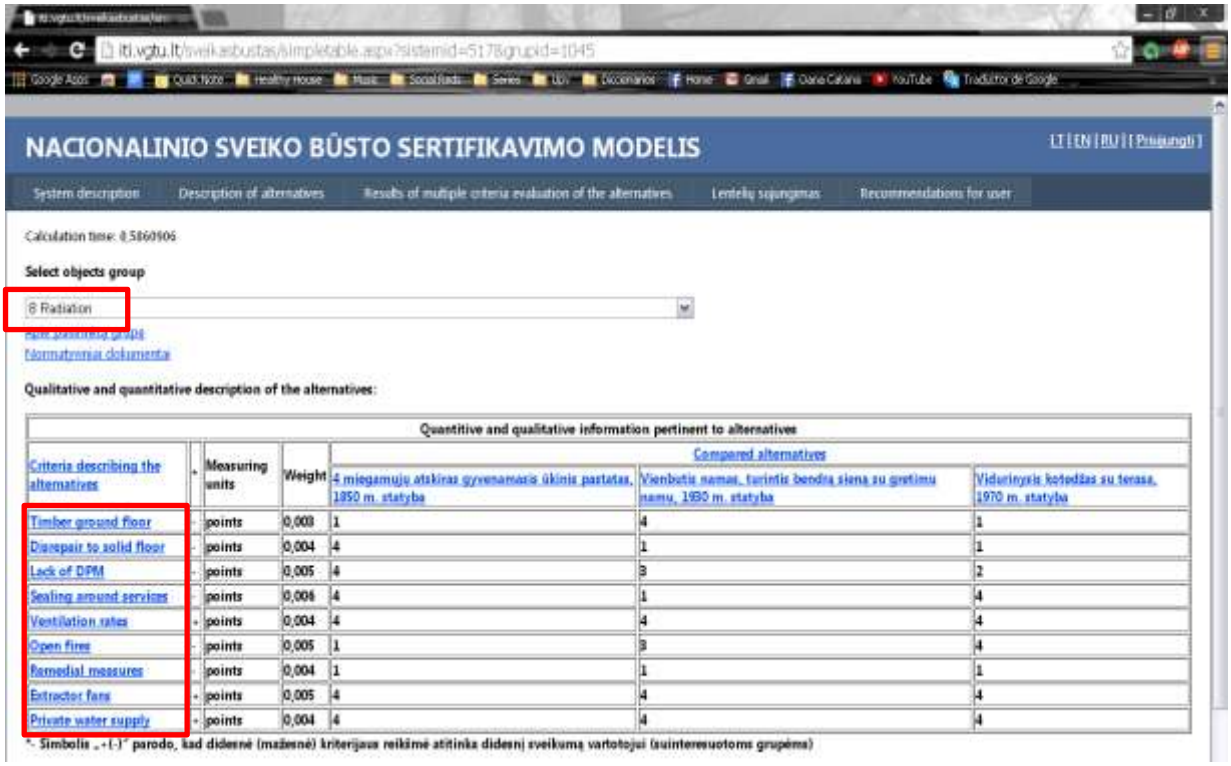


Fig.3.6. "Radiation" criteria and subcriterias

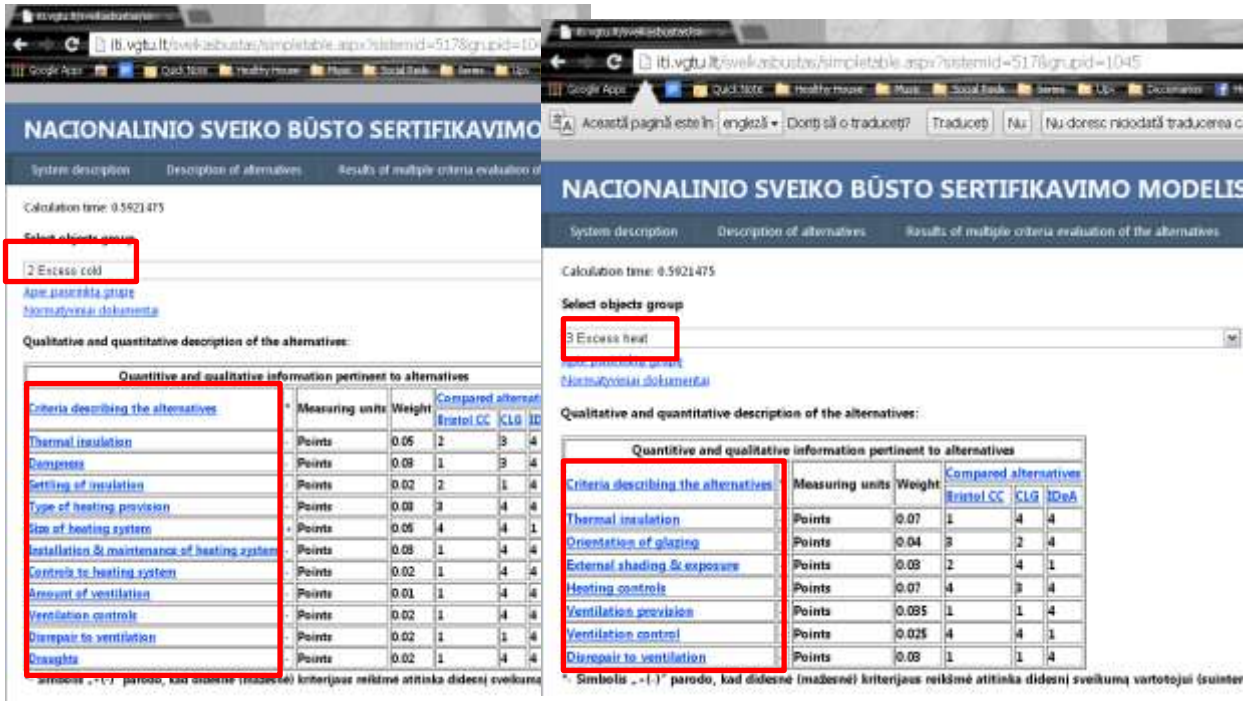


Fig.3.7. "Excess cold" and "Excess heat" criteria and subcriterias

3.4. Healthy House Calculators

Nowadays, specialists in the domain of "Healthy House" provide us with calculators which can be accesed online by the internet. There are calculators which can be used just by experts but also others which can help the occupant to improve their indoor air quality.

3.4.1. How warm, healthy and cost efficient is your home?

One easy calculator is one which can be accesed at

http://www.energywise.govt.nz/tools/warm-healthy-home.

The interface of *"How warm, healthy and cost efficentis your home"* is very enjoyable, can be understood by everyone (Fig.3.8.).

Fig.3.8. Healthy House calculator

Answering the questions marked with red the user will find the answer about how healthy is his/her house. The questions are: **"How efficient is your heater?", "Does your home have dampness and moisture problem?"**, **"What is the ventilation in your home?"**, **"How do you use the heater?"**

3.4.2. Dew Point Calculator

Another calculator, *"Dew point calculator"* (Fig.3.9.) combines three aspects: relative humidity (RH), temperature and the dew point.

The dew point temperature determines what combinations of temperature and RH will be possible in the storage environment. At a constant dew point, when the temperature goes up, the RH goes down and when the temperature goes down, the RH goes up. Controlling the dew point is the key to managing the risk of material decay [8].

If you want to five the dew point and you know the temperature and the relative humidity of your house the program will give information about the dew point and about the mold risk.

For example if the temperature in your house in 20 Celsius degrees and the relative humidity is more then 67, for example 68% will appear the next:

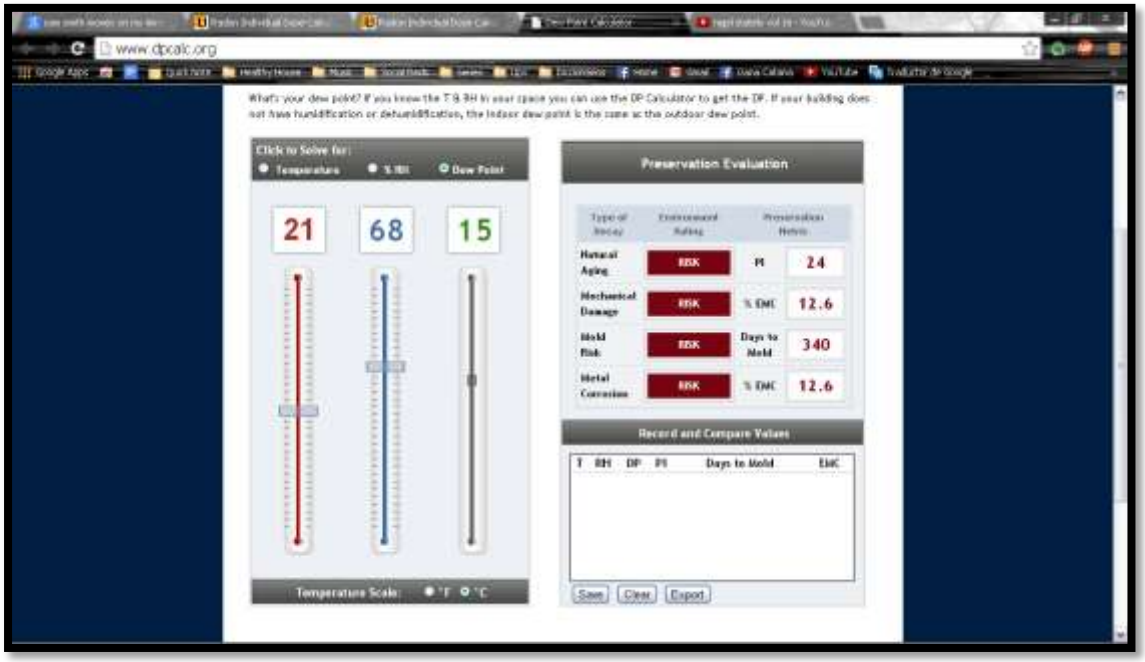


Fig.3.9. "Dew Point Calculator"

If the user will click on EXPORT, the information can be saved in the computer.

If the humidity increases, the number of the days in which the mold appears will be less.
For the same temperature and 78% humidity, the days to mold are 19 (Fig.3.10).

Fig.3.10. Example of how modifies the dew point

The user can play with the values of the temperature and of the relative humidity and compare the values, and to prevent.

For the calculation of heat loss there are various but to be use there is need to be an expert.

The program that can be accesed online, on the internet, is the one given by “Built it solar” and can be found at the following adress:
http://www.builditsolar.com/References/Calculators/HeatLoss/HeatLoss.htm.

This calculator will provide an estimate of the heat loss for your home, including:
- Maximum heat loss in BTU/hr for a coldest day (helpful for furnace sizing)
- Total yearly heat loss in millions of BTU.
- Total yearly cost for fuel.
- Total ten year cost for fuel (with 10% fuel price inflation per year).
- Pounds of CO2 gas emissions for heating your house [5].

To be used, the user has to field the tables (Fig. 3.11.) with information about its dwelling.

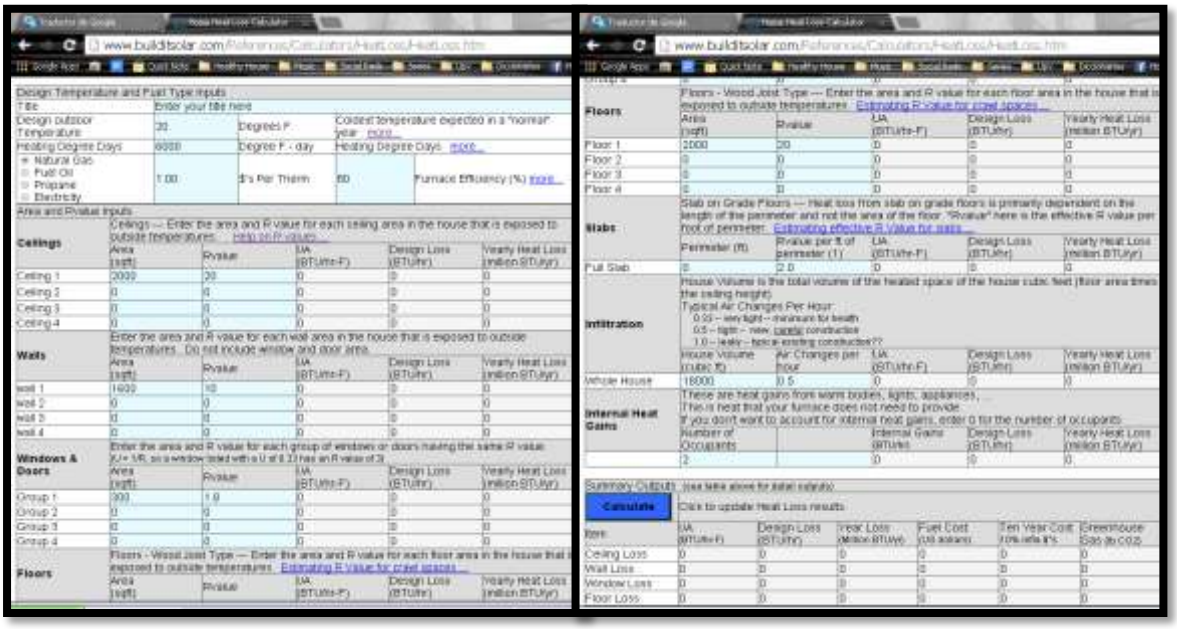


Fig.3.11. Fields that has to be completed by the occupant

3.4.3. Radon calculators

For the fourth hazard studied in the present thesis, radon, there are two calculators (Fig.3.12 and Fig.3.13).

Fig.3.12. "Radon Calculator" [34]

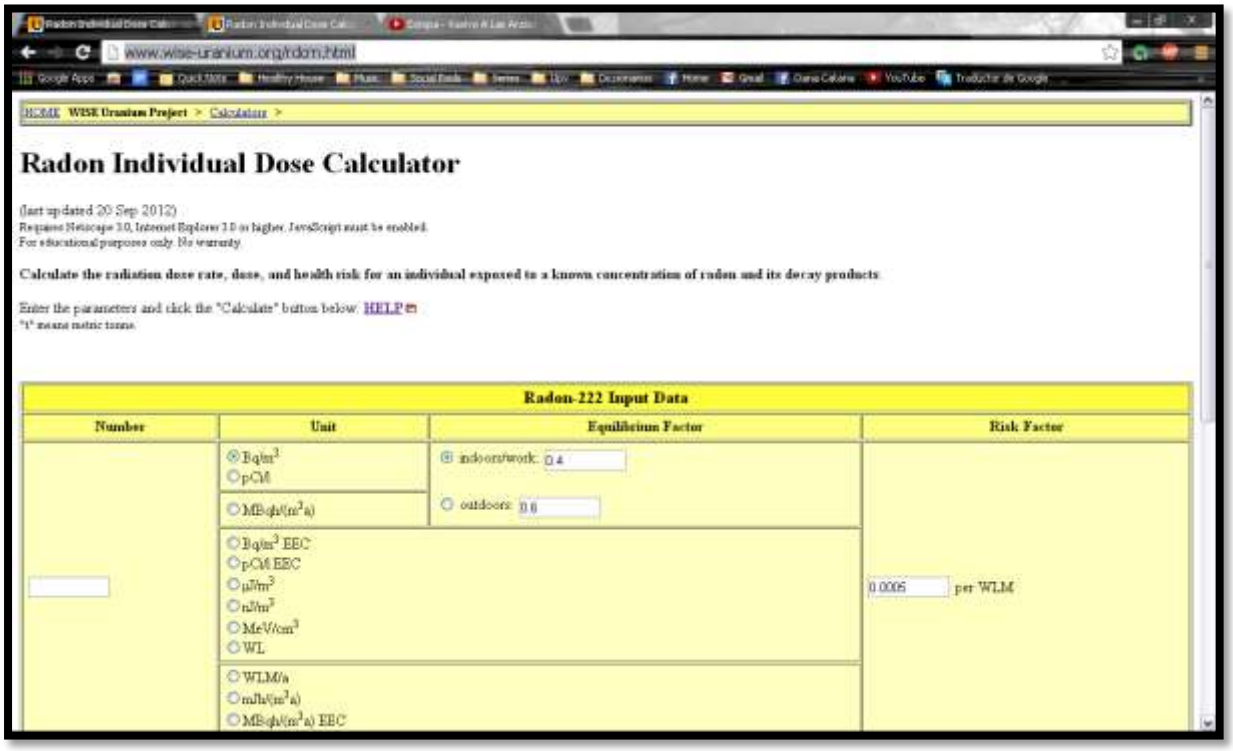


Fig.3.13. "Radon Individual Dose Calculator"[30]

The second one gives more information to the user about how to fill the fields.

Introduction

This calculator performs radiation dose calculations for individuals exposed to Radon-222 and its decay products.

The calculator only determines doses to exposed individuals. For collective dose calculations, see the Nuclear Fuel Population Health Risk Calculator.

The calculator only determines dose rates for situations, where the activity concentration or annual exposure of radon and/or its progeny is known. Otherwise, the Uranium Mine and Mill Resident Individual Dose Calculator, or some more sophisticated software has to be used (see Dose calculation software).

The parameters used for the calculation can be set in the Radon-222 Input Data table. These parameters show reasonable initial values which can be modified as needed. There are no other hidden parameters used in the calculation [30].

Chapter IV. Case study- Virtual tour

A virtual tour is a simulation of an existing location, usually composed of a sequence of video or still images. It may also use other multimedia elements such as sound effects, music, narration, and text. It is distinguished from the use of live television to effect tele-tourism [29].

The phrase "virtual tour" is often used to describe a variety of video and photographic-based media. Panorama indicates an unbroken view, since a panorama can be either a series of photographs or panning video footage. However, the phrases "panoramic tour" and "virtual tour" have mostly been associated with virtual tours created using still cameras. Such virtual tours are made up of a number of shots taken from a single vantage point. The camera and lens are rotated around what is referred to as a no parallax point (the exact point at the back of the lens where the light converges [29].

The method used for the creation of the present virtual tour is named “rectilinear stitching”.

This involves the rotation of a digital camera, typically in the portrait (up and down) position and centered directly over the tripod. As the operator manually rotates the camera clockwise, the camera stops or clicks into a detent such as every 30° [29].

Using specialized "photo stitching" software such as program the operator then assembles the "slices" into a rectangular one—typically 4,500 pixels to 6,000 pixels wide. This type of stitched panoramic view is also called "cylindrical"—as the resulting stitched panorama allows panning in a complete 360° but offers a limited look up or down of about 50° degrees above or below the horizon line [29].

The practical part consists in a virtual tour, a flat situated in Vilnius, Lithuania. With the help of this, the user can “walk” in the present dwelling, seeing all the problems, receiving information about the hazard and about how to resolve the present problem.

For the application, first of all we choose the dwelling were we are going to make the application. It is situated in Tauro gatve 8-9, Vilnius, Lithuania.

Next step was to take pictures of the flat (hall, bedroom, bathroom, kitchen and living room). The pictures were taken with a camera placed on a tripod, with the method that was mentioned before “rectilinear stitching”

After the picture were taken, with the program Color Autopano Giga 3.0 the panoramic picture was created (Fig.4.1.)

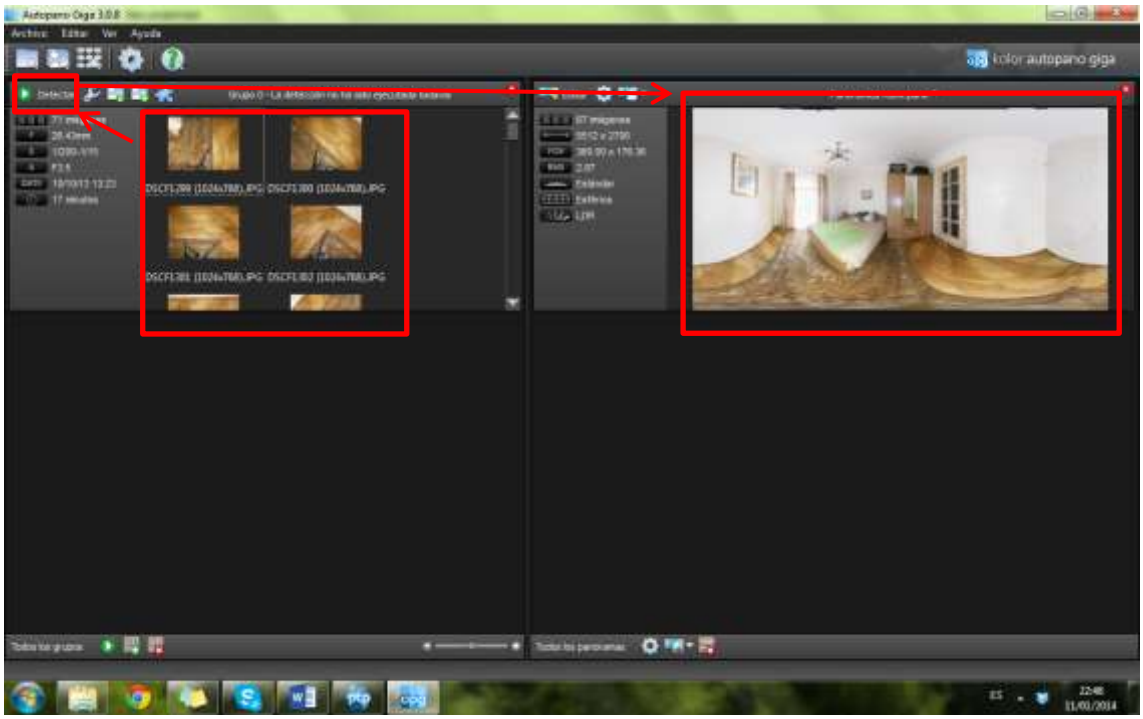


Fig. 4.1. Creation of panoramic picture with Autopano Giga 3.0

For example, the picures taken in the dormitory were open in the program. After this, pushing the bottom “detectar” in English “detect” the panoramic view is created.

This step was applied for the bathroom, hall, living room and kitchen (the last two ones are in the same space) (Fig.4.2.)

Fig.4.2. Four panoramic picture of the chosen dwelling

These four panoramic views were introduced in other program "Kolor Panotour Pro 1.8 (Fig. 4.3).

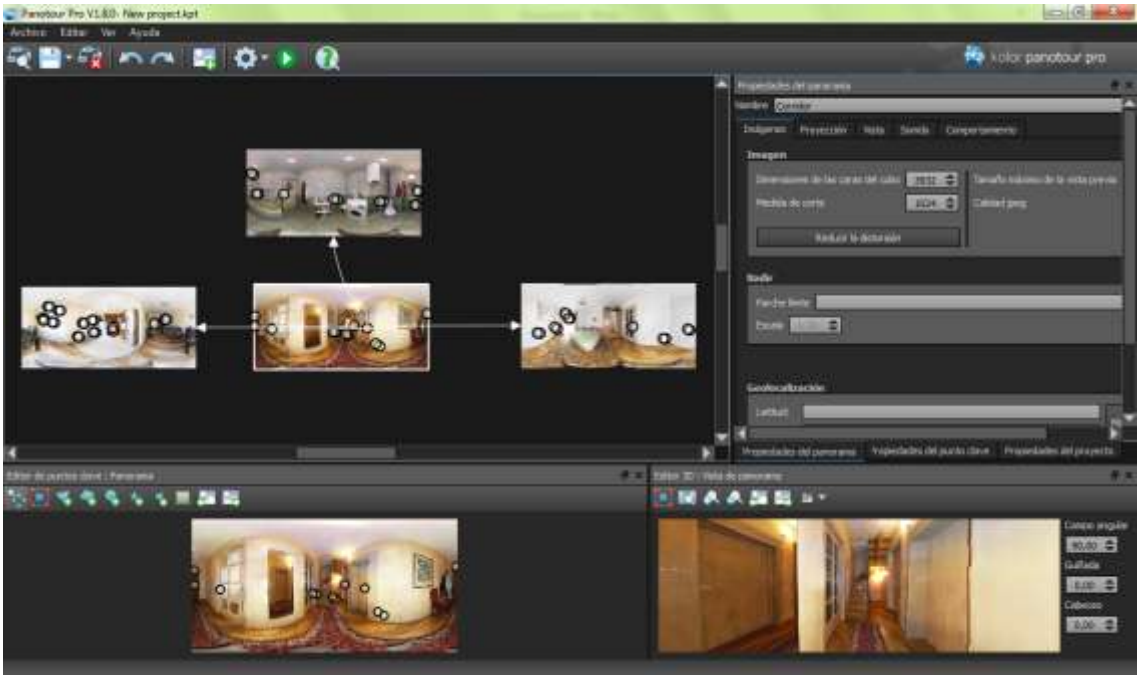


Fig.4.3. Introduction of the panoramic pictures in the program Panotour Pro 1.8. and the creation of the virtual tour

As can be seen, has to be created links between the rooms and in this way the user can enter from the corridor in the bedroom, bathroom and living room.

In the virtual tour will appear bottoms (Fig. 4.4.) which will help the user to "walk" in the virtual space.

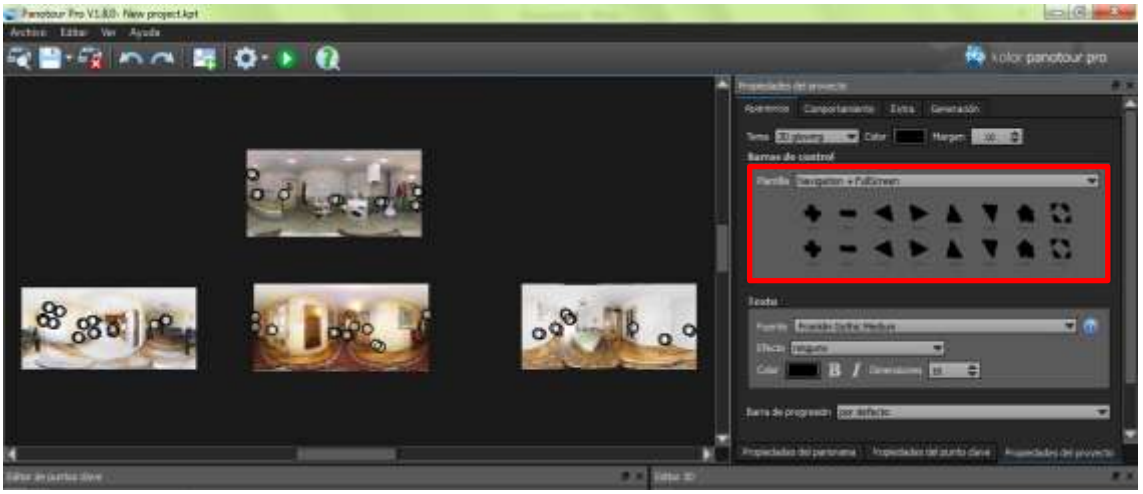


Fig.4.4. Introduction of the buttoms in the program

Using keyboard buttons ←↓→ or the buttoms, the user could view the entire space about, under or above. He/she could zoom in or out all required objects. The user could

directly go through view points and the entire real property facility. Consequently, the unified excursion (tour) feeling without going out from home could be formed (e.g. from one room to another, viewing the entire house). Opportunity to add particular objects to the vision is foreseen, i.e. you could add descriptions of objects incorporated into the tour or panorama (e.g., by clicking on the additional object installed on a wall you could review information about materials used in construction or finishing of the house), photos, sound tracks, video clips, flash or other elements of multimedia (Fig. 4.5.).

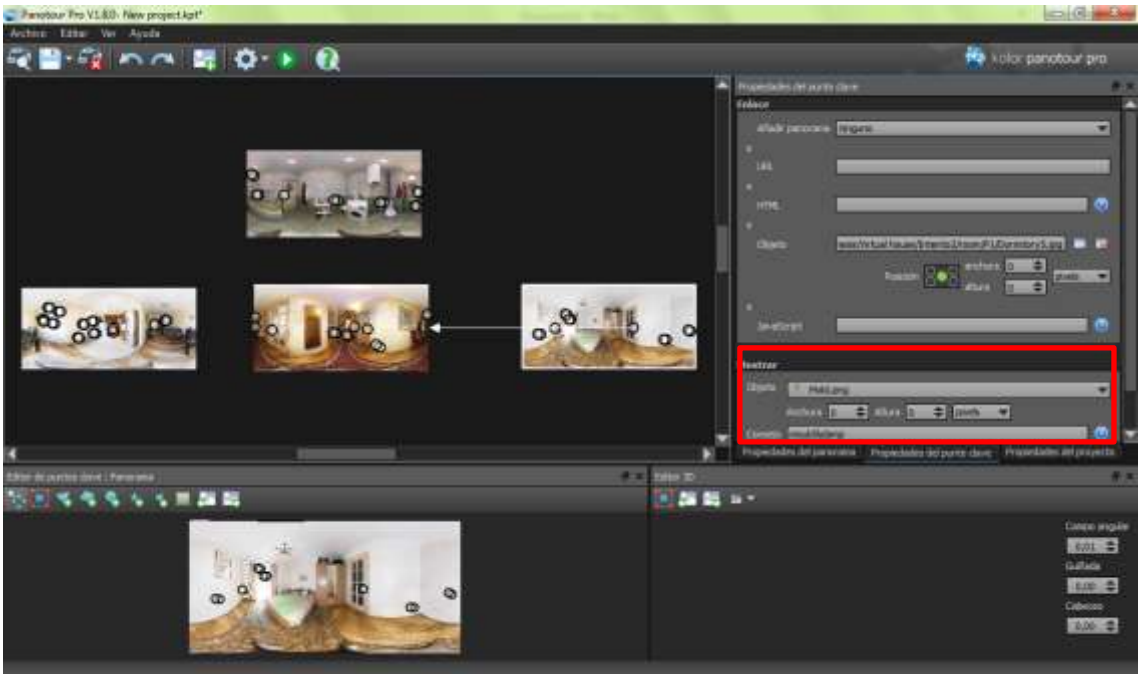


Fig.4.5. The add of particular objects in the virtual tour

In the virtual tour can be found the next buttoms:

Key

Cold

Heat

Damp and mould

Radiation

Information

Created virtual recommendation can be found at http://iti.vgtu.lt/imitacijosmain/oana_fatima1.swf.

Going through rooms of the house could be performed by clicking the "key" icon placed at the door. Apartment includes additional elements showing information about potential problems which could occur at the precise part of the construction, for example, moulds or insufficient heating. Each group of problems is displayed by different element, clicking on which could enable you to view figure with description of a particular problem. "i" icon for information is also located near the element of the problem. In our case the "i" icon will redirect you to the support system for decision making http://iti.vgtu.lt/sveikasbustas/simpletable.aspx?sistemid=517&grupid=1045, which provides reasons of occured problem and its solution or minimization methods. Each group of problems has its own address which will be launched upon clicking the "i" icon near the firgute of the problem. Clicking on flashing "i" icon will redirect you to the advisory system in accordance with foreign recommendations.

Also, near each hazard will appear the calculators studied in Chapter II, 3.4 "Healthy House Calculators".

The present virtual tour consists in:

First is the entrance. On the door appears a sign ▲ where the user can click and Google Maps will open and will indicate the position of the present dwelling (Fig.4.6).

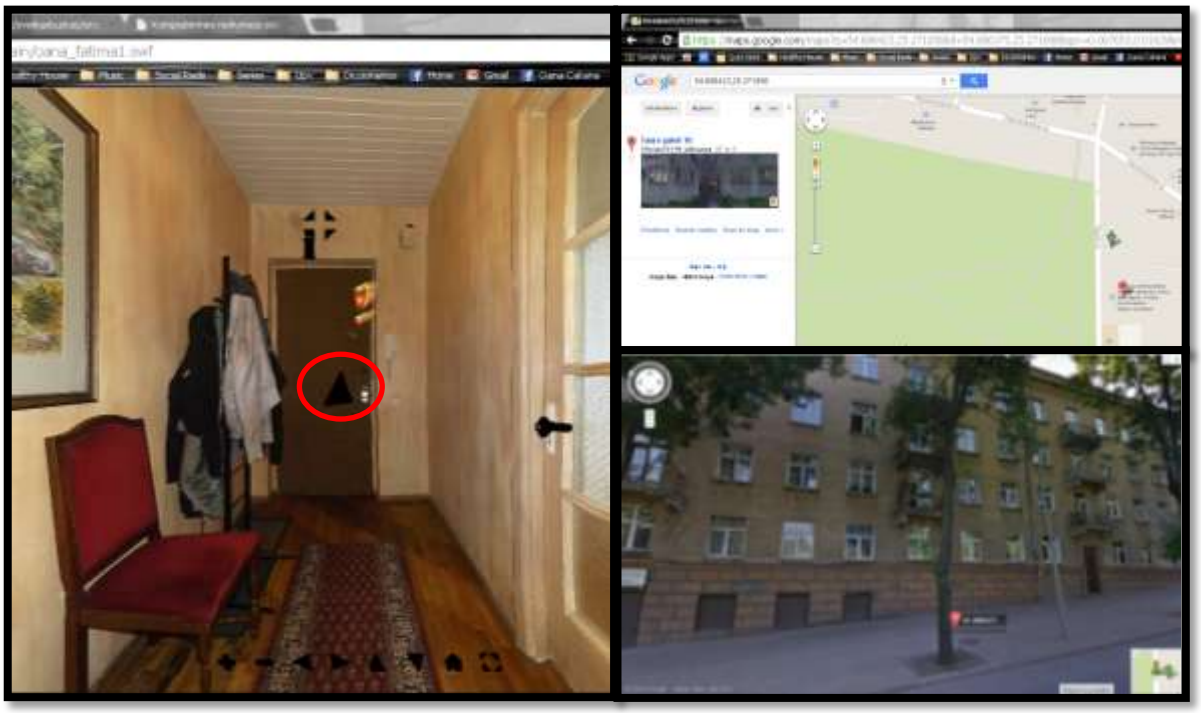


Fig. 4.6. The entrance on the virtual space and the location

Clicking the key sign, the user can enter in the room, in this case is the bedroom (Fig.4.7.)

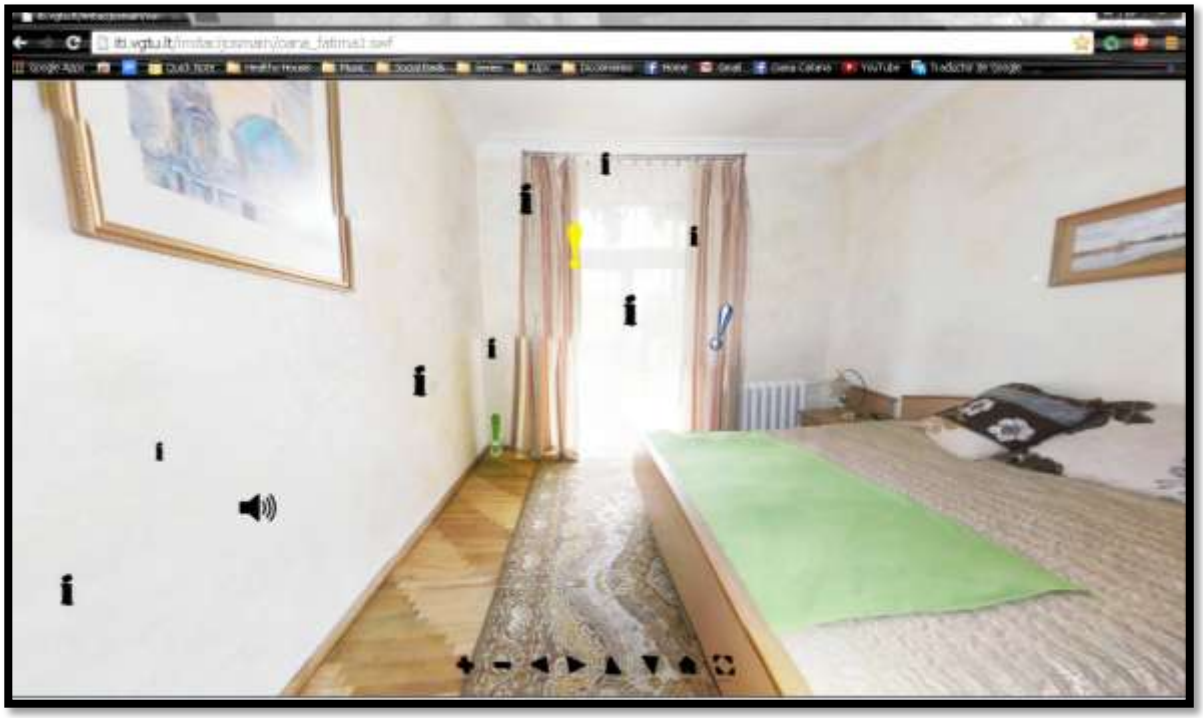


Fig. 4.7. Image from the bedroom in the virtual tour

As it can be seen, in this room appear or can appear hazards as damp and mould, excess of cold, lightning and noise.

When the user goes on each sign "!", just putting with the mouse on it, will appear the name of the problem. For example, if goes on the green sign "!" means that is damp and mould; clicking on it will appear a representative picture of that problem (Fig.4.8). Clicking the "i" buttoms will go on the internet pages which gives information about that hazards.

The first is "The National Healthy Housing Certification Model ", in Lithuanian called "Nacionalio Seiko Busto Sertifikavimo Modelis" (fig. 4.9.) and the second is "Computer Learning System", in lithuanian named "Kompiuterines mokymosi sistemos" (fig.4.10)

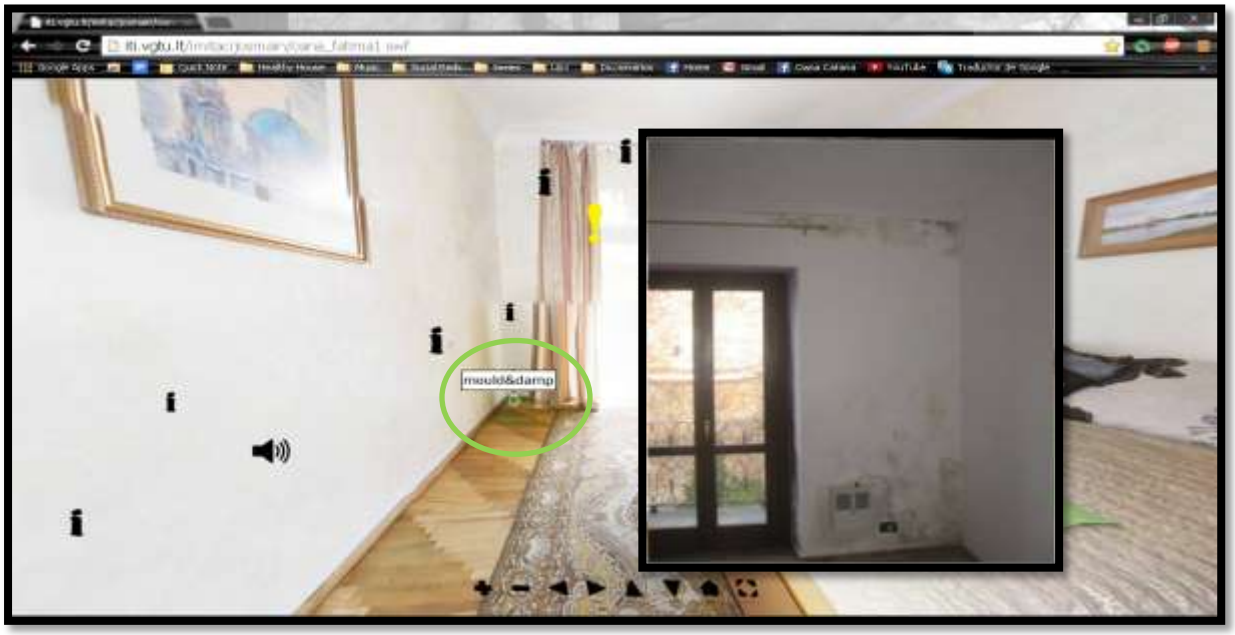


Fig. 4.8. Image with "damp and mould" in the virtual tour

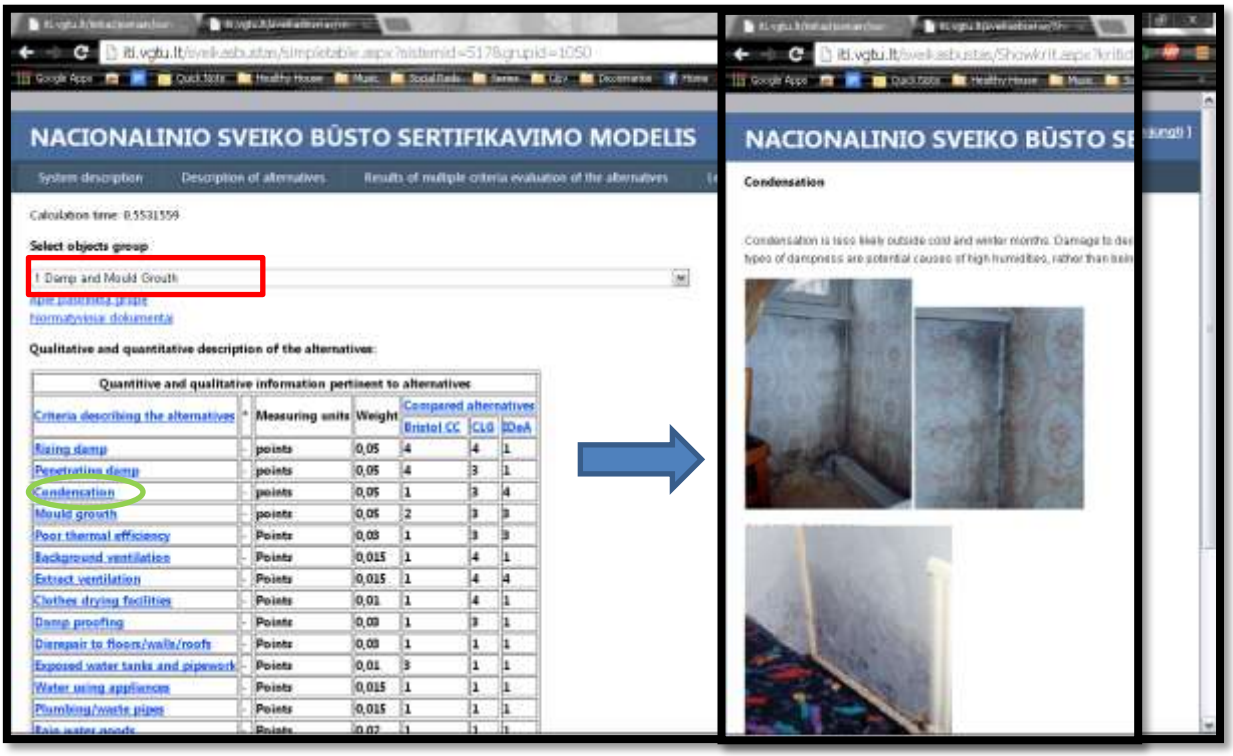


Fig. 4.9. "Damp and mould" criteria and subcriteria

For example if the user wants more information about condesantion, he/she clicks on condensation and other page opens (Fig.4.9).

When opens the page "Computer Learning System" it has to be answer with **YES** (in Lithuanian "taip") or with **NO** (in Lithuanian "ne") (fig.4.10) and after that by clicking the buttom "Gauti patarimus" which means "Give advice" the system will give recommandations (Fig. 4.11).

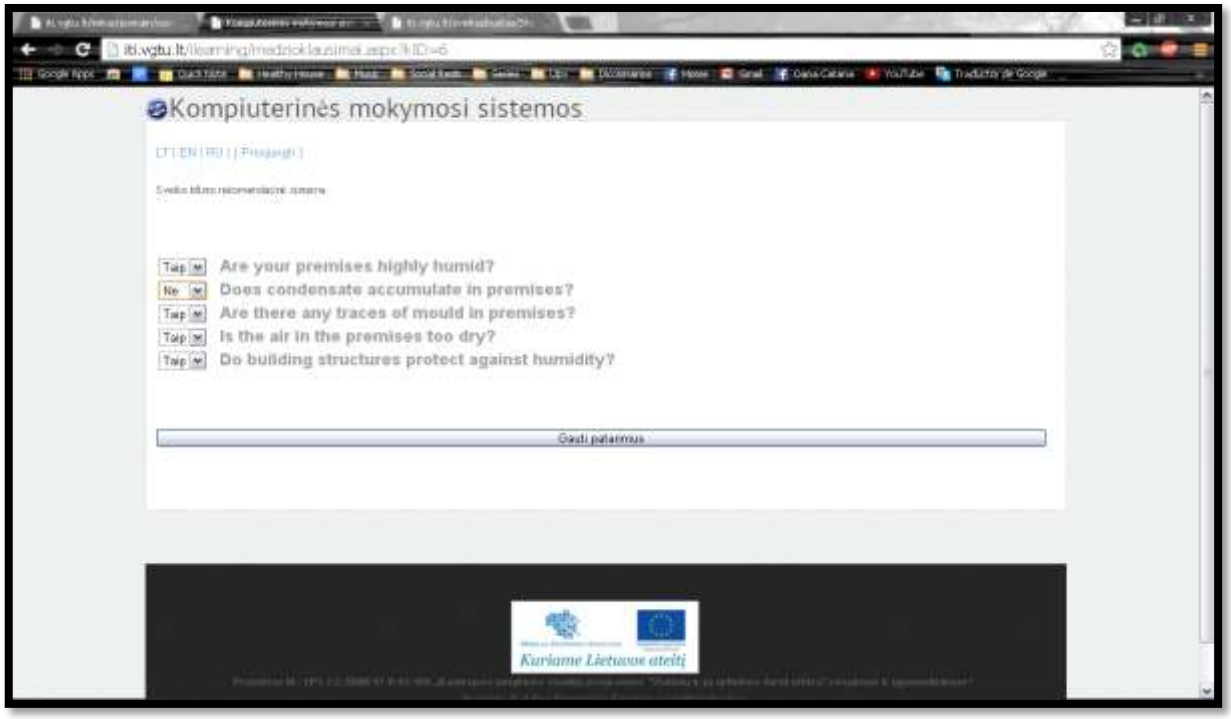


Fig.4.10. "Damp and mould" recommendations in the "Computer Learning System"

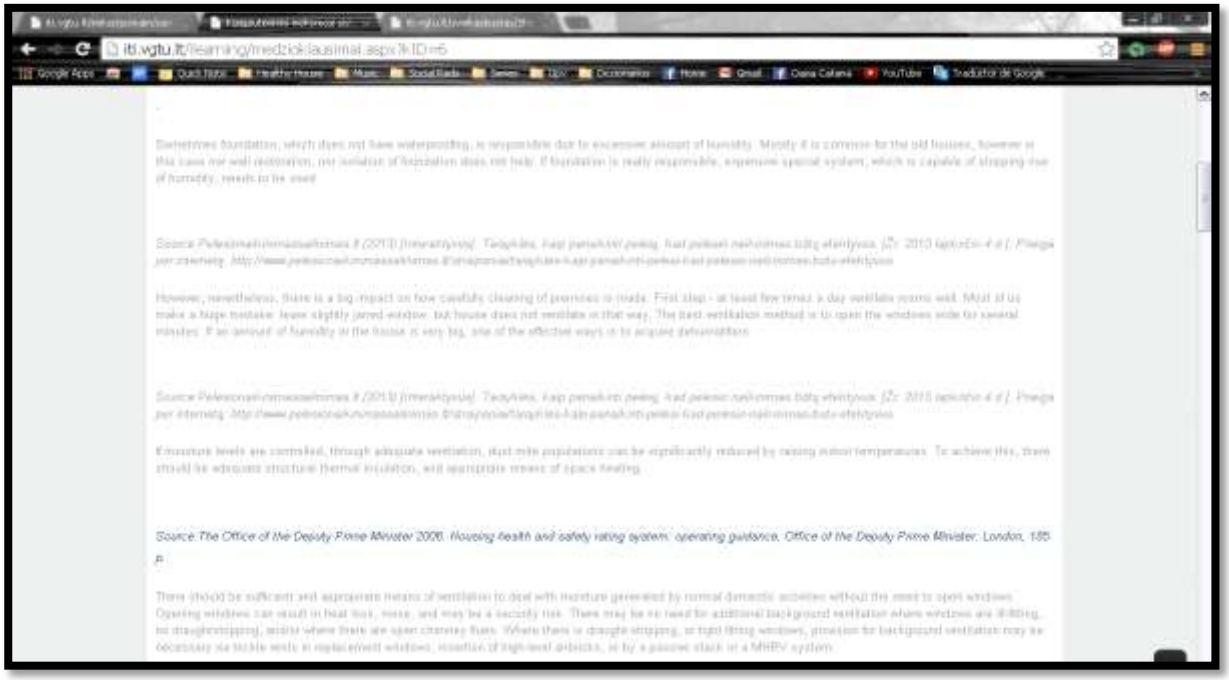


Fig. 4.11. Recommendation System for "Damp and mould"

The same steps will be applied for the other hazard signs (Fig. 4.12)

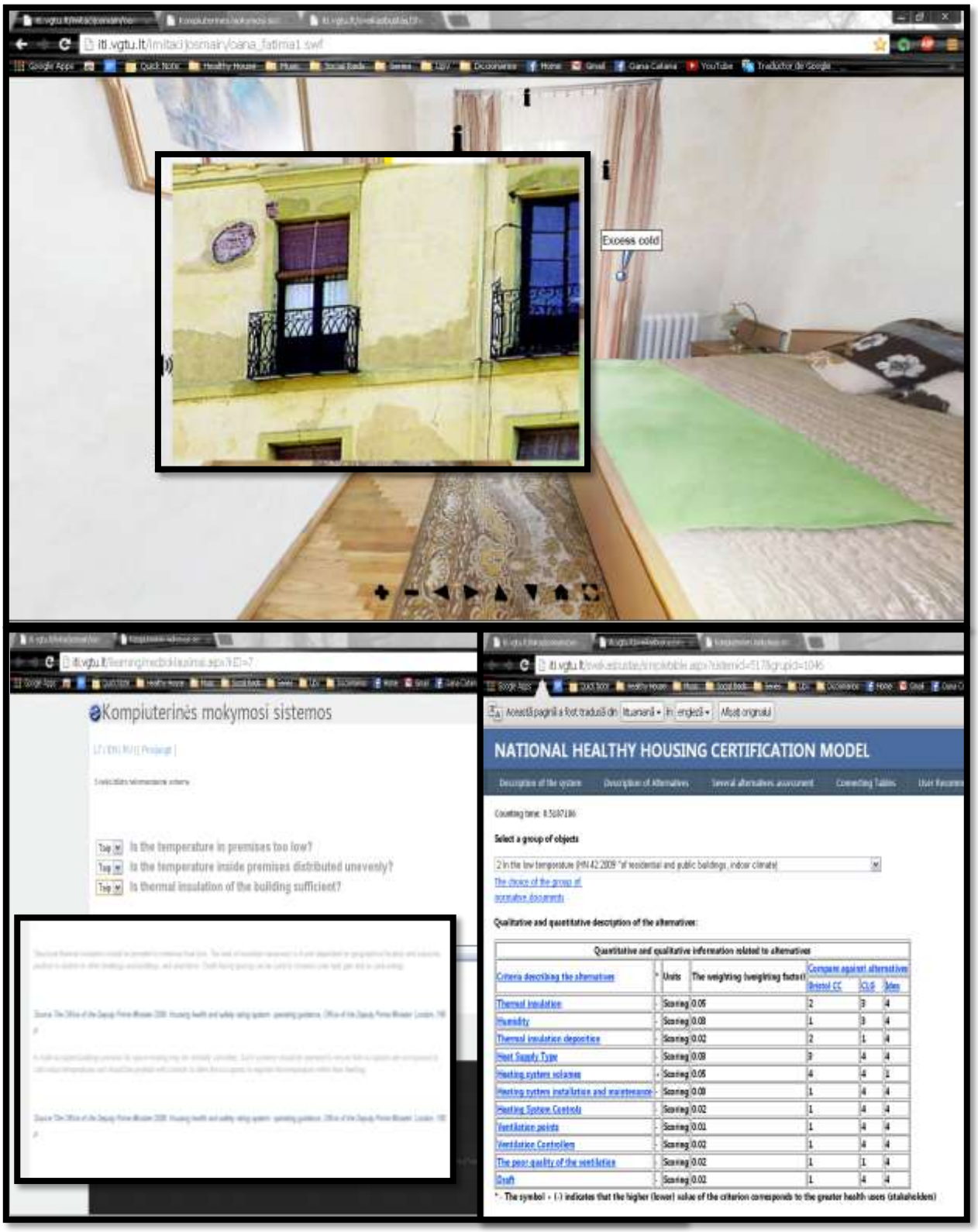


Fig. 4.12. Steps applies for "Excess Cold " problem

All this steps will be applied in for all the hazards that will be found in the investigated dwelling (Fig.4.13, Fig.4.14, Fig. 4.15.).

After seeing, observing, studying all the hazards from the bedroom, the user will go back in the hall by clicking on the key sign on the door.

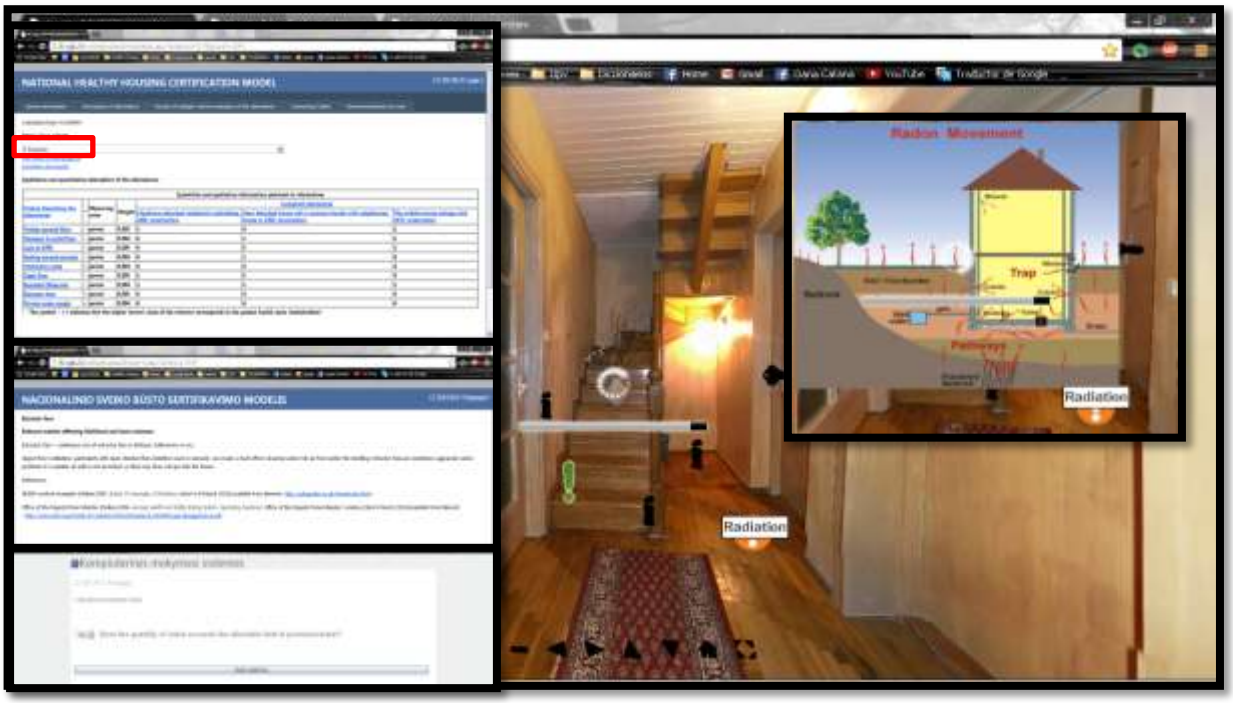


Fig.4.13. "Radiation" hazard in the dwellingFig.4.14. Problems that can appear or exist in the bathroom

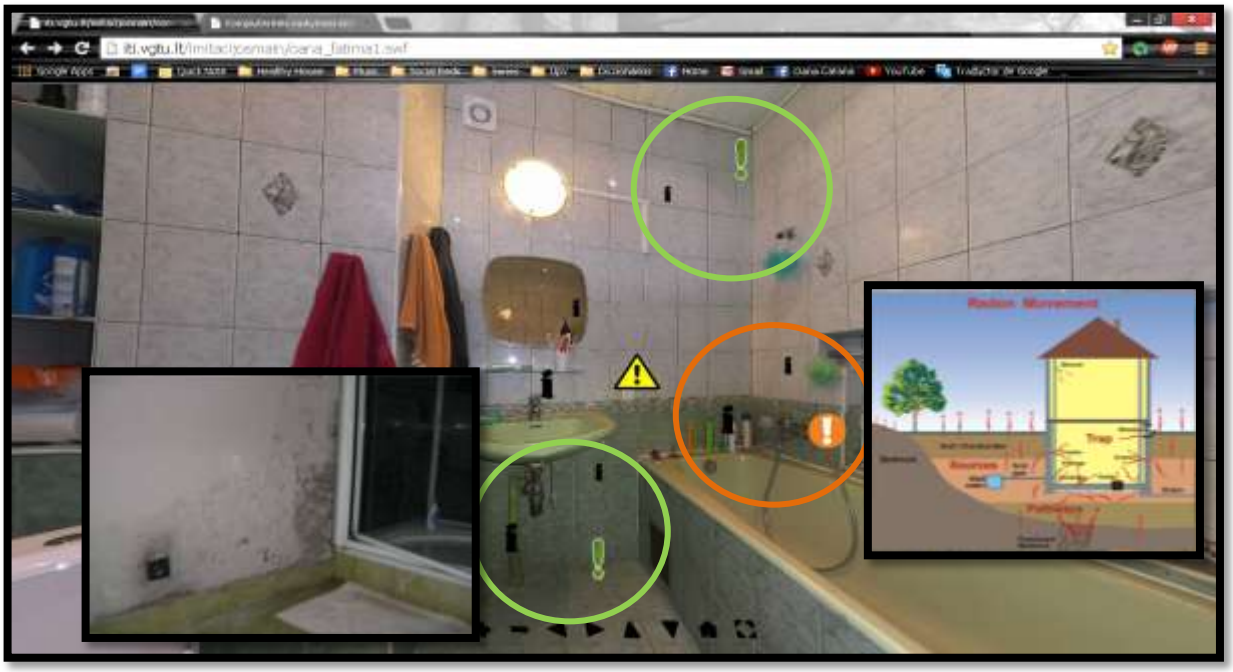


Fig.4.14. Problems in the bathroom as "Mould and Damp", "Radiation"

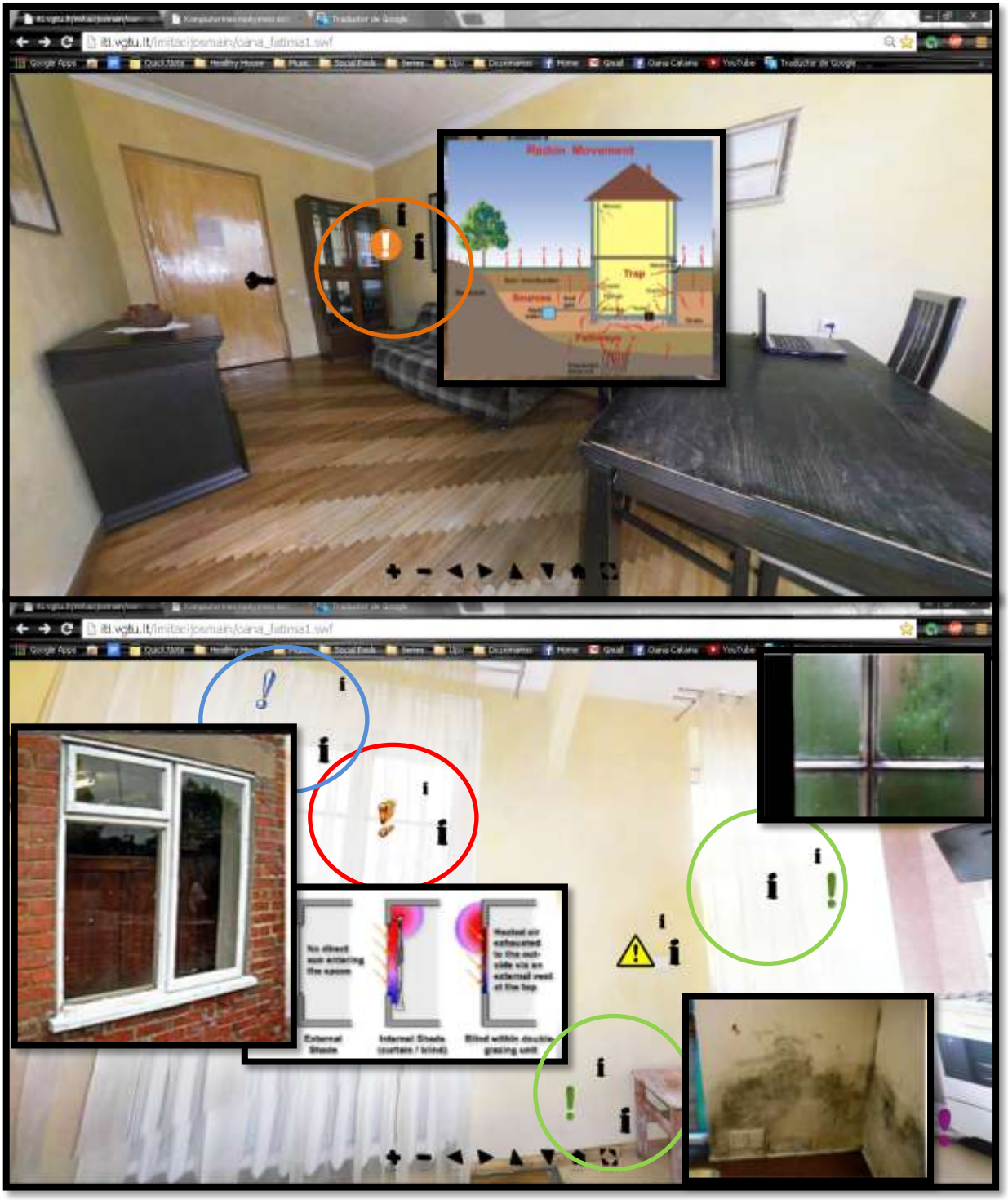


Fig.4.15. Problems in the living room-kitchen as "Mould and Damp", "Radiation", "Excess cold" or "Excess Heat"

Chapter V. Manual for the user

1.1. Description of Practical Tutoring System

Health and Safe Recommendation System could be launched at: http://iti.vgtu.lt/sveikasbustas/simpletable.aspx?sistemid=517&grupid=1045.

Health and Safe Recommendation System includes 29 facility groups (Fig. 5.1.): humidity and mould, excessively low temperature, excessively high temperature, asbestos and artificial mineral fibre, biocides, etc. The user could enter the main data matrix of every facility group by clicking "Description of alternatives" (Fig. 5.2.).

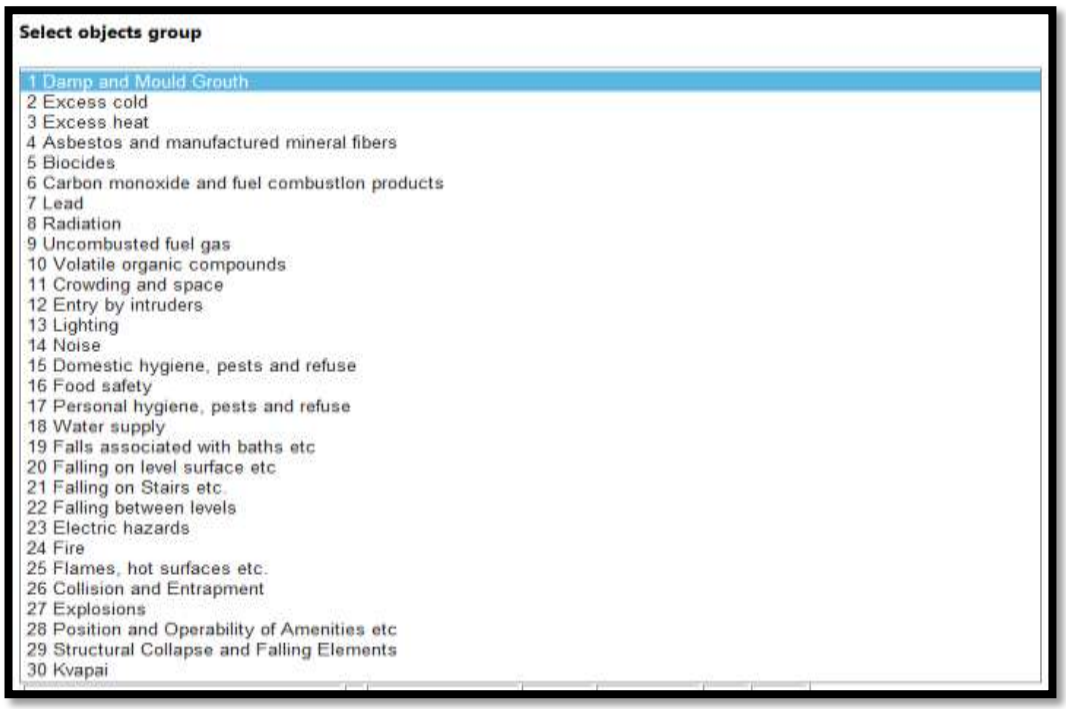


Fig. 5.1. Facility groups of Health and Safe Recommendation System

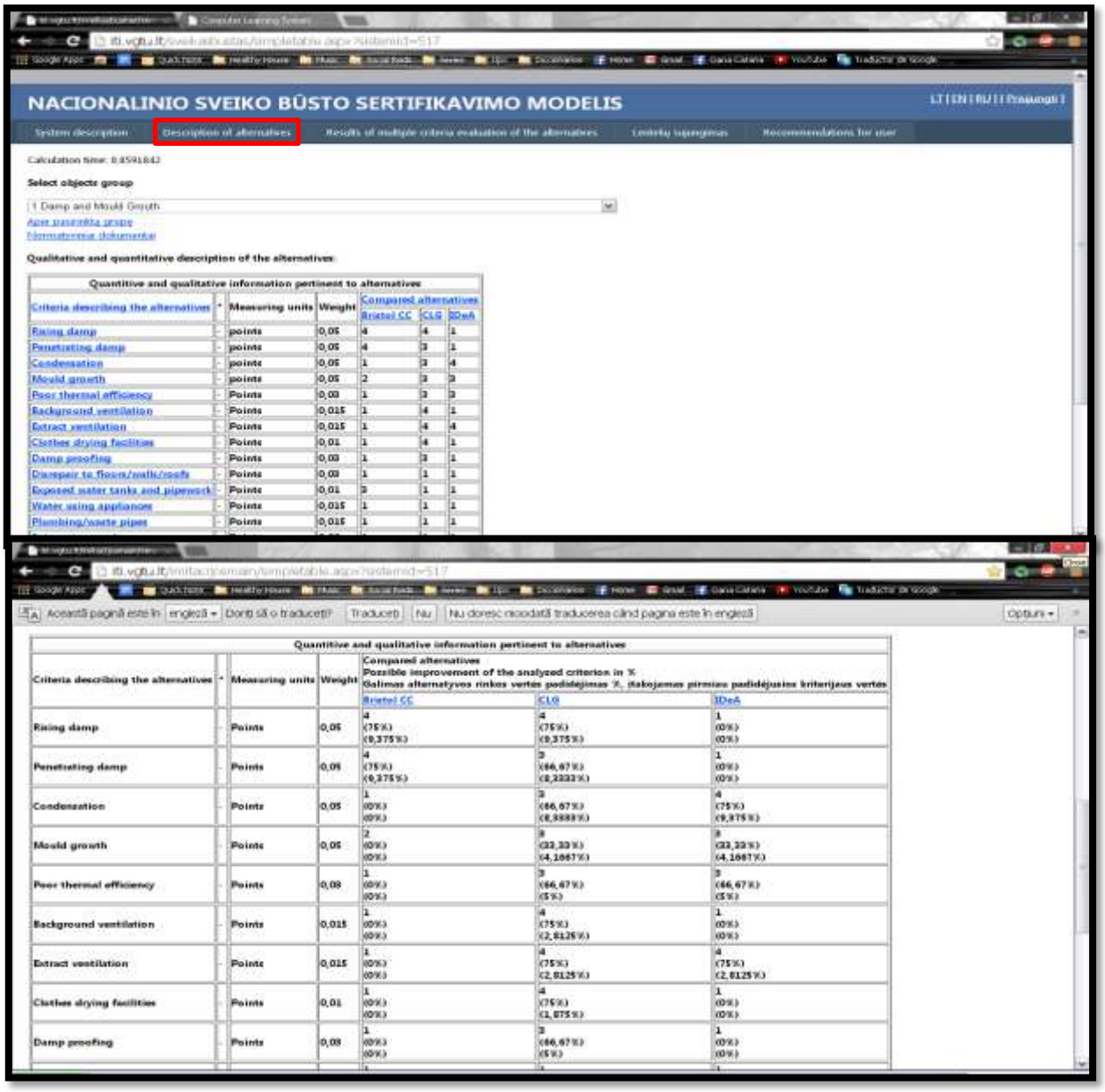


Fig.5.2. Matrix of alternatives for "Damp and mould" , Health and Safe Recommendation System

Every parameter has its own description, including its rating, minimization/ maximization opportunities, and criterion weight. Estimated alternatives to be compared are provided as well (Fig.5.3.).

Fig. 5.3. Description of the hazard for each alternative

Main data matrix could be normalized upon clicking the "Results of multiple criteria evaluation of the alternatives" and the system itself could provide values of alternatives, ratings and coefficient of efficiency (%) (Fig.5.4).

Performed calculations have shown that the healthiest recommendation in terms of moulds and humidity level is Bristol CC recommendation (100 %) (Fig.5.5.).

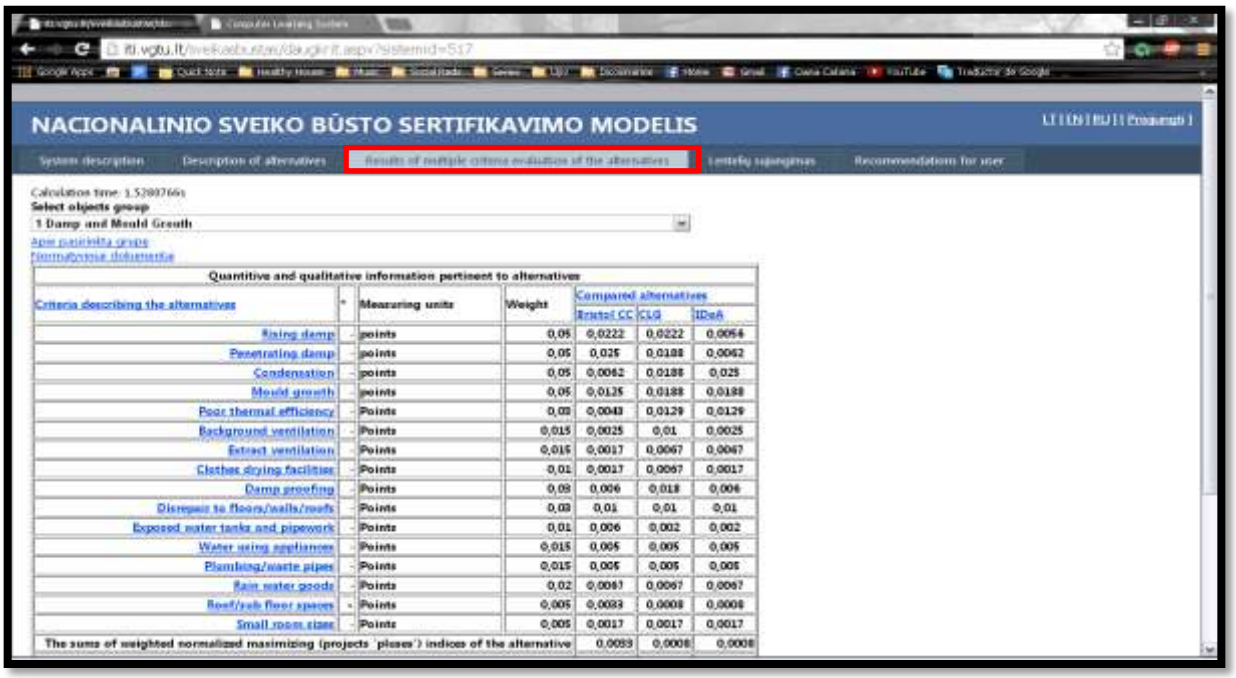


Fig.5.4. Multicriteria assessment of humidity level and moulds

Calculations for other groups are carried out by analogy.

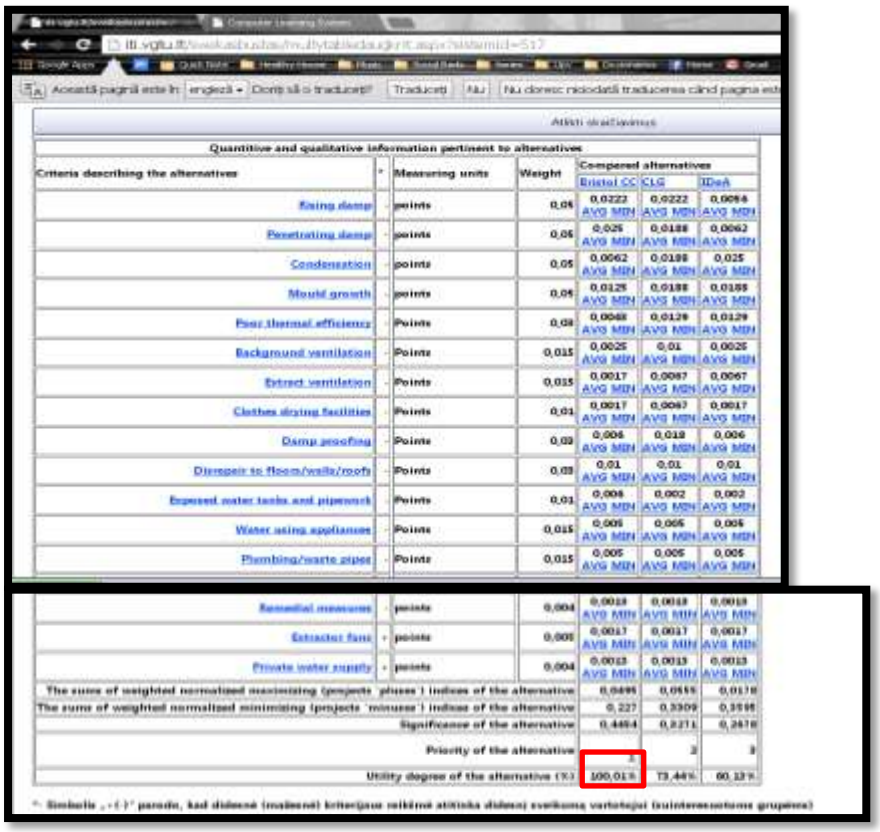


Fig.5.5. Performed calculation for "Damp and Mould" in Bristol CC

With "Connecting tables", in Lithuanian "Lentelių sujungimas", the user can add the hazards in which he/she has interest, click the buttom "add" and the system will give the results after pressing the buttom "Perform calculation" in Lithuanian "Atlikti skaičiavimus"(Fig.5.6.)

Fig.5.6. "Connecting tables"

Every parameter has its own description, including its rating, minimization/ maximization opportunities, and criterion weight (Fig.5.5.). Estimated alternatives to be compared are provided as well.

With "Recommendations for user" has to be chosen an object group and will appear a table with qualitative and quantitative information pertinent to alternatives (Fig.5.7.)

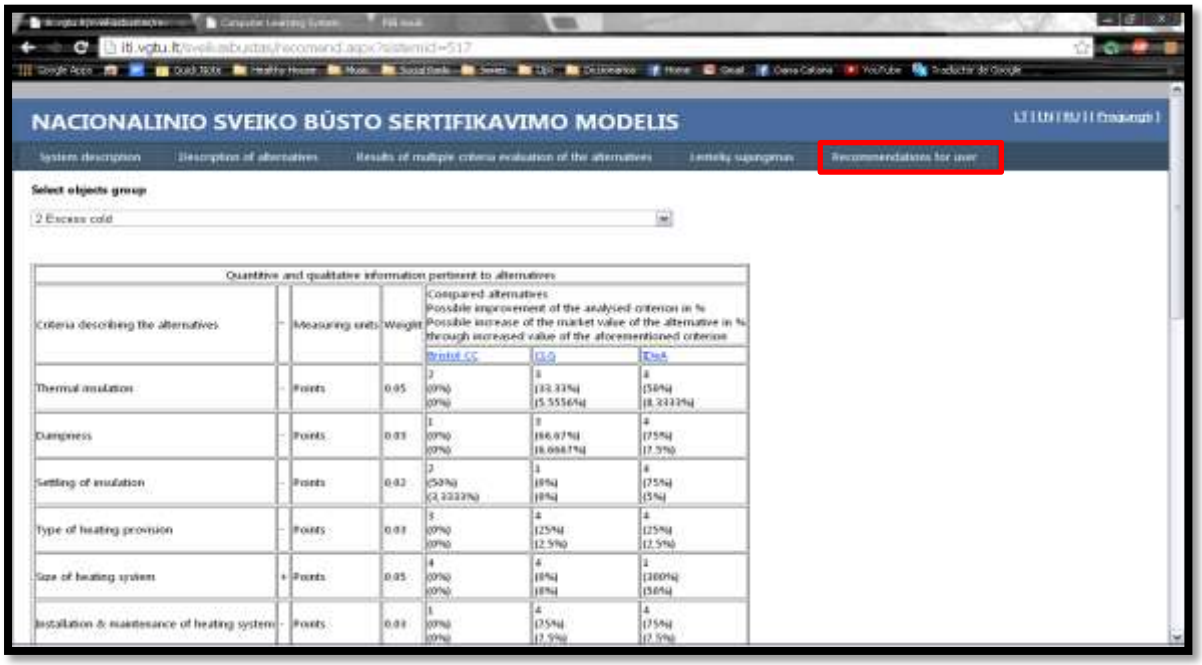


Fig.5.7. "Recommendatios for the uses" and "Table with qualitative and quantitative information pertinent to alternatives"

In the bottom of the page appers information about the object criterions that have greatest influence on ranking (Fig.5.8.)

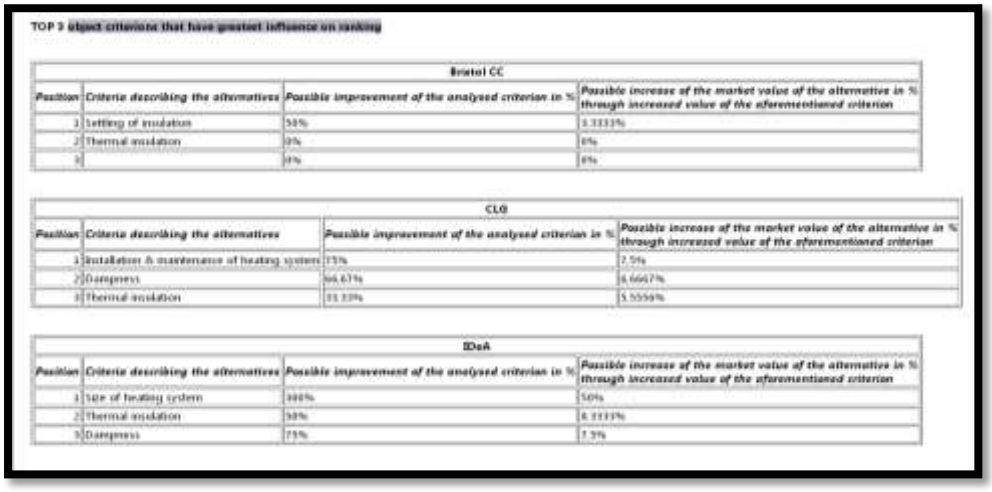


Fig.5.8. Object criterions that have greatest influence on ranking

1.2. Operation manual for National Health Recommendation Certification Model Advisory System

Health recommendation certification system is based on the integrated experience of foreign countries and advisory system, which provides proper recommendations on living conditions enhancement in terms of answers to the questions generated by the system. The system could be launched at: http://iti.vgtu.lt/ilearning/kapateikti.aspx (Fig.5.9.).

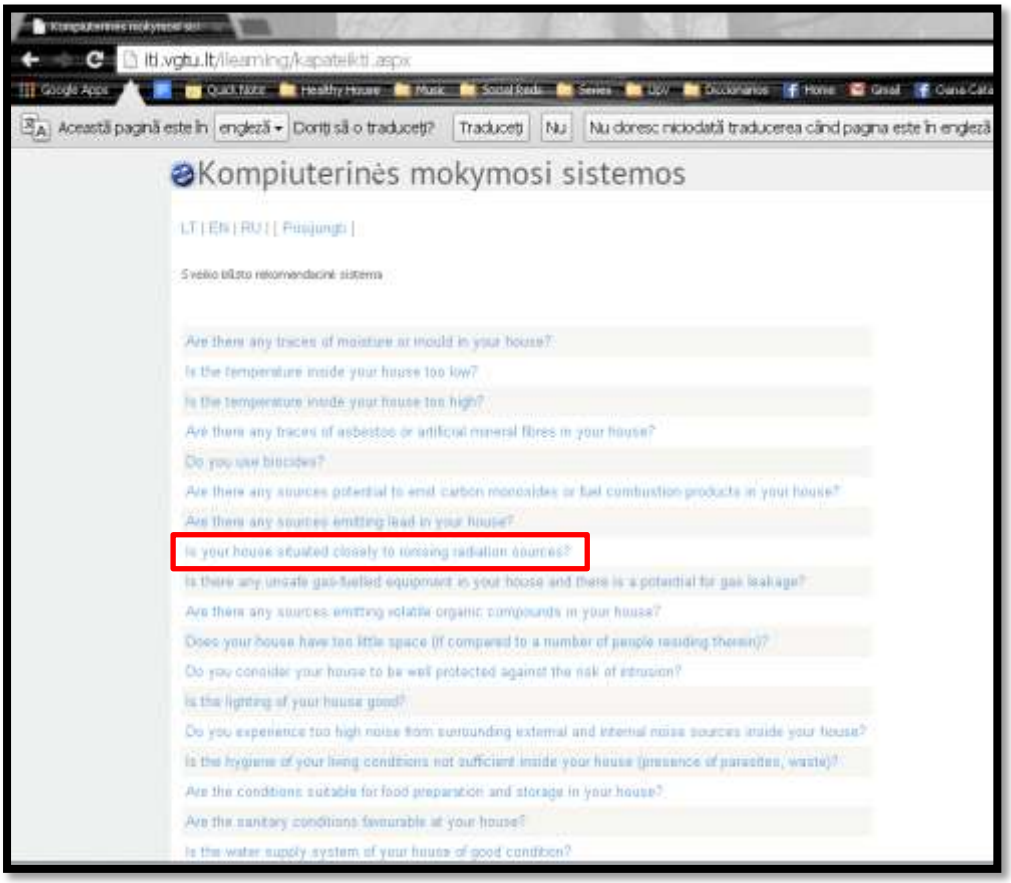


Fig.5.9. Health Recommendation Advisory System

Title page includes 29 questions. The user could select needed aspect, for example, recommendation is equipped with radon, which could cause lung cancer, and the user strains after minimization of the abovementioned hazard and improve safety level of its recommendation. By clicking appropriate icon the user could tick the question “Is your house situated closely to ionising radiation sources?” The system will generate additional questions enabling the determination of main hazard sources, for example “Does the quantity of radon Exceeds the allowable limit in premises / water?” (Fig.5.10.).

Fig. 5.10. Additional advisory questions of health recommendation system about radon.

Upon answering to the additional questions, the user could click on "Get advice". The system will evaluate answers and generate recommendations related to the improvement of stairs quality and to the means required in order to enhance safety level of stairs (Fig.5.11.).

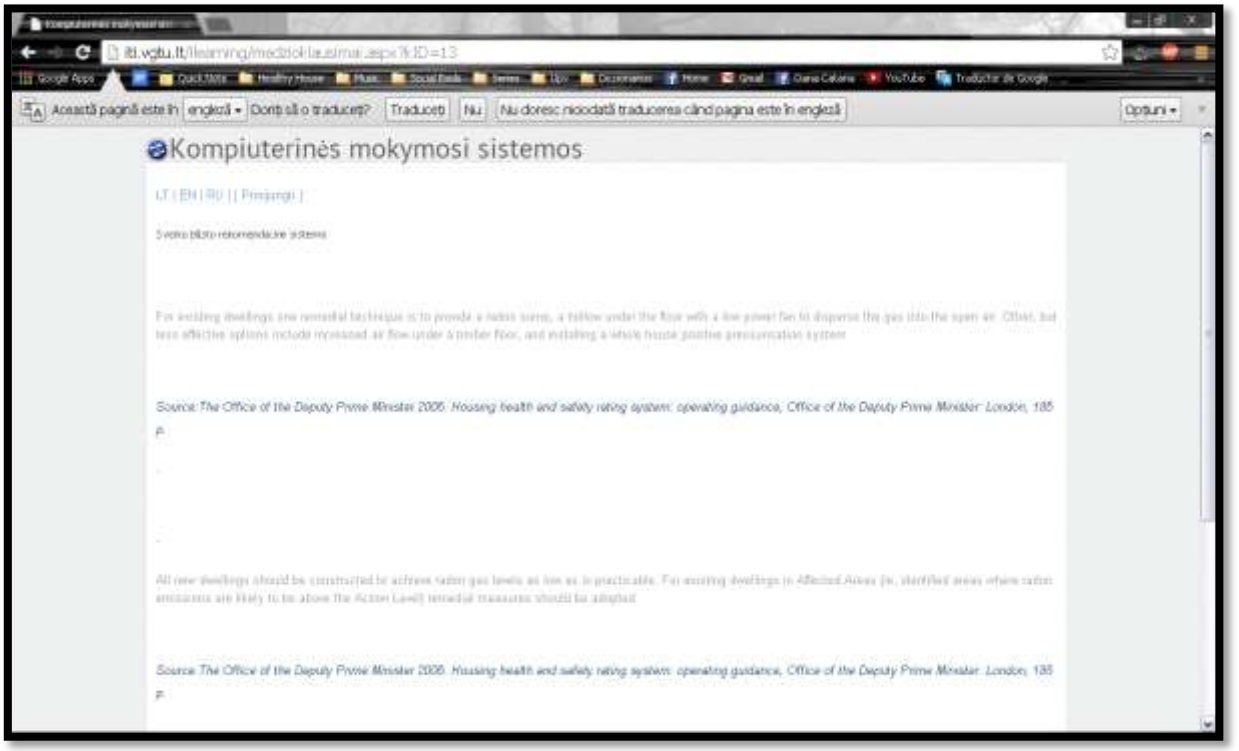


Fig.5. 11. Recommendations to the user.

1.3. Guide to the Practical Training System: Adding Content

1.3.1. Creating system's description

1.3.1.1.Creating a new student account

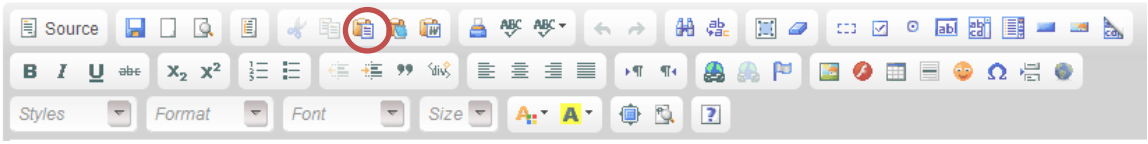
1. Go to http://iti2.vgtu.lt/imitacijosmain/simpletable.aspx
2. Click *[Log in]*.
3. Then click *Sign up*.
4. Enter the following data in the form *Account Information*:
    a. your system login name in the field *Username*;
    b. your e-mail address in the field *E-mail*;
    c. your system login password in the field *Password*;
    d. repeat your password in the field *Confirm Password* for verification.
5. Click *Create User*.

1.3.1.2. Logging in to the system

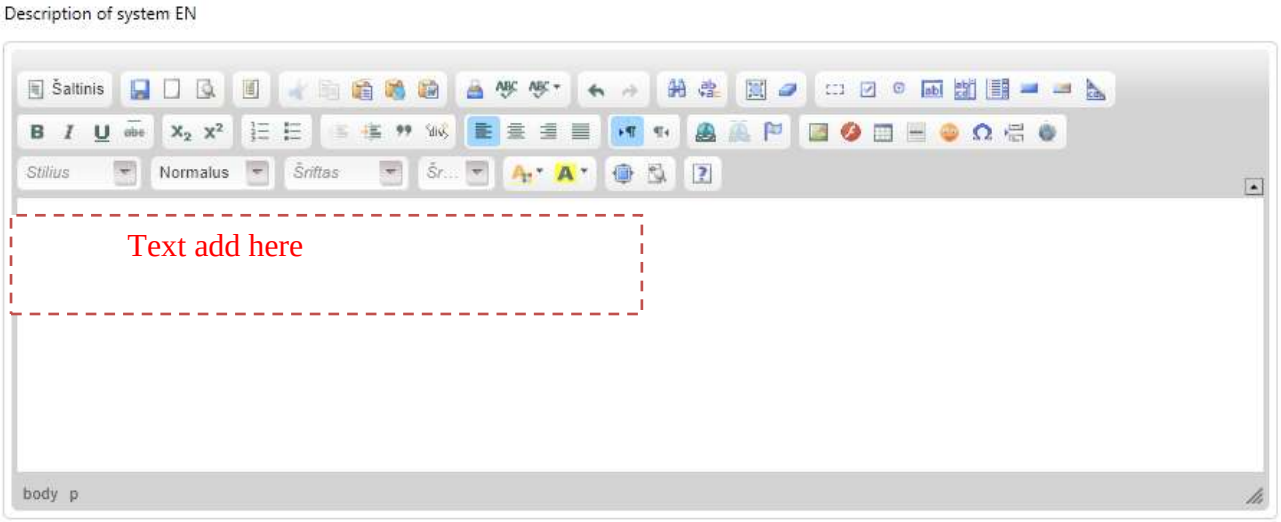
1. If you already have a username and password, go to http://iti.vgtu.lt/imitacijosmain/Account/Login.aspx
2. Enter your username and password and click *Log in* .

3. Click the menu option *Administration* and then *Create a New System*.
4. From the list *Choose a System*, select the type of your new system:
    a. Computer-based practical training system for construction works of exceptional significance;
    b. Computer-based practical training system for structural solutions of construction works of exceptional significance;
    c. Computer-based practical training system for property developers;

5. From the list *Choose a Subsystem*, select the subsystem you need.
6. Enter the system's name in the field *New System's Name*.
7. Enter the system's name in English in the field *New System's Name, EN*.
8. In the field *New System description*, paste the text copied in advance to your clipboard:
    a. click *Paste as Plain Text*;



    b. click on the pop-up window with your mouse and use the keyboard shortcut Ctrl+V to paste the text from your clipboard;

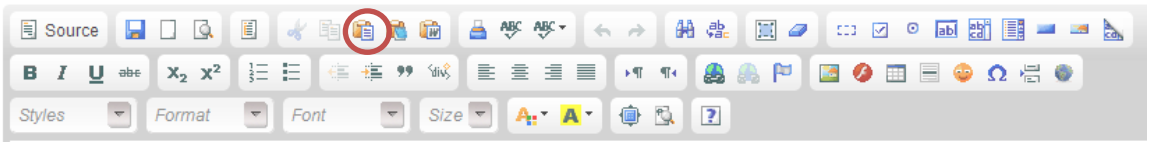


    c. follow the same procedure as in points (a) and (b) to paste your text in the field *About the new system, EN*.
9. Use the field *System Icon* to add the system's logo. The procedure is as follows:
    a. click *Browse*;
    b. in the pop-up window, chose any JPG, PNG or GIF image from your computer,
    c. click *Open*.
10. Tick the option *Make Public at Once* if you want to make your new system public.

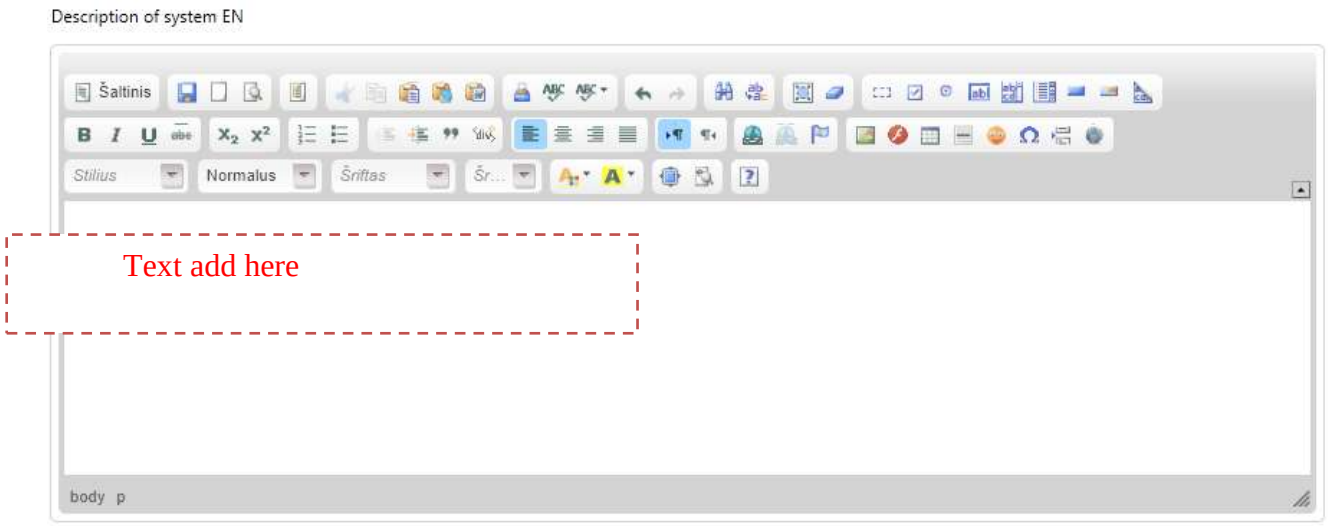
11. Once you have filled in all the fields, click *Add the System* at the bottom of the page.
12. To see whether the system has been successfully added to the lists, click the menu option *Your Systems* at the top of the page. You should see a brief description of your system in the list below this menu option.

1.3.2. Creating groups of system's objects

1. Click the menu option *Administration* and then *Groups of System's Objects*.
2. From the list *Your Systems*, select the name of your system to which you want to add groups of objects.
3. Enter the group's name in the field *Group's Name* (e.g. *Stogas*; other groups may be Langai, Durys, etc.).
4. Likewise (as in point 3), use the field *Group's Name, EN* to enter the group's name in English.
5. In the field *About the Group of Objects*, paste the text copied in advance to your clipboard:
    a. click *Paste as Plain Text*;

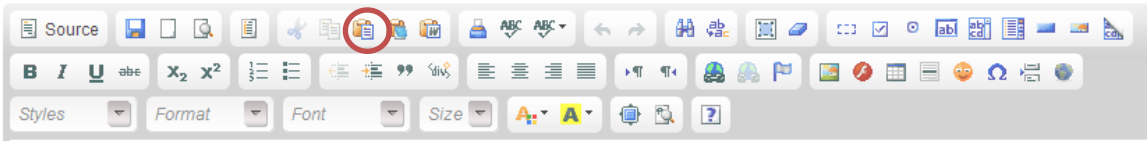


    b. click on the pop-up window with your mouse and use the keyboard shortcut Ctrl+V to paste the text from your clipboard.
    c. follow the same procedure as in points (a) and (b) to add your text to the field *About the group of objects, EN*.
6. Once all the fields have been filled in, click *Add the Group*.



1.3.3. System's objects (alternatives)

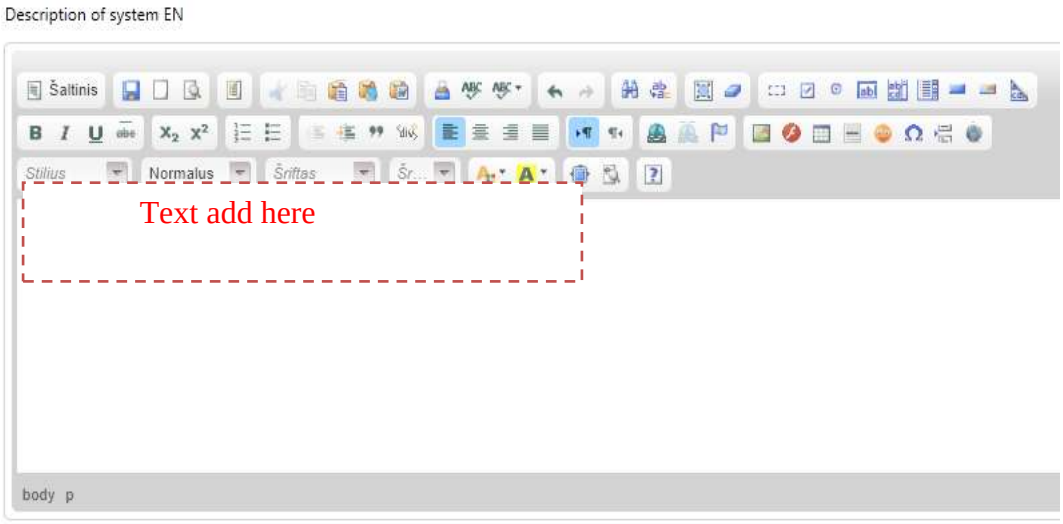
1. Click the menu option *Administration* and then S*ystems' Objects*.
2. From the list *Your Systems*, select the name of your system to which you want to add alternatives.
3. From the list *Groups of System's Objects*, select the group of objects to which you want to add alternatives.
4. Enter a short name of the alternative in the field *Object's Name*.
5. Enter a short name of the alternative in English in the field *Object's Name, EN*.
6. In the field *About the Object*, paste the text copied in advance to the clipboard:
    a. click *Paste as Plain Text*;



    b. click on the pop-up window with your mouse and use the keyboard shortcut Ctrl+V to paste the text from your clipboard;

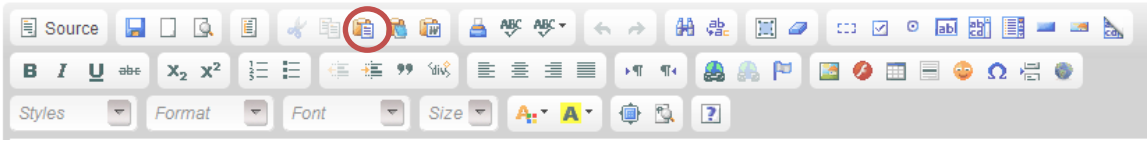
c. follow the same procedure as in points (a) and (b) to add your text to the field *About the object, EN*.

7. Once all the fields have been filled in, click *Add the Object*.

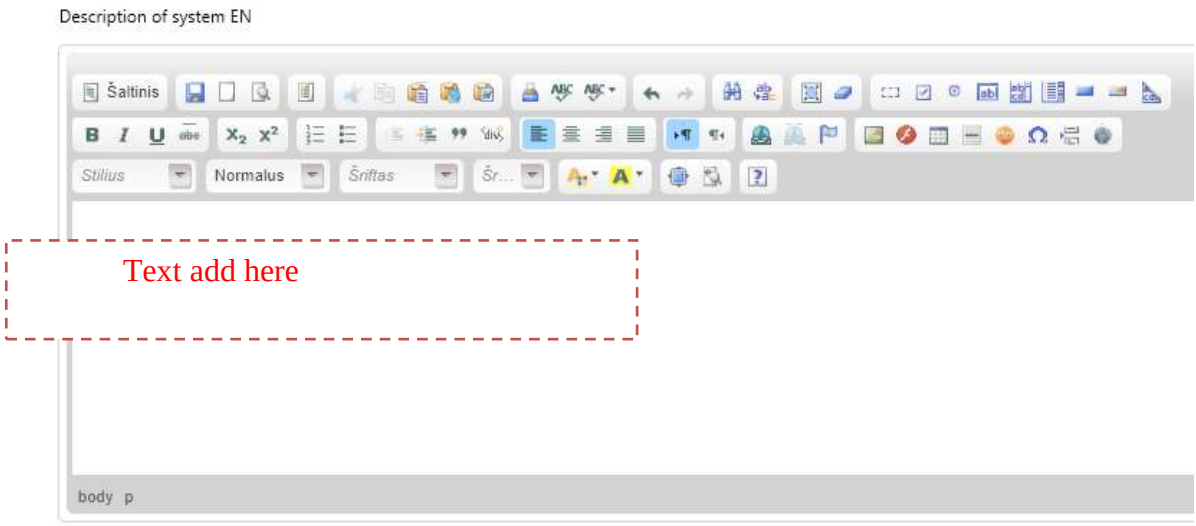


1.3.4. System criteria

1. Click the menu option *Administration* and then *System Criteria*.
2. From the list *Your Systems*, select the name of your system to which you want to add alternatives.
3. From the list *Groups of System's Objects*, select the group of objects to which you want to add criteria.
4. Enter the name of your criterion in the field *Criterion's Name*.
5. Enter the name of your criterion in English in the field *Criterion's Name, EN*.
6. In the field *About the Criterion*, paste the text copied in advance to the clipboard:
   a. click *Paste as Plain Text*;



   b. click on the pop-up window with your mouse and use the keyboard shortcut Ctrl+V to paste the text from your clipboard;



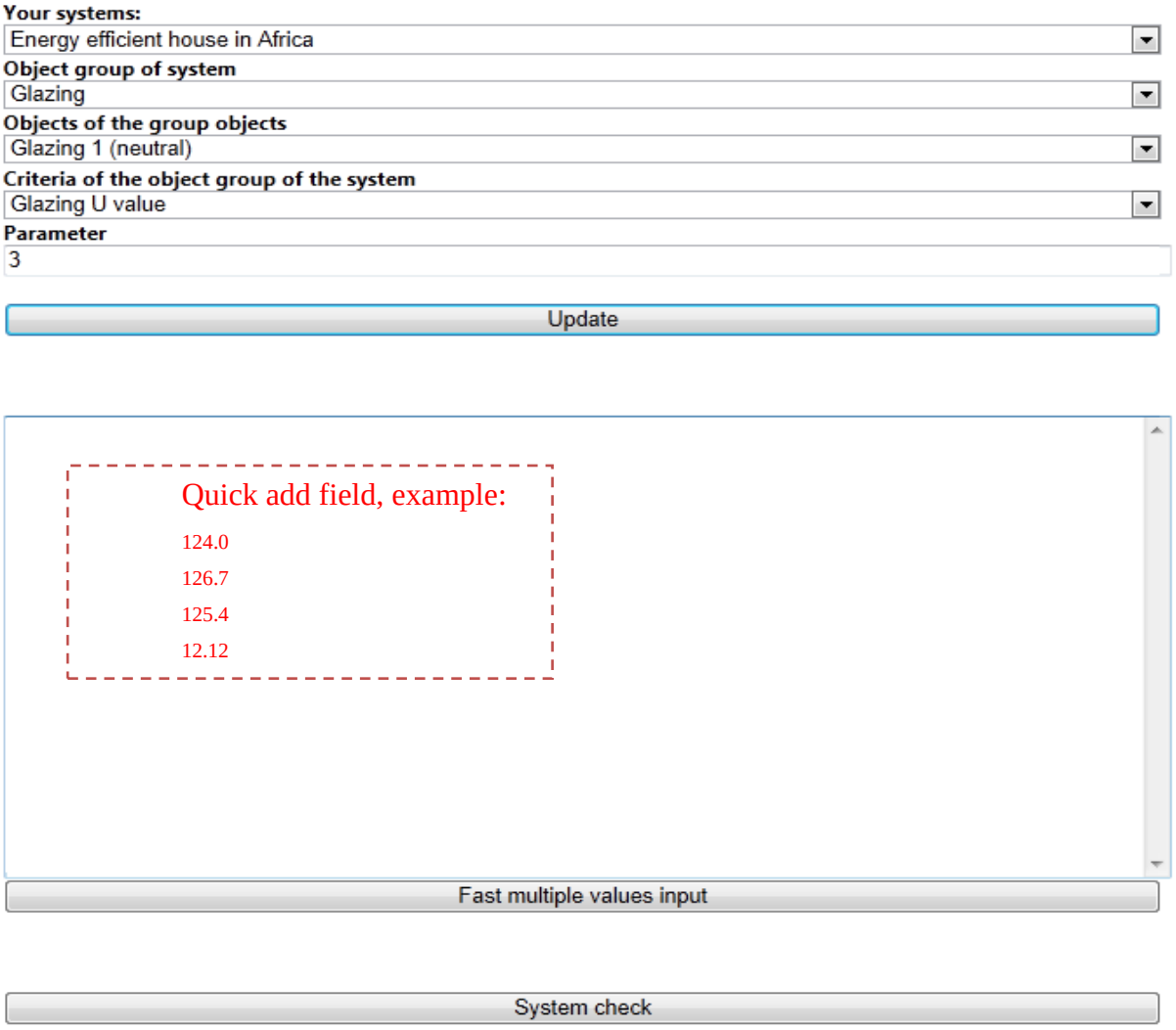
c. follow the same procedure as in points (a) and (b) to add your text to the field *About the Criterion, EN*.

7. Tick the option *Maximising Criterion* if the criterion is maximising (+); if the criterion is minimising (-), leave the option unticked.
8. Enter the criterion's weight (e.g., 0.089) in the field *Criterion's Weight*.
9. Select the measuring unit for this criterion (e.g., '000 LTL, points, etc.) from the list *Criterion's Measuring Unit*.
    a. If you don't see the required measuring unit in the list:
        i. click the menu option *Administration* and then *Measuring Units*;
        ii. enter the measuring units you need in the field *Name* (the units will be added to the list specified in Point 9 above);
        iii. click *Add*.
10. Click *Add*.

1.3.5. System's parameters

1. Click the menu option *Administration* and then *System's Parameters*.
2. From the list *Your Systems*, select the name of your system to which you want to add alternatives.
3. From the list *Groups of System's Objects*, select the group of objects to which you want to add criteria.
4. Select the alternative from the list *Group's Objects*.

5. From the list *Group's Criteria*, select the criterion (e.g., *RE offer price*) the value of which you want to enter (change the parameter).
6. Enter the value (e.g., 247.2) in the field *Parameter* and click *Update*.
    a. To add values for all criteria of one alternative at once, use the quick update field between the buttons *Update* and *Quick Update*.



    b. Enter the data in a column (you may also paste your data—use Ctrl+V).
    c. Then click *Quick Update*.
7. Likewise, enter the values for any other alternatives selected from the list *Group's Objects*.
8. To end your session, click *[Logout]* at the top-right corner.

Chapter VI. Conclusions

Indoor air quality is an important matter, as everything we breathe affects our health.

With only studying four of the hazards that can appear in a dwelling, mould and damp, excess cold, excess heat, radon, it is shown at how many risks we are exposed, how many diseases can threaten us: breathing difficulties, depression, anxiety, asthma, hypothermia, heart attacks, strokes or lung cancer.

In the present thesis, the 29 hazards presented in the "Healthy House and Safety Rating System" UK Government's program are integrated in the virtual reality in different ways.

VGTU presents the "Intelligent Tutoring System" which is about virtual services that can be used in the intellectual training system, which will consist of the base and the modules database.

"National Healthy Housing Certification Model" provides information about the 29 hazards, analyse them and gives recommendations. The other program that was presented in the present work is "Computer Learning System" and gives answers (recommendations) to the various questions regarding the 29 hazards. It is trying to improve those programs, to find more recommendations all over the world, to translate them (in the present the information is in three languages: Lithuanian, Russian and English) and as can be seen in the Anexes the recommendations were translated in Romanian and Spanish too.

As a case study, in the existent thesis, was created a virtual tour, a scenary where were included pictures with the studied hazards (damp and mould, excess cold, excess heat and radon), the two intelligent systems and also calculators for each hazard. All these information it is supposed that will help the user to understand better the risks that can appear in its life, how can avoid those problems, or if they already exist how they can disappear.

Of course, there are problems which the occupant of the dwelling can not handle without the help of an expert, but there are recommendations for all of these.

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Figures

Tables

Appendixes

Appendix I

Damp and mould recommendations

1.Damp and mould		
English	**Spanish**	**Romanian**
A mould appears because of the poorly ventilated rooms, where warm air and humidity is circulating and frequently because of not enough cleaned houses	El moho aparece por una mala ventilación en las habitaciones, donde circula aire caliente y humedad, y frecuentemente porque la limpieza en casa no es suficiente	Mucegaiul apare datoritã slabei ventilaţii a incãperii unde aerul cald şi umiditatea circulã şi apare in mod frecvent şi datoritã faptului cã nu este suficient de curat în casã.
You need to fight with a mould instantly in several ways: first of all you need to remove reasons, which lead to formation of mould, then eliminate already existing moulds. The humidity in house accumulates from wide variety of phenomena like from watered flowers, cooked food, washed and dried clothes and etc. Rising water vapour gathers on the walls and in such way creates good conditions for the moulds to grow. A mould can appear for many reasons, starting with poor ventilation of the rooms and ending with building spoilage.	Tienes que luchar contra el moho instantáneamente mediante varios pasos. En primer lugar necesita eliminar las razones que llevan a la producción del moho; a continuación elimine el moho existente. La humedad que se acumula en las casas tiene diferentes orígenes, como el agua de regar las flores, de cocinar la comida, de lavar y secar ropa, etc. El vapor de agua se acumula en las paredes creando buenas condiciones para la aparición de moho. El moho puede aparecer por muchas razones, empezando por una mala ventilación en la habitación y terminando por el deterioro de la construcción.	Împotriva mucegaiului se poate apela la urmãtoarele variante: in primul rând trebuie indepãrtate toate cauzele ce pot duce la apariţia şi formarea mucegaiului, apoi trebuie eliminat mucegaiul deja apãrut. Umiditatea în casă se acumulează datoritã unei mari varietaţi de fenomene, cum ar fi din udatul florilor, mâncare gãtita, hainele spălate şi uscate, etc. Vaporii de apă se adună pe pereţi creând condiţii bune pentru creşterea mucegaiului. Un mucegai poate apărea din mai multe motive, începând cu ventilaţie slabă de camere şi terminând cu deteriorarea constructiei.
However, nevertheless, there is a big impact on how carefully cleaning of premises is made. First step - at least few times a day ventilate rooms well. Most of us make a huge mistake: leave slightly jammed	Pero, sin embargo, es muy importante cómo hay que hacer la limpieza de las dependencias. El primer paso, es ventilar bien las habitaciones un par de veces al día. La mayoría de nosotros cometemos un gran error:	Cu toate acestea, totuşi, există un impact mare cu privire la modul de curăţare a spaţiilor . Primul pas - cel puţin de câteva ori pe zi, aerisiţi bine camerele. Cei mai mulţi dintre noi fac o mare greşeală: lăsam

window, but house does not ventilate in that way. The best ventilation method is to open the windows wide for several minutes. If an amount of humidity in the house is very big, one of the effective ways is to acquire dehumidifiers.	dejamos ligeramente "atascada" la ventana, pero la casa no se ventila de esta forma. El mejor método de ventilación es abrir la ventana durante varios minutos. Si la cantidad de humedad en la casa es muy grande, uno de los más efectivos métodos es adquirir deshumidificadores.	fereastra uşor deschisa , dar casa nu se ventileaza în acest fel. Cea mai bună metodă de ventilaţie este de a deschide ferestrele larg, timp de câteva minute. În cazul în care cantitatea de umiditate din casă este foarte mare, una dintre cele mai eficiente metode este de a achiziţiona dezumidificatoare (uscătoare).
Sometimes foundation, which does not have waterproofing, is responsible due to excessive amount of humidity. Mostly it is common for the old houses, however in this case nor wall restoration, nor isolation of foundation does not help. If foundation is really responsible, expensive special system, which is capable of stopping rise of humidity, needs to be used.	A veces los cimientos, que no tienen impermeabilización, son los responsables de una cantidad excesiva humedad. Sobre todo es muy común en las casas antiguas; sin embargo, en este caso, ni la restauración de muros, ni el aislamiento en cimientos ayuda. Si los cimientos son realmente los responsables, se necesita usar un sistema especial caro, que es capaz de detener el aumento de la humedad.	Uneori fundaţia, cea fara impermeabilitate, este responsabilă pentru o cantitate excesivă de umiditate.Această problemă se întâlneşte în general la casele vechi, în acest caz, nici restaurarea peretelui, nici izolarea fundaţie nu ajută. Dacă fundaţia este adevărata problemă,este nevoie de un sistem special, scump, ce este capabil sa oprească creşterea umidităţii.
First of all mould focus has to be neutralized – in order to prevent mould from spreading in its removal process. Mould needs to be scraped from the surface well. Since mould gathers not only on surface, but penetrates to the walls too, therefore it needs to try to exterminate it from inside. For that baking soda and washing powder solution can be used(add 100 grams of baking soda and a tablespoon of washing powder to the 10 litres hot water). With this solution damaged wall spots are washed. It is not enough to disinfect with mould removal preparations.	Primeramente el foco de moho debe ser anulado, con el fin de prevenir que se extienda durante el proceso de eliminación. El moho necesita ser bien raspado de la superficie. Si el moho no está solo en la superficie, sino que ha penetrado también en el muro, habrá que exterminarlo por lo tanto desde el interior. Para ello puede ser usada que la solución de bicarbonato de sodio y detergente en polvo (añada 100 gramos de bicarbonato de sodio y una cucharada de detergente en polvo en 10 litros de agua caliente). Con esta solución se lavan las manchas de la pared dañada. No es necesario	Mai întâi de toate trebuie să fie neutralizat nucleul (rădăcina) mucegaiului - în scopul de a preveni răspândirea mucegaiului în procesul de îndepărtare. Mucegaiul trebuie răzuit de la suprafaţă. Deoarece mucegaiul nu se adună doar lasuprafată, ci pătrunde şi în pereţi, trebuie să se încerce exterminarea din interior. Praful de bicarbonat de sodiu şi detergentul pot fi utilizate astfel: se adaugă 100 de grame de bicarbonat de sodiu şi o lingură de detergent la 10 litri de apă fierbinte. Cu această soluţie petele de pe peretele deteriorat sunt spălate. Nu

	desinfectar los preparativos para la eliminación del moho.	este suficientă dezinfectarea peretului doar cu preparate de ştergere a mucegaiului.
Next step in mould extermination process is examination of adjacent zones and disinfection. For this step special equipment needs to be used, which helps to identify whether mould infected the surrounding surfaces, because as it is known, in his early stages mould cannot be seen with a naked eye. It is very important stage, because after cleaning only the clearly visible hot spots without disinfecting surrounding areas, provides a possibility of formation of a new mould or generally, mould problem renewal in house.	El siguiente paso en el proceso de exterminación de moho, es examinar las zonas adyacentes y su desinfección. Para este paso se necesita usar equipos especiales, los cuales nos ayudan a identificar si el moho ha infectado las superficies de los alrededores, ya que como es sabido, el moho en su primera etapa no se ve a simple vista. Es una etapa muy importante, porque después de la limpieza de los puntos afectados claramente visibles si no desinfectamos las zonas circundantes, puede provocar la formación de un nuevo moho, o en general, la renovación del problema de moho en la casa.	Următorul pas în procesul de exterminare a mucegaiului este examinarea zonelor adiacente şi dezinfectarea acestora. Pentru acest pas trebuie utilizat echipament special care ajută la identificarea locului unde mucegaiul a afectat suprafețele din împrejur, deoarece, după cum se ştie, în stadii incipiente, mucegaiul nu pot fi văzut cu ochiul liber. Este o tapă foarte importantă, pentru că, după curățarea acestor locuri invizibile, doar acelea clar vizibile, fără dezinfectare, oferă o posibilitate de formare a unui nou mucegai sau, în general, reformarea mucegaiului în casă.
Formation of condensate	**Formación de condensación**	**Formarea condensului**
The reason why windows dew is simple - humidity is in premises. The warmer air, the more it stimulates emergence of moisture. The coldest spot in windows is glass package. Warm indoor air contacts with cooler glass surface and becomes water. This problem often arises in winter time, when air temperature is very low outside. Although condensate may occur in summer. In winter, condensate appears from the inside, on the surface of glass, in summer - from outside. If it happens in summer - it is only esthetical	La razón de la condensación en las ventanas es simple – la humedad es la razón. El aire caliente, es lo que más estimula la aparición de humedad. El lugar más frío de la ventana es la caja de la ventana. El aire caliente del interior en contacto con la fría superficie de la ventana se convierte en agua. Este problema se presenta a menudo en invierno, cuando la temperatura del aire es muy baja en el exterior. Aunque la condensación también puede aparecer en verano. En invierno, la condensación aparece desde el interior, en la	Motivul pentru roua din ferestre este simplu - umiditatea încăperilor. Cu cât aerul este mai cald , cu atât mai mult se stimulează aparitia umidității . Cel mai rece loc din fereastră este sticla . Aerul cald din interior intra in contact cu suprafața de sticle rece şi se transforma în apă . Această problemă apare de multe ori în timpul iernii , atunci când temperatura aerului este foarte scăzută afară .Condensul poate apărea şi în timpul verii . În timpul iernii, condensul apare din interior , pe suprafața sticlei

problem, but in winter condensate (or even icing) can damage the same windows and window opening. Window less isolates indoors from cold than insulated wall, no matter what kind of glass would be in use in glass unit. If unfavourable conditions arise, condensate can appear on plastic or wooden window and on all kind of glass. However, if vapour or condensate arises inside of glass package, it means, that it is not hermetic. Then window's glass package has to be replaced by the new one. If condensate or ice arises from room side, it means, that room window is too moist. Within the perimeter of the glass unit there is remote aluminium frame, therefore a corner of window's glass package is the coolest (of course, if temperature outside is lower than inside). When weather is too moist, then water vapour in air condensates in direction of coolest window part and if temperature outside is very low, water on window freezes. Later on ice melts and water leaks on windowsill. The reason, why condensate appears on one window and on other does not, is that level of moist in different rooms is various.	superficie del vidrio, en verano – desde el exterior. Si pasa en verano – es sólo un problema estético, pero una condensación en invierno (o incluso la formación de hielo) puede dañar la propia ventana o afectar a su apertura. Las ventanas deben estar al menos aisladas del frío en el interior al igual que los muros, no importa el tipo de vidrio que se use. Si surgen condiciones desfavorables, la condensación puede aparecer en ventanas de plástico y de madera, y en todos los tipos de vidrio. Sin embargo, si el vapor o condensación surge en el interior del vidrio, significa, que no es hermético. Por tanto, el vidrio de la ventana debe ser reemplazado por uno nuevo. Si la condensación o el hielo aparecen por el lado de la habitación, significa que la ventana de la habitación es demasiado húmeda. En el perímetro del vidrio hay un marco de aluminio, por lo tanto, esa esquina del vidrio de la ventana es la más frío (por supuesto, si la temperatura exterior es menor que en el interior). Cuando el clima es demasiado húmedo, entonces el vapor de agua se condensa en el aire en dirección a las partes más frías de la ventana, y si la temperatura exterior es muy baja, el agua se congela en las ventanas. Más tarde el hielo se derrite y aparecen fugas de agua en la ventana. La razón de porqué puede aparecer condensación en unas ventanas sí y en otras no, es	, în vara - din exterior . În cazul în care se întâmplă în timpul verii - este doar o problemă estetică , dar condensul iarna (sau chiar glazură) poate deteriora fereastra sau poate împiedica deschiderea ferestrei . Fereastrele izolează mai puțin interiorul încăperii față de peretele izolat , indiferent de ce fel de sticlă se utilizează. Dacă apar condiții nefavorabile , condensul poate apărea pe fereastra din plastic sau lemn şi pe toate tipurile de sticlă . Cu toate acestea , în cazul în cape apar vapori sau condens în interiorul geamului, înseamnă că acesta nu este ermetic . Geamul ar trebui să fie înlocuit cu unul nou . Dacă condensul sau gheață se formează din interiorul camerei înseamnă că fereastra camerei este prea umedă . În perimetrul unității de sticlă există un cadru de aluminiu izolat, prin urmare, un colț de geam este mai rece(desigur , în cazul în care temperatura exterioară este mai scăzută decât cea din interior) . Când vremea este prea umedă, vaporii de apă din aer se condensează în partea cea mai rece a ferestrei iar dacă temperatura exterioară este foarte scăzută , apa îngheață pe fereastră . Mai târziu, gheața se topește și apar scurgeri de apă pe pervazul ferestrei . Motivul pentru care condensul apare pe o fereastră şi pe alta nu este

	que el nivel de humedad varía en las diferentes habitaciones.	acela că nivelul de umiditate al camerelor este diferit.
It is very important to avoid condensate and ice creation on glass. New, modern window main advantage “airtightness” in this case became a little deficiency. Therefore indoors need to be ventilated by opening a window. It is required to ventilate premises few times per day. Short ventilation is enough in order to fill room with fresh air, while temperature do not decrease much.	Es muy importante evitar la condensación y la formación de hielo en el virio. La principal ventaja de las nuevas y modernas ventanas es su “hermeticidad”, que en este caso se convierte en una pequeña deficiencia. Por la necesidad de ventilar el interior mediante la apertura de ventanas. Es necesario ventilar las habitaciones varias veces por día. Una ventilación corta es suficiente para llenar la habitación con aire fresco, sin que la temperatura disminuya mucho.	Este foarte important să se evite crearea de condens şi gheață pe sticla. În acest caz, principalul avantaj al ferestrei moderne, "etanşeitatea" a devenit un mic deficit. Prin urmare, interiorul camerei trebuie să fie ventilat prin deschiderea ferestrei. Acest lucru trebuie repetat de câteva ori pe zi. Ventilarea rapidă este suficientă pentru a aerisi încăperea, în timp ce temperatura nu scade prea mult.
If there is possibility, maintain internal glass temperature as high as possible. If there is radiator under a window, try not to cover it with wide windowsill or mill the holes in a sill. Long curtains or louvers, which prevent air circulation, should not be in premises. Do not cover radiator, do not dry clothes on radiator, do not cook food or grow big amount of plants, because that way creation of moisture is promoted and it does not allow air circulate normally.	Si hay posibilidad, mantenga la temperatura interna del vidrio lo más alto posible. Si hay un radiador debajo de la ventana, no debería estar cubierto por el alfeizar de la ventana, ni debe haber agujeros en el alfeizar. No debería haber cortinas largas o persianas que impidan la circulación del aire. No cubra el radiador, no seque ropa en él, no cocine o tenga muchas plantas, ya que podría promover la aparición de humedad y no permite la circulación normal de aire.	Dacă există posibilitatea, mențineți temperatura internă a sticlei cât mai ridicată posibil. Dacă există calorifer sub o fereastră, nu încercați să-l acoperiți cu pervaz lat sau dați găuri în pervaz. Perdele sau jaluzele lungi, care împiedică circulația aerului, nu ar trebui să fie în camere. Nu acoperiți caloriferul, nu uscați haine pe calorifer, nu gătiți mâncare sau nu creşteți cantitate mare de plante, pentru că în acest fel sporiți crearea umidității şi aerul nu circulă normal.
The structure and finishes of a dwelling should be maintained free from rising, penetrating and traumatic dampness, or persistent condensation.	La estructura y los acabados de una vivienda deben mantenerse libres de aumentos, penetraciones o importantes humedades, o de condensación persistente.	Structura şi finisajele unei locuințe ar trebui să fie protejate de creşterea, pătrunderea umidității dăunătoare sau a condensului persistent.
Dwellings should be warm, dry and well-ventilated. Indoor relative humidity	Las viviendas deben ser cálidas, secas y bien ventiladas. La humedad	Locuințele ar trebui să fie calde, uscate şi bine ventilate. Umiditatea

should be between 40% and 60%, except for short periods of fluctuation. This range is the optimum to limit the growth of house dust mite populations and mould growth. It is also the recognized comfort zone.	relativa en el interior debe estar entre un 40% y un 60%, excepto en cortos períodos de variaciones. Este rango es el óptimo para limitar la aparición de ácaros de polvo doméstico y la aparición de moho. También es la zona de confort reconocido.	relativă din interior ar trebui să fie între 40% şi 60%, cu excepţia unor perioade scurte de fluctuaţie. Aceste valori sunt optime pentru a limita creşterea populaţiilor de acarieni şi creşterea mucegaiului. De asemenea este recunoscută sub numele de "zona de confort".
Rising and penetrating dampness should be prevented by proper and adequate dampproofing including damp proof courses and membranes and detailing around door and window openings. The external fabric should be kept in repair to prevent rain penetration. Preventative measures including frost protection, will help avoid traumatic problems such as burst pipes and tanks.	El aumento y la penetración de humedad deben ser prevenidas mediante una impermeabilización apropiada y adecuada, incluidos aislantes hidrófugos y membranas, y detalles alrededor de la puerta y en las aberturas de las ventanas. Las fachadas deben mantenerse reparadas para prevenir la entrada de agua. Las medidas preventivas, incluida la protección contra heladas, ayudarán a evitar importantes problemas como el estallido de tuberías y depósitos.	Creşterea şi pătrunderea umidităţii ar trebui să fie împiedicate de o hidroizolare corectă şi adecvată, inclusiv de membrane de hidroizolare, membrane de drenare a apei şi detalii în jurul deschiderii uşilor şi ferestrelor. Faţada ar trebui să fie reparată mereu, pentru a preveni pătrunderea ploii. Măsurile preventive, în special de protecţie la îngheţ, vor ajuta la evitarea problemelor grave , cum ar fi plesnirea conductelor şi a rezervoarelor.
All facilities which involve the use of water (for example, baths, wash hand basins, sinks, showers, and wc basins) should be properly installed to prevent or at least minimise the risk of dampness from splashing during normal use. Such facilities should be properly connected to a waste pipe capable of safely carrying waste water to a drainage inlet outside the dwelling.	Todas las instalaciones que implican el uso de agua (como baños, lavabos, fregaderos, duchas, lavabos y wc) deben instalarse correctamente para evitar, o al menos minimizar, el riesgo de humedad por las salpicaduras durante su uso normal. Dichas instalaciones deberán estar debidamente conectados a una tubería de desagüe capaz de transportar de manera segura de las aguas residuales a una entrada de drenaje fuera de la vivienda.	Toate facilităţile care implică utilizarea apei (de exemplu, băi, chiuvete,duşuri şi bazine wc) ar trebui să fie instalate în mod corespunzător pentru a preveni sau cel puţin a minimiza riscul de umiditate prin stropire în timpul utilizării normale. Aceste facilităţi ar trebui să fie corect conectate la o conductă de deşeuri cu capacitatea de a transporta apă reziduală, în condiţii de siguranţă, la staţie de epurare.
There should be properly	Dispositivos para aguas	Sistemul de canalizare al

installed rain water goods, including eaves gutters and rainwater fall pipes, capable of safely collecting rainwater discharged from the roof and carrying it safely away from the dwelling either into a drainage inlet or other proper means of disposal	pluviales deberán estar correctamente instalados, incluyendo aleros, canalones y tuberías de recogida de aguas pluviales, capaces de recoger de forma segura el agua de lluvia de la cubierta y llevarla con seguridad lejos de la vivienda, ya sea mediante un drenaje de entrada u otros medios adecuados de eliminación.	apelor meteorice trebuie instalat în mod corespunzător, inclusiv jgheaburi şi conducte de apă, capabile să evacueze în condiții de siguranță apa meteorică de pe acoperiş şi să o transporte la canalizare sau alte mijloace adecvate, departe de locuință, de forma cea mai sigură.
Roof and underfloor spaces should be properly ventilated to ensure timber remains airdry to minimize the chance of fungal infection.	Cubiertas y forjados de madera deben estar bien ventilados, para asegurar que la madera se mantiene seca, minimizando el riesgo de infección por hongos.	Acoperişul şi pardoseală ar trebui să fie ventilate în mod corespunzător pentru a fi siguri că lemnul rămâne uscat şi pentru a minimiza şansa de apariție a infecțiilor fungice
The dwelling should be able to cope with normal occupant moisture producing activities without persistently high relative humidities. There should be provision for the safe removal of moisture-laden air during peak production. This should include extraction during cooking or bathing, either by mechanical means, or passive stack ventilation and direct venting of clothes drying facilities (whether tumble driers or drying cabinets) to the exterior.	La vivienda debe ser capaz de hacer frente a las actividades normales de los ocupantes que producen humedad, sin que haya una persistente alta humedad relativa. Debería haber provisiones para una eliminación segura del aire húmedo durante los picos de producción. Esto debe incluir la extracción durante la cocción o el baño, ya sea mediante medios mecánicos o conductos de ventilación pasiva, o ventilación directa hacia el exterior para el secado de la ropa (aunque haya secadores o máquinas secadoras).	Locuința ar trebui să fie capabilă să facă fată activităților normale ale ocupanților ce produc umezeala, fără a produce în continuu umidități relativ-ridicate. Ar trebui să existe prevederi pentru eliminarea (în condiții de sigurant) a aerului umed în timpul producției de vârf. Aceasta ar trebui să includă eliminarea umidității în timpul gătitului, duşului, fie prin mijloace mecanice, fie prin ventilație pasivă sau directă rezultată din uscarea hainelor (uscător de rufe sau dulapuri de uscare)
There should be sufficient and appropriate means of ventilation to deal with moisture generated by normal domestic activities without the need to open windows. Opening windows can result in heat loss, noise, and may be a security risk. There may be no need for	Deberá hamber suficiente y apropiados medios de ventilación para hacer frente a los problemas de humedad generados por las actividades domésticas sin necesidad de abrir ventanas: La apertura de ventanas provocan una pérdida de calor, ruido; y	Ar trebui să existe mijloace suficiente şi adecvate de ventilație pentu a face față umidității generate de activitățile interne menajere fără a fi nevoie de deschiderea ferestrelor. Deschiderea ferestrelor poate duce la pierderea de căldură, la sporirea

additional background ventilation where windows are ill-fitting, no draughtstripping, and/or where there are open chimney flues. Where there is draught-stripping, or tight fitting windows, provision for background ventilation may be necessary via trickle vents in replacement windows, insertion of high-level airbricks, or by a passive stack or a MHRV system.	puede ser un riesgo de seguridad. No habra necesidad de ventilación adicional donde las ventanas estén mal colocadas, existan corrientes de aire y/o donde haya conductos de ventilacion abiertos. Donde no existan corrientes de aire, o ventanas herméticas, será necesaria una ventilación adicional a través de conductos de ventilación en lugar de ventanas, implantación de ladrillos de ventilacion en zonas superiores o por conductos pasivos o un sistema MHR	zgomotului şi poate fi un risc de securitate. Se poate să nu fie nevoie de aerisire suplimentară de fond în cazul în care ferestrele sunt greşit montate, exista curenți de aer, şi/sau în cazul în care există coşuri de fum deschise. În cazul în care nu există curenți de aer sau ferestre ermetice, asigurarea unei ventilații suplimentare este necesară prin montarea conductelor de ventilație, punerea de cărămizi cu performanțe ridicate de ventilare, ventilare pasivă sau un sistem de ventilație mecanică pentru recuperarea căldurii
If moisture levels are controlled, through adequate ventilation, dust mite populations can be significantly reduced by raising indoor temperatures. To achieve this, there should be adequate structural thermal insulation, and appropriate means of space heating.	Si se controlan los niveles de humedad, a través de una ventilación adecuada, las ocupaciones de ácaros del polvo se pueden reducir de forma significativa levantando la temperatura interior. Para lograr esto, debe haber aislamiento térmico estructural adecuado, y los medios apropiados de calefacción	În cazul în care nivelul de umiditate este controlat, prin ventilație adecvată, populațiile acariene pot fi reduse semnificativ prin creşterea temperaturilor de interior. Pentru a realiza acest lucru, ar trebui să existe o izolație termică adecvată a structurii precum şi mijloace adecvate de încălzire a spațiului.
Damp&Mould brochure		
In Europe, an estimated 10-50% of the indoor environments where human beings live, work and play are damp. Too much moisture makes a home stuffy and gives it a faint odour. Humid walls create a coldness that makes more heating necessary and increases energy bills.	En Europa, se estima que entre el 10-50% de los espacios interiores donde viven los seres humanos, traban y juegan, son húmedos. Una casa mal ventilada hace que haya demasiada humedad y le da un ligero olor. Las paredes húmedas crean un ambiente frío, siendo necesaria la calefacción, y aumentando las facturas de energía.	În Europa, un procent estimat de 10-50% din mediile de interior, unde trăiesc, muncesc sau se joacă ființele umane, sunt umede. Prea multă umiditate face ca o casă să fie sufocantă şi îi dă un miros neplăcut. Zidurile umede creează răcirea spațiului, ceea ce duce la încălzirea inutilă şi la creşterea facturilor de energie.

Occupants of damp or mouldy buildings are at increased risk of experiencing health problems such as symptoms, respiratory infections, allergic rhinitis and asthma.	Los ocupantes de edificios con moho y humedad están en riesgo constante de sufrir problemas de salud como síntomas, infecciones respiratorias, alergias, rinitis y asma.	Ocupanții clădirilor umede sau mucegăite au un risc crescut de a suferi de probleme de sănătate, cum ar fi simptome, infecții respiratorii, rinită alergică şi astm.
The problem of Excessive Moisture can take the form of: DAMP AIR, CONDENSATION ON SURFACES and INCREASED HUMIDITY levels in materials.	El problema del un exceso de moho puede provocar: aire húmedo, condensaciones en superficies y aumentar el nivel de humedad en materiales.	Problema umezelii excesive poate lua următoarele forme: aer umed, condens pe suprafețe și niveluri de umiditate ridicată în materiale.
If you have concerns about a health problem that may be related to humidity in your home, always contact your general practitioner.	**Si está preocupado por un problema de salud y cree que puede estar relacionado con humedad en su casa, contacte siempre con su médico de cabecera.**	**Dacă aveți nelămuriri cu privire la o problemă de sănătate ce pot fi legată de umiditatea în casa, contactați întotdeauna medicul de familie.**
Practical tips on getting rid of damp and mould	**Consejos prácticos sobre la eliminación de humedad y moho**	**Sfaturi practice pentru a scăpa de umiditate şi mucegai**
Measures to prevent or reduce moisture are the main way to limit the development of mould (and any microbial) growth: WITHOUT WATER - NO MOULD!!!	**Medidas para prevenir o reducir el moho, es el principal camino para limitar que el desarrollo de moho (y cualquier microbio) aumente: SIN AGUA - NO HUMEDAD!!!**	**Măsurile de prevenire sau reducere a umezelii sunt principala modalitate de a limita dezvoltarea mucegaiului (şi orice microbiană): FĂRĂ APĂ - NU EXISTĂ MUCEGAI!**
1. Detecting and locating the source of the moisture problem	**1. Detecte y localice la fuente del problema de humedad**	**1. Detectarea şi localizarea sursei problemei de umiditate**
Moulds only grow when there is sufficient moisture. When moulds appears, the first task is to establish where the moisture is coming from	**El moho solo aparece cuando hay suficiente humedad. Cuando aparece moho, el primer paso es detectar de donde proviene la humedad.**	**Mucegaiul creşte numai atunci când există suficientă umezeală. Când apare mucegai, prima sarcină este de a stabili de unde apare umiditatea**
Major causes for excessive moisture are: 1. Leaking pipes, wastes or owerflows; 2. Rain seeping through the roof where a tile or slate is missing, spiling from a blocked gutter, penetrating	**Las principales causas de una humedad excesiva son**: 1. Tuberías con fugas, residuos o desbordamientos; 2. Filtración de lluvia a través de la cubierta en la que falta una teja o pizarra, desbordamiento de un canalón	**Cauze majore de umiditate excesivă sunt:** 1. Scurgeri prin țevi, deşeuri sau alte scurgeri; 2. Scurgerea ploii prin acoperişul în care o țiglă sau o placă lipseşte, revărsare de la un canal

around window frames, or leaking through a cracked pipe and; 3. Rising damp due to a defective damp course or because there is no damp-course.	bloqueado, penetración por los marcos de las ventanas, o escape a través de un tubo roto y, 3. La humedad capilar debido a un curso húmedo defectuoso o porque no hay un transcurso para la humedad.	blocat, patruderea apei în jurul ramei ferestrei, sau scurgeri printr-o conductă spartă ; 3. Apariția umidității ca urmare a unui curs umed defect sau inexistența acestuia
These causes of damp leave a "tidemark" and you should have the necessary repairs carried out to remove the source of damp.	Estas causas de humedad dejan un “cerco”, y debería realizar las necesarias reparaciones para eliminar la fuente de humedad.	Aceste cauze ale umidității lăsa o pată și ar trebui să se facă reparațiile necesare pentru a elimina sursa de umiditate.
If your house is newly-built it may be damp because the water used during its construction is still drying out.	Estas causas de humedad dejan un “cerco”, y debería realizar las necesarias reparaciones para eliminar la fuente de humedad.	În cazul în care casa este nou-construită, poate exista umezeală deoarece apa folosită în timpul construirii nu este încă uscată.
If your home is damp for any if these reasons, it may take weeks of heating and ventilating to dry out. Hiring a dehumidifier may also help.	Si su vivienda tiene humedad por alguna de estas razones, le llevará semanas de calefacción y ventilación para secarlo. La contratación de un deshumidificador también puede ayudar.	Dacă în casa ta există umezeala din cauza oricărui dintre aceste motive, se poate că procesul de încălzire sau ventilare să dureze mai multe săptămâni. Un dezumidificator poate ajuta de asemenea.
When the source of moisture does not appear to be related to structural faults, leaks or rising damp or the newness of the property, it is probably due to condensation	Cuando la fuente de humedad no parezca estar relacionada con defectos estructurales, filtraciones o humedad ascendente, o la novedad de la propiedad, es probable que sea debido a condensación.	Atunci când sursa de umiditate nu este legată de defecte structurale, scurgeri sau igrasie sau de faptul că locuința este nou construitra, se poate că aceasta să fie condensul.
2. Removing the mould	**2. Eliminación del moho**	**Îndepărtarea igrasiei**
After indentifying and reducing /removing the moisture sources, the next step is to decide whether removing the mould from the affected areas is something that can be managed without professional help.	**Después de identificar y reducir/eliminar las fuentes de humedad, el siguiente paso es decidir si la zona donde hay que eliminar el moho requiere la ayuda de un profesional**	**După identificarea si reducerea / eliminarea surselor de umiditate, următorul pas este de a decide dacă eliminarea mucegaiului din zonele afectate este ceva ce poate fi gestionat fără ajutorul unui profesionist.**
When the cause of the mould is related to building faults (leakages etc.) and/or the mould is also present in the	Cuando la causa del moho esté relacionada con defectos constructivos (fugas, etc.) y/o el moho esté presente también	Atunci când cauza mucegaiului este legată de defecte de construcție (scurgeri etc) și / sau

building structure and material, it is recommended to get professional help. In this case, it may be useful to consult a national or local source of information to guide you in your selection of a suitable contractor	en la estructura y el material de construcción, se recomienda la ayuda de un profesional. En este caso, podría ser útil consultar una fuente nacional o local de información que le ayude a la selección de una empresa adecuada.	mucegaiul este prezent şi în structura construcției şi în material, este recomandat ajutorul unui profesionist. În acest caz, ar putea fi util a consulta o sursă națională sau locală de informații pentru a vă ghida în selecția unui contractant adecvat
If mould growth is due to condensation and the mould area is less than 1 m2 (i.e., 1 metre high by 1 metre wide or roughly 3 feet high by 3 feet wide) and is not caused by sewage or other contaminated water, you can probably manage the job yourself following these guidelines or some of those listed in the references, such as the guidelines of the US Environment Protection Agency (EPA). Many national institutes have also published guidance documents in national languages	Si la aparición de moho se debe a la condensación y el área del moho es de menos de 1 m2 (es decir, 1 metro de alto por 1 metro de ancho o aproximadamente 3 metros de alto por 3 metros de ancho) y no es causada por aguas residuales u otras aguas contaminadas, probablemente pueda gestionar el trabajo usted mismo siguiendo estas directrices o algunos de los enumerados en las referencias, tales como las directrices de la Agencia de Protección del Medio Ambiente de EE.UU. (EPA). Muchos institutos nacionales también han publicado documentos de orientación en los idiomas nacionales.	În cazul în care mucegaiul este din cauza condensului şi zona de mucegai este mai mică de 1 m2 (de exemplu, 1 m înălțime şi 1 m lățime sau aproximativ 3 picioare înălțime şi 3 lățime) şi nu este cauzat din cauza canalizării sau a apei contaminate, probabil puteți gestiona această problemă de unul singur cu ajutorul manualelor de specialitate, instrucțiunilor, cum ar fi cel de la US Environment Protection Agency (EPA). Multe instituții naționale au publicat, de asemenea, ghiduri de specialitate în propria limbă.
Whether the job is undertaken by a contractor or yourself, care has to be taken to avoid personal exposure to microscopic mould spores and the spread of spores within the building. If you yourself are undertaking the task of the mould removal, use a protective mask which covers your nose and mouth, wear goggles (without ventilation holes) to avoid getting mould or mould spores in your eyes, and	Si el trabajo es llevado a cabo por una empresa o por usted mismo, se debe tener cuidado para evitar la exposición personal a las esporas microscópicas de moho y la propagación de las esporas dentro del edificio. Si usted está llevando a cabo la tarea de la eliminación de moho, utilice una máscara protectora que le cubra la nariz y la boca, utilice gafas (sin agujeros de ventilación) para evitar moho o esporas de moho en los ojos, y proteja las manos con guantes de goma,	Dacă îndepărtarea mucegaiului este efectuată de către un specialist sau de către tine, trebuie luate măsuri de siguranță împotriva expunerii personale la sporii microscopici de mucegai şi a răspândirii sporilor în interiorul clădirii. Dacă eliminați mucegaiul de unul singur, folosiți o mască de protecție ce acoperă nasul şi gură, purtați ochelari de protecție (fără deschideri pentru ventilare) pentru a evita ca

protect your hands by wearing rubber gloves, preferably long ones.	preferiblemente largos.	mucegaiul sau sporii mucegaiului să ajungă n ochii tăi şi protejaţi mâinile purtând mănuşi de cauciuc, de preferabil lungi.
`Chemical desinfection and the use of biocides are not recommended as a routine practice for mould control as it may be toxic for the occupants. The application of disinfecting substances also does not solve the cause of the problem, and therefore may provide more health risks than benefits.	La desinfección química y el uso de biocidas no se recomienda como una práctica de rutina para el control del moho, ya que puede ser tóxico para los ocupantes. La aplicación de sustancias desinfectantes tampoco no resuelve la causa del problema, y por lo tanto puede ofrecer más riesgos para la salud que beneficios.	Dezinfectarea chimică şi utilizarea biocidelor nu sunt recomandate că o practică de rutină pentrul controlul mucegaiului deoarece pot fi toxice pentru locuitori. Aplicarea substanţelor dezinfectante nu rezolvă cauza problemei şi pot provoca mai multe riscuri sănătăţii locuitorilor decât beneficii.
Removal of mould-contaminated materiales: a) Have a big bag ready to take away mildewed clothes, curtanins, rugs and carpets for cleaning. Consider replacing a mattress or soft toy that smells and feels damp. b) The process of cleaning will release mould spores into the air. Open any windows but close doors tightly to help prevent the spores being spread to other areas of the house. Leave the windows open during and after the clean up activity. c) Prepare a bucket of water, some mild detergent, such as washing up liquid or a soap used for hand washing clothes, and some rags that can be thrown away after removing the mould. d) Carefully wipe the mould off the wall surface with the soapy rag. Take a dry rag to wipe down and remove the moisture following the cleaning process. Put the rags in a plastic prior to disposal.	Eliminación de materiales contaminados por moho: a) tenga preparada una gran bolsa para llevar la ropa con moho, cortinas, tapetes y alfombras a limpiar. Considere reemplazar los colchones o juguetes que huelan o se sientan húmedos. b) el proceso de limpieza suelta las esporas de moho en el aire. Abra las ventanas, pero cierre las puertas herméticamente, para evitar que las esporas se extiendan a otras áreas de la casa. Deje las ventanas abiertas durante, y después, de la limpieza. c) Prepare un cubo con agua, un poco de detergente suave, tal como el detergente o jabón que use para lavar la ropa a mano, y algunos trapos que se puedan tirar a la basura después del proceso. d) Limpie cuidadosamente el moho de la superficie de la pared con el trapo y jabón. Coja un trapo seco para limpiar y eliminar la humedad tras el proceso de limpieza. Ponga los trapos en un	Îndepărtarea mucegaiului din materialele contaminate: a)Trebuie să aveţi un sac mare pentru a pune în el hainele impregante cu mucegai , perdele , carpete şi covoare pentru a le duce la curăţare . Luaţi în considerare înlocuirea saltelelor sau jucăriilor pufoase care miros şi se simt umede b) Procesul de curăţare va lansa sporii de mucegai în aer . Deschideţi toate ferestrele dar inchedti uşile pentru a preveni răspândirea sporilor în casă. Lăsaţi ferestrele deschise în timpul şi după terminarea activităţii de curăţare. c) Pregătiţi o găleată de apă, slab detergent, cum ar fi detergent lichid sau săpun folosit la spălarea hainelor de mână şi nişte cârpe ce pot fi aruncate după îndepărtarea mucegaiului. d) Cu o cârpă îmbibată în apă cu săpun, ştergeţi cu grijă mucegaiul de pe

e) After mould removal, allsurfaces in the room should be thoroughly cleaned either by wet wiping or vacuum cleaning, preferably with a HEPA filter to remove spores that have spread during mould removal.	plástico antes de tirarlos. e) Después de la eliminación del moho, todas las superficies de la habitación deben limpiarse a fondo, ya sea por frotación húmeda o con aspiradora, preferiblemente con un filtro HEPA para eliminar las esporas que se han extendido durante la eliminación del moho.	suprafața peretelui. Cu o cârpă uscată se va şterge umezeala după procesul de curățare. e) După îndepărtarea mucegaiului, toate suprafețele din camera trebuie curățate fie prin ştergere umedă sau prin aspirare, preferabil cu un filtru HEPA (de eficiența maximă particulară pentru absorbție) pentru a înlătura sporii ce s-au răspândit pe durata procesului de îndepărtare a mucegaiului.
Once the work of removing the mould is completed, your energies should turn to preventing it from reappearing. The following section provides advice on preventing dampness and condensation.	Una vez que el trabajo de eliminación de moho se ha completado, sus energías deben dirigirse a impedir que vuelvan a aparecer. La siguiente sección ofrece un asesoramiento sobre la prevención de la humedad y la condensación.	Odată ce procesul de înlăturare al mucegaiului a fost finalizat, atenția voastră trebuie să se întoarcă înspre prevenirea reapariției mucegaiului. Următoarea secțiune va da sfaturi despre cum se poate preveni igrasia şi condensul.
3. Taking action to control excessive moisture and condensation	**3. Tome acciones para controlar una excesiva humedad y condensación**	**3. Luarea de măsuri pentru a controla umezeală şi condensul**
If your problem is not from a leak or a faulty or non-existent damp-course, it is probably caused by condensation.	**Si su problema no es debido a una fuga o a la inexistencia de transcurso para la humedad, es probable que la causa sea condensación**	**În cazul în care problema nu este de la o scurgere, un defect sau inexistenta unei membrane hidroizolatoare, cauză este probabil condensul.**
Three factors contribute to the condensation of water on building surfaces: high humidity of indoor air, low temperature of the walls/surfaces and poor ventilation	**Tres factores son los que contribuyen a la condensación de agua en la superficie de los edificios: alta humedad en el aire interior, baja temperatura en los muros y superficies y escasa ventilación**	**Trei factori contribuie la condensarea apei pe suprafele construcției: umiditatea ridicată a aerului din interior, temperatură scăzută a pereților / suprafețelor şi slabă ventilare.**
1) Humidity of indoor air: condensation appears when the indoor air in a room cannot hold the level of moisture than cold air. For	**1) Humedad del aire interior**: la condensación aparece cuando el aire interior en una habitación no puede alcanzar el nivel de humedad	**1) Umiditatea aerului din interior**: condensarea apare atunci când aerul din interior într-o cameră nu are acelaşi nivel de umiditate

example, running a bath causes steam. As the air in the bathroom fills up with water vapour, it can no longer hold all the moisture that it contains. As a result, tiny drops of water appear, and develop first on cold surfaces such as mirrors and window sills.	como el aire frío. Por ejemplo, tomar una ducha causa vapor. Como el aire del cuarto de baño se llena de vapor de agua, no puede mantener toda la humedad que contiene. Como resultado, aparecen pequeñas gotas de agua, y se desarrolla primero en superficies frías como espejos y marcos de ventanas.	ca cel al aerului rece. De exemplu, atunci când se face duş se formează vapori. Cum aerul din baie este plin de vapori de apă, acesta nu mai poate ține toată umiditatea. Ca rezultat, apar picături mici de apă, ce se dezvolta mai întâi pe suprafețe reci cum ar fi oglinzi sau pe pervazul geamului.
2) Low tenperature: Condensation can be worse when it is cold. The humid air comes into contact with cold indoor surfaces, transforms into surfaces mist and then into water that runs down the window causing wooden frames to rot and wallpaper and painted walls to blister. The tell-tale signs of dampness are often found on north-facing walls, the cooler sie of any home, and especially in corners of rooms.	**2) Baja temperatura**: la condensación puede ser peor cuando hace frío. El aire húmedo entra en contacto con las superficies interiores frías, transformándose en superficies con rocío y luego en agua que discurren por las ventanas causando la putrefacción de los marcos de madera, y ampollas en papel pintado y paredes pintadas. Los signos reveladores de humedad a menudo se encuentran en las paredes que dan al norte, la parte más fría de la casa, y especialmente en las esquinas de las habitaciones.	**2) Temperatura scăzută**: Condensul se poate înrăutăți atunci când este frig. Aerul umed vine în contact cu suprafețele interioare reci, se transformă în brumă apoi în apă care se prelinge în jos pe ferestre, cauzând putrezirea ramelor de lemn, a tapetului şi umflarea pereților. Semnele umezelii apar de cele mai multe ori pe pereții din partea de nord (partea cea mai răcoroasă a oricărei case), în special în colțurile camerei.
3) Poor ventilation: Humidity of indoor air can be reduces by ventilation. If air exchange is inadequate, then humidity accumulates indoors and leads to increased condensation. In addition, walls remain cool when a lack of free movement of indoor air prevents warm air from reaching them. Mould may therefore form where there is little movement of air, for example, in a windowless basement, or behind wardrobes and cupboards. In places where low ventilation	**3) Mala ventilación**: la humedad del aire interior puede ser reducida mediante ventilación. Si el intercambio de aire es inadecuado, entonces la humedad se acumula en el interior, provocando un aumento de la condensación. Además, los muros permanecen fríos cuando una falta de circulación interior de aire e vita que el aire caliente llegue a ellos. Por lo tanto, se puede formar moho donde hay poca circulación de aire, por ejemplo, en un sótano sin ventanas, o detrás de armarios	**3) Ventilație slabă**: Umiditatea aerului din interior poate fi redusă prin ventilație. Dacă schimbul de aer este inadecvat, atunci se acumulează în interior umiditate, ceea ce duce la creşterea condensului. În plus, pereții rămân reci atunci când lipsa de circulație liberă a aerului împiedica aerul cald să ajungă la ei. Mucegaiul se poate forma atunci când exista o slabă mişcare a aerului, spre exemplu, într-un beci fără geamuri sau în

comes together with cold surfaces, they become the priority risk areas for mould growth.	y cómodas. Los lugares donde hay escasa ventilación, además de superficies frías, se convierten en zonas de riesgo prioritarios para que aparezca moho.	spatele dulapului şi spațiilor de depozitare. În locurile unde slabă ventilație apare împreună cu suprafețele reci exista un mare risc de formare a mucegaiului.
After cleaning up mould due to condensation, stopping the dampness from coming back means understanding and dealing with each other of the causes of condensation.	Después de la limpieza del moho debido a la condensación, parar la humedad para que no vuelva a salir significa entender y tratar el resto de causas de condensación	După curățarea mucegaiului datorat condensului, oprirea apariției umezelii înseamnă apoi înțelegerea şi rezolvarea altor cauze ale apariției condensului.
How to prevent condensation	**Como prevenir condensación**	**Cum să prevenim condesul?**
a. Produce less moiusture: 1.put a lid on saucepans to keep the steam inside 2. Do not leave kettles boiling 3. Dry washing outside if possible. Otherwise, hang it up in the bathroom, close the dooe and have the window open or a fan working continuosly while it dries 4.Try to avoid usig paraffin or bottled-gas heaters that do not have an exhaust pipe to the outside. Burning paraffin or gas produces considerables amounts of water.	**a. Producir menos humedad:** 1.ponga tapas en cacerolas para mantener el vapor en el interior. 2. No deje teteras hirviendo. 3. Seque la ropa en el exterior si es posible. De lo contrario, cuélguelo en el baño, cierre la puerta y tenga la ventana abierta, o use un ventilador que trabaje continuamente mientras se seca. 4. Intente evitar el uso de calentadores de queroseno o bombonas de gas, sin tubos de escape al exterior. La quema de queroseno o de gas produce considerables cantidades de agua.	**a. Produceți mai puțină umezeală:** 1. puneți un capac peste tigaie pentru a menține aburii înăuntru 2. nu lăsați apa din oala să fiarbă 3. uscați rufele afară cât mai mult posibil. Dacă nu, agățați rufele în baie, închideți uşa şi lăsați geamul deschis sau ventilatorul să funcționeze în mod continuu pe durata uscării 4. încercați să evitați încălzitoare cu parafina sau gaz îmbuteliat ce nu au conducta de evacuare la exterior.Arderea parafinei sau gazului produce cantități considerabile de apă.
b. Ventilate to remove moisture: 1. ventilate all the rooms at the regular intervals to remove humid air. Note that tight buildings require more active ventilation! 2. Mechanical ventilation systems should not be stopped 3. Cooking, bathing and showering all produce	**b. Ventile para eliminar la humedad**: 1. Ventilar todas las habitaciones a intervalos regulares para eliminar el aire húmedo. Tenga en cuenta que los edificios herméticos requieren más ventilación. 2. Los sistemas de ventilación mecánica no deben ser detenidos. 3. Cocinar, bañarse	**b. Ventilați pentru a înlătura umezeala:** 1. Aerisiți toate încăperile la intervale de timp regulate pentru a înlătura aerul umed. Țineți cont de faptul că clădirile închise necesită mai multă aerisire. 2. Sistemul de ventilarea mecanică ar trebui să

steam. Open the window or put on the fan and close the door to prevent the damp air circulating into other rooms. 4. At other times, leave all the doors to different rooms open to allow the air to circulate 5. To avoid condensation in bedrooms, open the window for 15 minutes each morning. Human breathing puts considerable moisture into the indoor air 6. Move items of furniture away from the wall slightly so that air can pass behind them. Leave the doors of cupbroads open from time to time to air them. 7. Do not ventilate cold basements when the outside temperature exceeds the inside temperature because the humidity of the warm air will condensate on the cold surfaces. In summer, only ventilate basements at night when outdoor temperatures have dropped.	y ducharse producen vapor. Abra la ventana o ponga en marcha el ventilador y cierre la puerta para evitar que el aire húmedo circule a otras habitaciones. 4. Otras veces deje todas las puertas abiertas para permitir la circulación del aire. 6. Mueva los elementos de mobiliario un poco de la pared para que el aire pueda pasar por detrás de ellos. Deje las puertas abiertas de armarios de vez en cuando para ventilarlos. 7. No ventile sótanos fríos cuando la temperatura del exterior es superior a la que hay en el interior, debido a que la humedad del aire caliente se condensará en las superficies frías. En verano, sólo ventilar los sótanos de noche, cuando la temperatura exterior se haya reducido.	funcționeze în mod continuu 3. Gătitul, îmbăierea sau dușul, produc vapori. Deschideți geamul sau puneți în funcțiune ventilatorul şi închideți uşa pentru a preveni circularea aerului umed în alte camere. 4. Când nu există aer umed, lăsați toate uşile deschise pentru o bună circulare a aerului 5. Pentru evitarea condensului în dormitoare, lăsați geamul deschis 15 minute în fiecare dimineață. Respirația umană produce umiditate în aerul interior. 6. Mutați mobilierul mai departe de perete pentru a permite circulația aerului prin spatele lor. 7. Nu aerisiți beciul rece când afară temperatura aerului este mai mare decât cea din interiorul beciului deoarece umiditatea aerului cald va condensa pe suprafața rece. Vara, aerisiți beciul doar pe durata nopții când temperatura din exterior scade.
c. Insulate your building or heat your home a little more: 1. Thermal comfort ranges are very subjective. When at home, the ideal temperature usually ranges between 19-22 degrees Celsius in the living room, including the kitchen and bathroom, and 16-20 degrees Celsius in the bedrooms 2. When away from home, the temperature in the rooms should not drop under 15	**c. Aísle su edificio o caliente su casa un poco más.** 1. Los rangos de confort térmico son muy subjetivos. Cuando esté en casa, la temperatura ideal, por lo general, oscila entre 19ºC y 22ºC en la sala de estar, incluyendo cocina y el baño, y entre 16ºC y 20ºC en dormitorios. 2. Cuando esté fuera de casa, la temperatura en las habitaciones no debe caer por debajo de 15ºC, para evitar la condensación y el	**c. Izolați clădirea sau încălziți mai mult casa:** 1. Limitele confortului termic sunt subiective, Când sunteți acasă, temperatura ideală este de 19-22 grade Celsius în living-room, incluzând bucătăria şi baie, iar în dormitor de 16-22 grade Celsius, 2. Când nu sunteți acasă, temperatura camerelor nu ar trebui să fie de mai puțin de

degrees Celsius to avoit condensation and increased humidity levels 3. Do not heat up cold bedrooms in the evening by opening the door to heated rooms. The warm air and humid air will condensate on the cold walls on the bedroom. 4. Good insulation on the building helps preventing mould growth due to higher temperature of the walls. Again: note that tight windows and buildings require more active ventilation!	aumento de los niveles de humedad. 3. No calentar las habitaciones frías en la noche con la apertura de la puerta a las habitaciones con calefacción. El aire cálido y la humedad del aire se condensan en las paredes frías de la habitación. 4. Un buen aislamiento en la construcción ayuda a prevenir la aparición de moho, debido a la mayor temperatura de las paredes. Una vez más: tenga en cuenta que las ventanas y edificios herméticos requieren una ventilación más activa.	15 grade Celsius pentru a evita condensul şi creşterea nivelului de umiditate. 3. Nu încălziți dormitoarele reci pe durata serii deschizând uşa spre camerele calde. Aerul cald şi cel umed vor condensa pe pereții reci ai dormitorului. 4. O bună izolare a clădirii vor ajuta, prevenind creşterea mucegaiului datorită creşterii temperaturii pereților. Din nou: geamurile mici şi clădirile închise necesită mai multă ventilare!
If the problem persist!!! Some households will find that despite taking steps to reduce the condensation, humidity remains a problem. It may then be worth considering: 1.covering cold surfaces, such as cold water pipes, with insulation 2. installing ventilation flaps or grills in windows 3. using electric fans and forces ventilation systems 4. contracting a professional building inspector for a thermal insulation assessment 5. insulating the loft or wall cavity, and draught-proofing windows and doors.	**Si el problema persiste**!!! Algunos hogares encuentran que, a pesar de tomar medidas para reducir la condensación, la humedad sigue siendo un problema. Entonces puede valer la pena considerar: 1. Recubrir las superficies frías, tales como tuberías de agua fría, con aislamiento. 2. Instalación de válvulas de ventilación o rejillas en las ventanas. 3. El uso de ventiladores eléctricos y un sistema de ventilación forzada. 4. La contratación de un inspector profesional de la construcción para una evaluación del aislamiento térmico. 5. Aislar el ático o las cavidades en muros, y sellar puertas y ventanas.	**Dacă problema persistă!!!** Unii deținători de casă, cred că în ciuda tuturor paşilor de prevenire a condensului, umezeala rămâne o problemă. Se propune să : 1. acoperiți suprafețele reci, cum ar fi conductele reci, cu izolație. 2. instalați fante sau zăbrele la geam. 3. folosiți ventilaroare electrice sau sisteme forțate de ventilare 4. contractați un serviciu profesional de inspectare a clădirii pentru izolarea termică 5. Izolați găurile pereților şi protejați împotriva curentului de aer geamurile şi uşile.

Appendix II

Excess cold and heat recommendations

2. Excess of cold and of heat		
English	**Spanish**	**Romanian**
In multi-occupied buildings provision for space heating may be centrally controlled. Such systems should be operated to ensure that occupants are not exposed to cold indoor temperatures and should be provided with controls to allow the occupants to regulate the temperature within their dwelling. There should be means for ensuring low level background ventilation without excessive heat loss or draughts. It should be controllable, properly installed and maintained, and appropriate to the particular part of the dwelling. There should be means for rapid ventilation at times of high moisture production in kitchens and bathrooms.	En edificios de viviendas plurifamiliares, el suministro de calefacción puede ser centralmente controlado. Estos sistemas deben funcionar de forma que asegure que los ocupantes no están expuestos a temperaturas interiores frías, y debe estar provista de un control que permita a los ocupantes regular la temperatura dentro de su vivienda. Debe haber medios para asegurar un bajo nivel de ventilación ambiental, sin pérdidas excesivas de calor o corrientes de aire. Debería ser controlable, correctamente instalados y mantenidos, y acorde con la parte de la vivienda que se trate. Deberá haber un medio de ventilación rápida para momentos de alta producción de humedad en cocinas y baños	În blocuri de locuințe se poate ca încălzirea termică să fie comună şi să fie controlată la nivel central. Astfel de sisteme trebuie să fie operate astfel încât locuitorii să nu fie expuşi la temperaturi reci interioare sau ar trebui prevăzute termostate care să permită locuitorilor controlarea temperaturii propriei locuințe. Ar trebui să existe mijloace pentru asigurarea unei minime ventilații a mediului, fără pierderi excesive de căldura sau curenți de aer. Ar trebui să fie controlabilă, cu instalare şi menținere adecvate, şi potrivită pentru părți specifice ale clădirii. Ar trebui să existe mijloace pentru ventilare rapidă atunci când nivelul de umiditate este ridicat în bucătărie sau în baie.
Heating should be controllable by the occupants, and safely and properly installed and maintained. It should be appropriate to the design, layout and construction, such that the whole of the dwelling can be adequately and efficiently heated	La calefacción deberá ser controlable por los ocupantes, y segura y adecuadamente instalada y mantenida. Deberá tener un apropiado diseño, disposición y construcción, tal que toda la vivienda esté adecuadamente y eficientemente calentada.	Încălzirea ar trebui controlată de către locuitori, instalată corect, în siguranță şi menținută. Ar trebui adecvată proiectării şi planului construcției , astfel încât întreaga clădire să fie încălzită corespunzător şi eficient.
Structural thermal insulation should be provided to minimise heat loss. The level	El aislamiento térmico estructural debe permitir minimizar la pérdida de calor.	Izolarea termică a structurii ar trebui prevăzută astfel încât să minimizeze

of insulation necessary is in part dependent on geographical location and exposure, position in relation to other dwellings and buildings, and orientation. South facing glazing can be used to increase solar heat gain and so save energy.	El nivel de aislamiento necesario depende, en parte, de la localización geográfica y la exposición, la posición en relación con otras viviendas y edificios, y la orientación. Un acristalamiento orientado hacia el sur, puede ser utilizado para aumentar la ganancia de calor solar y ahorrar así energía.	pierderea de căldură. Nivelul de izolare este dependent de zona geografică şi de expunere, de poziția clădirii în relație cu alte locuințe, clădiri şi de orientare. Geamurile orientate înspre sud pot fi folosite pentre a spori căldura solară şi pentru a salva energie.
The structure of the dwelling should provide or incorporate sufficient thermal insulation, having regard to its construction, its geographical location, its position in relation to other dwellings and buildings and its orientation.	La estructura de la vivienda debería estar prevista o incorporar suficiente aislamiento térmico, en consideración con su construcción, su situación geográfica, su posición en relación con otras viviendas y edificios y su orientación.	În structura unei clădiri ar trebui prevăzută sau incorporată suficientă izolație termică, având în vedere construcția ei, poziția geografică, poziționarea ei față de alte clădiri, locuințe şi orientarea ei.
Where there are large expanses of south facing glazing there should be appropriate shuttering or blinds to control solar heat gain in summer months.	Donde haya una gran extensión de acristalamiento orientado hacia el sur deberá haber adecuados shutters o ventanas para controlar el aumento de calor solar en los meses de verano.	Unde există o mare extindere a cristalului orientat înspre sud, ar trebui să existe obloane sau jaluzele adecvate pentru a controla căldura solară în lunile de vară.
There should be adequate controls to the heating system within the dwelling, particularly for district heating systems, enabling the occupier to control temperature.	Deberá haber un control adecuado del sistema de calefacción dentro de la vivienda, especialmente en los sistemas de calefacción por zonas, permitiendo al ocupante el control de la temperatura.	Ar trebui să existe un control adecvat al centralei termice înăuntrul locuinței, în particular al acelei comune, permițând locuitorului să controleze temperatura.
There should be means for cooling during hot summer weather, either by natural ventilation or by air conditioning. The means should be controllable, properly installed and maintained, and appropriate, having regard to the particular part of the dwelling. While openable windows can provide ventilation, occupiers may be reluctant to use them for security reasons, or	Deberá haber medios de refrigeración para el clima caliente del verano, ya sea mediante ventilación natural o mediante aire acondicionado. Estos medios deberán ser controlables, correctamente instalados y mantenidos, y adecuados respecto la zona específica de la vivienda de que se trate. Abrir las ventanas nos proporciona ventilación, pero los ocupantes pueden ser reacios a ello por razones de	Ar trebui să existe mijloace de răcire pentru clima caldă din timpul verii, fie prin ventilare naturală, fie prin aer condiționat. Aceste mijloace trebuie să fie controlabile, corect instalate, menținute şi adecvate zonelor specifice ale clădirii. Deschiderea ferestrelor poate produce ventilație, dar se poate ca locuitorii să fie indeciși cu privire la acest aspect din

because of external noise levels, especially at night.	seguridad, o debido a los niveles de ruido externos, especialmente durante la noche.	cauza motivelor de securitate sau din cauza zgomotului, în special în timpul nopții.
Others recommendations for EXCESS COLD		
Access appropriate energy advice about improving the energy effciency of your home and staying warm in winter	Obtenga asesoramiento sobre una adecuada entrada de energía, a fin de mejorar la eficiencia energética de su hogar y mantener el calor en invierno.	Accesați sfaturi adecvate despre energie, despre cum să îmbunătățim eficiența energetică a căminului nostru şi despre cum să rămână cald pe durata iernii.
Protect water pipes from freezing if possible	Proteja las tuberías de agua ante congelación si es posible.	Protejați conductele de apă împotriva înghețului pe cât posibil.
Have all gas, solid fuel and oil burning appliances (boilers, heaters, cookers etc.) services by an appropriately registered engineer to present breakdown	Tenga todos los aparatos de gas, combustible o petróleo (calderas, calentadores, cocinas, etc) apropiadamente registrados por un ingeniero para casos de averías.	Aveți toate aparatele de gaz, combustibil sau petrol (boilere, centrale termice, sobe etc.) revizate de către un inginer în cazul în care prezintă avarii.
If you plan to use fireplace or wood stove for emergency heating, have your chimney or flue inspected each year	Si va a usar chimenea o estufa de leña como calefacción de emergencia, éstas deben ser inspeccionadas cada año.	Dacă plănuiți să folosiți şemineul sau soba cu lemne pentru încălzire de urgență, acestea trebuie inspectate în fiecare an.
If you will be using a fireplace, wood stove or kerosene heater, install a smoke detector and a battery-operated carbon monoxide detector near the area to be heated. Test them monthly	Si va a usar chimenea, estufa de leña o calentador de queroseno, debe instalar detectores de humo y de monóxido de carbono cerca de las zonas a calentar. Deben hacerse revisiones mensuales de los mismos.	Dacă folosiți şemineu, soba cu lemne, încălzire cu kerosen, instalați un detector de fum şi un detector de monoxid decarbon cu baterie lângă zona ce va fi încălzită. Testați-le lunar.
Maintein regular contact with vulnerable people and neighbours you know to be at risk in cold weather	Mantenga un contacto regular con las personas vulnerables y vecinos que conozca que puedan estar en riesgo en tiempos fríos.	Mențineți contact în mod regulat cu persoane vulnerabile şi cu vecinii care ştiți că sunt predispuşi la frig în timpul iernii.
Stay turned into the weather forecast and ensure you are stocked with food and medications in advance	Esté informado del pronóstico del tiempo y asegúrese de tener previsión de alimentos y medicamentos por adelantado.	Informați-vă despre starea vremii şi asigurați-vă că aveți mâncare şi medicamente în avans.
If you are likely to be restricted to one room during the winter period or during a	Si durante el período de invierno o por una ola de frío, fuese restringido salir al	Dacă s-ar putea să fiți restricționat într-o singură cameră pe perioada iernii

cold spell, make sure that it can be kept at or above recommended temperatures	exterior, asegúrese de que se puede mantener en, o por encima, de las temperaturas recomendadas en su vivienda.	sau pe perioada vremii reci, asigurați-vă că această încăpere poate să fie menținută la, sau peste, temperaturile recomandate.
Check ambient room temperatures-especially those rooms where disabled or vulnerable people spend most of their time	Compruebe la temperatura ambiente en las habitaciones, especialmente en aquellas donde la gente vulnerable pasa la mayor parte de su tiempo.	Verificați temperatura mediului ambient a camerelor, în special în acelea unde persoanele vulnerabile, își petrec majoritatea timpului.
Keep active	Manténgase activo	Fiți activ.
Dress warmly, eat warm food, take warm drinks regulary	Vístase abrigado, coma comida caliente y tome bebidas calientes regularmente.	Îmbrăcați-vă bine, mâncați mâncare caldă şi beți lichide calde în mod regulat.
Others recommendations for EXCESS HEAT		
Reduce the humidity using air conditioning and dehumidiers, or reduce the sources of moisture	Reduzca la humedad usando aire acondicionado y deshumidificadores o reduciendo la fuente de humedad	Reduceți umiditatea utilizând aer condiționat şi dezumidificatoare, sau reduceți sursele de umiditate.
• Wear loosefitting, lightweight, light-colored clothing. Excess, dark or tight clothing holds in heat and doesn't let your body cool properly because it inhibits sweat evaporation.	Use ropa holgada, ligera y de colores claros. El exceso de ropa oscura o apretada mantiene el calor y no deja que su cuerpo se enfríe adecuadamente debido a que inhibe la evaporación del sudor.	Utilizați haine largi, lejere, deschise la culoare. Excesul de haine închise la culoare sau cele strâmte mențin căldura şi nu lasa corpul să se răcească corect, deoarece inhiba evaporarea sudorii.
• Avoid sunburn. If you're going to be outdoors, wear a lightweight, wide-brimmed hat or use an umbrella to protect yourself from the sun, and apply sunscreen to any exposed skin. Having a sunburn reduces your body's ability to rid itself of heat.	Evite las quemaduras solares. Si va a estar al aire libre, use sombreros de ala ancha o paraguas para protegerse del sol, aplíquese protector solar en las partes del cuerpo que vayan a quedar expuestas al sol. Tener quemaduras solares reduce la capacidad del cuerpo para deshacerse del calor.	Evitați arsurile solare. Dacă se va sta la aer liber, utilizați pălării uşoare cu margini late, sau folosiți umbrela pentru a vă proteja împotriva soarelui şi aplicați protecție solare părților corpului ce se vor expune la soare. Arsurile reduc capacitatea corpului de a se elibera de căldură.
• Seek a cooler place. Being in an air-conditioned building, even for just a few hours, is one of the best ways to	Busque lugares frescos. Estar en edificios con aire acondicionado, aunque sea solo por unas horas, es una de las mejores maneras de	Căutați locuri răcoroase. Fiind în clădiri cu aer-conditionat, chiar dacă este doar pentru câteva ore, este una dintre cele mai bune

prevent heat exhaustion. If your home doesn't have an air conditioner, consider spending time at a library or shopping mall. At the least, find a well-shaded spot. Fans alone aren't adequate to counter high heat and humidity.	prevenir un golpe de calor. Si su casa no tiene aire acondicionado, considere la posibilidad de pasar tiempo en una biblioteca o en un centro comercial. O por lo menos, encontrar lugares donde haya sombra. El uso solo de ventiladores no es suficiente para contrarrestar el calor y la humedad.	metode de a preveni epuizarea datorată expunerii la soare. Dacă în casa ta nu există aer condiționat, puteți petrece timp la bibliotecă sau într-un centru comercial. Sau cel puțin, căutați locuri cu umbra. Doar utilizarea ventilatoarelor nu este suficientă pentru a lupta împotriva căldurii excesive şi a umidității.
• Drink plenty of fluids. Staying hydrated will help your body sweat and maintain a normal body temperature. If your doctor has told you to limit fluids because of a health condition, be sure to check with him or her about how much extra you need to drink when the temperature rises. Avoid alcoholic beverages.	Tome líquidos en abundancia. Mantenerse hidratado ayudará a su transpiración corporal y a mantener una temperatura corporal normal. Si su médico le ha limitado la ingesta de líquidos a causa de alguna condición de salud, asegúrese de consultar con él sobre la cantidad extra que tendrá que beber cuando se produzca un aumento de temperatura. Evite las bebidas alcohólicas.	Beți în abundenta lichide, Menținerea hidratată a corpului va ajuta la transpirația corporală şi la menținerea temperaturii normale a corpului, Dacă medicul v-a limitat volumul de lichide din cauza condiției sănătății, consultați-l atunci când temperatura aerului creşte. Evitați excesele de alcool.
• Take extra precautions with certain medications. Ask your doctor or pharmacist whether the medications you take make you more susceptible to heat exhaustion and, if so, what you can do to keep your body from overheating	Tome precauciones adicionales con ciertos medicamentos. Pregúntele a su médico o farmacéutico si los medicamentos que toma lo vuelve más susceptible a un golpe de calor y, si es así, qué se puede hacer para evitar que su cuerpo se sobrecaliente.	Luați-vă precauțiuni adiționale cu anumite medicamente. Întrebați medicul sau farmacistul dacă medicamentele pe care le luați fă fac să fiți mai predispuşi la exteniuare datorită căldurii şi dacă este aşa, ce se poate face pentru a evita creşterea temperaturii corpului.
• Avoid hot spots. On a hot day, the temperature in your parked car can rise 20 F (about 6.7 C) in just 10 minutes. Let your car cool off before you drive it. Never leave children or anyone else in a parked car in hot weather for any period of time.	Evite los lugares calurosos. En un día caluroso, la temperatura de su coche aparcado puede elevarse 20ºF (alrededor de 6,7ºC) en tan solo 10 minutos. Deje que su coche se enfríe antes de conducirlo. No deje nunca niños o cualquier otra persona en el coche aparcado en épocas de altas temperaturas por ningún	Evitați locurile călduroase. Într-o zi călduroasă, temperatura maşinii parcate se poate ridica la 20 F (circa 6,7 grade Celsius) doar în 10 min. Lasă maşina să se răcească înainte de a te urca în ea. Nu lăsa niciodată copiii sau orice altă persoană în

	período de tiempo.	maşină parcată atunci când temperaturile sunt ridicate pentru nici cea mai mică perioadă de timp.
• Let your body acclimate to the heat. If you travel to somewhere hot, or the temperatures suddenly jump in your area, it can take several weeks for your body to get used to the heat. You'll still need to take precautions, but working or exercising in heat should become more tolerable. If you're on vacation, you probably don't have several weeks to wait, but it's a good idea to wait at least a few days before attempting vigorous activity in the heat.	Deje que su cuerpo se aclimate al calor. Si viajas a algún lugar donde la temperatura sea alta, o la temperatura en su zona aumenta de repente, podría tomar varias semanas que su cuerpo se acostumbrara al calor. No obstante, deberá tomar precauciones, pero trabajar o hacer ejercicio en un clima caluroso deberá ser más tolerable. Si estás de vacaciones, probablemente no tengas que esperar semanas, pero sería una buena idea esperar al menos unos días para realizar actividades fuertes ante el calor.	Lasă-ți corpul să se obişnuiască cu căldură. Dacă o să călătoriți într-un loc unde temperatura este înalta, sau unde temperatura creşte dintr-o dată, s-ar putea să dureze mai multe săptămâni până ce corpul se va obişnui. Trebuie să fiți în continuare precaut, dar lucrând sau făcând exerciții în căldura va deveni mai tolerabil. Dacă sunteți în vacanță, probabil nu aveți mai mult timp pentru a aştepta, dar este o idee bună să aşteptați câteva zile înainte de a avea activități în soare.

Appendix III

Radon recommendations

4. Radon		
English	**Spanish**	**Romanian**
For existing dwellings one remedial technique is to provide a radon sump, a hollow under the floor with a low power fan to disperse the gas into the open air. Other, but less effective options include increased air flow under a timber floor, and installing a whole house positive pressurisation system.	Para las viviendas existentes una técnica de corrección es proporcionar una absorción de radón, un hueco bajo el suelo con un ventilador de baja potencia para dispersar el gas hacia el aire libre. Otras opciones, aunque menos eficaces, son un mayor flujo de aire bajo un suelo de madera, y la instalación de un sistema control de presión positiva.	Pentru clădirile existente o tehnică pentru remedierea problemei radonului este de a prevedea un colector de radon, o gaură sub podea cu ventilator de slabă putere ce va dispera gazul în aer liber. Alte opțiuni, dar mai puțin eficiente ,includ creșterea fluxului de aer sub podeaua de lemn, precum și instalarea unui sistem de presurizare în toată casa.
All new dwellings should be constructed to achieve radon gas levels as low as is practicable. For existing dwellings in Affected Areas (ie, identified areas where radon emissions are likely to be above the Action Level) remedial measures should be adopted.	Todas las viviendas de nueva construcción deberán estar construidas para lograr unos niveles de gas radón tan bajos como sea posible. Para las viviendas existentes en áreas afectadas (por ejemplo, áreas identificadas donde es probable que las emisiones de radón estén por encima del nivel de acción) deberán tomarse medidas correctivas.	Toate casele nou-construite ar trebui executate astfel încât să aibă un nivel de radon cât mai mic posibil. Pentru clădirile existente în zone afectate (de exemplu, zonele identificate a avea un nivel mai ridicat de emisii de radon), ar trebui adoptate măsuri de remedier
It is easier and much less expensive to design and construct a new building with radon-resistant and/or easy to mitigate features than to add these features after the building is completed and occupied.	Es más fácil y mucho menos costoso diseñar y construir un nuevo edificio resistente al radón y/o suavizar características, más que añadir nuevas características cuando el edificio esté terminado y ocupado.	Este mai ușor și mai puțin costisitor să se proiecteze și să se construiască o nouă clădire rezistenta la acțiunea radonului, și/sau să se diminueze caracteristici, decât să se adauge noi caracteristici după ce clădirea a fost completată și locuită.
There are three techniques that help us to prevent radon: 1. Install and active soil depressurization (ASD) system 2. Pressurize the building using the heating, ventilating and air conditioning (HVAC) system	Hay tres técnicas que nos ayudan a prevenir el radón: 1. Instalar y activar un sistema de despresurización del suelo (ASD) 2. Presurizar el edificio instalando calefacción, ventilación y sistemas de aire acondicionado (HVAC)	Există trei tehnici ce ne ajută la prevenirea radonului: 1. Instalarea și activarea unui sistem de egalizare a presiunii solului (ASD). 2. Presurizarea clădirii utilizând încălzire, ventilație și sisteme de aer-conditionat (HVAC).

3. Seal major radon entry routes	3. Sellar las principales vías de entrada de radón.	3. Astuparea principalelor intrări ale radonului.
Radon can enter in a building in different ways: from the soil gas through pressure driven transport, through difussion, well water and construction materials	El radón puede entrar en un edificio de diferentes maneras: desde el gas de la tierra impulsado por presión, como por difusión, así como por el agua y materiales de construcción.	Radonul poate intra într-o clădire prin diferite căi: de la gazele de sol prin intermediul transportului condus prin presiune, prin difuzie, prin apă sau prin materiale de construcție.
Pressure driven transport: A suction fan is used to produce a low-pressure field under the slab.This low-pressure field prevents radon entry by causing air to flow from the building into the soil.	**Despresurización del suelo**: para producir un campo de baja presión bajo el suelo se utiliza un ventilador de succión. Este campo de baja presión evita la entrada de radón haciendo que el aire fluya desde el edificio hacia el suelo.	**Transportul prin presiuni**: un ventilator de aspirație este folosit pentru a produce un câmp de presiune scăzută sub dala. Acest câmp de presiune scăzută previne intrarea radonului, trimițând aerul din clădire în sol.
Difussion is the same mechanism that causes a drop of food coloring placed in a glass of water to sperad through the entire glass; is rarely met. Well water that is supplied directly to a building and that is in contact with radium-bearing formations can be a source of radon in a building. Radon can also emanate from building materials but is very rarely.	**Difusión**: es el mismo mecanismo que hace que una gota de colorante vertida en un vaso de agua se extienda por todo el vaso; rara vez ocurre. El agua de pozo que es suministrada directamente a un edificio y que está en contacto con formaciones de radio puede ser una fuente de radón en un edificio. El radón también puede emanar de los materiales de construcción, pero es muy raro.	**Difuzia** este mecanismul care determină ca un colorant alimentar introdus în apă să se răspândească în întreaga sticlă. Este destul de rar întâlnit. Apa din pământ care este furnizată direct clădirii şi care este în contact cu formațiuni purtătoare de radium poate fi o sursă de radon într-o clădire. Radonul, poate fi de asemenea emanat de către materialele de construcție dar se întâmplă foarte rar.
Soil Depressurization. A suction fan is used to producea low-pressure field under the slab.This low-pressure field prevents radon entry by causing air to flow from the building into the soil.	**Despresurización del suelo**: para producir un campo de baja presión bajo el suelo se utiliza un ventilador de succión. Este campo de baja presión evita la entrada de radón haciendo que el aire fluya desde el edificio hacia el suelo.	**Depresurizarea solului**. Un ventilator de aspirație este folosit pentru a produce un câmp de presiune scăzută. Acest câmp va preveni intrarea radonului prin împingerea aerului din interiorul clădirii în sol.
Steps	**Pasos**	**Paşi**
1. Place a clean layer of coarse aggregate of narrow particle size distribution	1. Coloque una estrecha capa limpia de agregado grueso (grava de origen natural o de	1. Sub placa se va plasa un strat îngust de agregat de dimensiuni mari (pietriş sau

(naturally occurring gravel or crushed bedrock) beneath the slab. 2. Eliminate all major barriers to extension of the subslab low pressure zone, such as interior subslab walls. 3. Install radon suction pit(s) beneath the slab in the aggregate (one radon suction pit for each area separated by subslab walls) 4.Install a vent stack from the radon suction pit(s) under the slab to the roof. 5. Install a suction fan on the vent stack. (The fan should be operated continuously, and the system should be equipped with a warning device to indicate loss of negative pressure through fan failure or other causes.) 6. Seal all major slab and foundation penetrations.	lecho de roca triturada) debajo de la solería. 2. Elimine las principales barreras de extensión de las zonas de baja presión del subsuelo, como las paredes interiores del subsuelo. 3. Instale fosas de succión de radón bajo el suelo en los agregados (una fosa de succión de radón por cada zona separada). 4. Instale un conducto de ventilación desde la fosa de succión de radón bajo el techo. 5. Instale un ventilador de succión en el tubo de ventilación (el ventilador debe funcionar de forma continua, y el sistema debe estar equipado con un sistema de advertencia para indicar la pérdida de presión negativa por un fallo en el ventilador u otras causas) 6. Selle las principales penetraciones del suelo y cimientos.	rocă spartă). 2. Se elimină toate barierele pentru a extinde zona de presiune scăzută de sub placă, cum ar fi pereții interiori de sub placă. 3. Se face o gură de aspirație a radonului sub placă în agregat (o gaură pentru fiecare suprafață separată de pereții de sub placă) 4.Se instalează o conductă de aerisire de la gaura de aspirație de sub placă până la acoperiş. 5. Se instalează un ventilator de aspirație pe conducta de aerisire (ventilatorul ar trebui să funcționeze continuu şi sistemul ar trebui echipat cu un sistem de avertizare pentru a indica pierderea de presiune negativă din cauza deficientei ventilatorului sau alte cauze). 6. Astupați toate penetrațiile plăcii şi ale fundației.
Building Pressurization. Indoor/subslab pressure relationships are controlled to prevent radon entry. More outdoor air is supplied than exhausted so that the building is slightly pressurized compared to both the exterior of the building and the subslab area.	**Presurización del edificio**. La relación entre la presión en el subsuelo y el interior deben estar controlados para evitar la entrada de radón. La entrada de aire del exterior es mayor que la que se expulsa, por lo que el edificio se presuriza ligeramente en comparación, tanto con el exterior del edificio como con la zona del subsuelo.	**Presurizarea clădirii**. Relațiile presiunilor din subplaca şi interiorul clădirii sunt controlate pentru a prevedea pătrunderea radonului. Este adus mai mult aer din exterior decât eliminat, de aceea clădirea este uşor sub presiune în comparație cu exteriorul ei şi cu suprafața de sub placă.
Steps	**Pasos**	**Paşi:**
1. In radon-prone areas, eliminate air supply and return ductwork located beneath a slab, in a basemen or in a crawl space 2. Supply outdoor air	1. En las zonas propensas a radón, eliminar el suministro de aire a través de conductos localizados bajo el subsuelo, en sótanos o en un espacio reducido.	1.În zonele predispuse la radon, eliminați suplimentul de aer şi reîntoarceți conductele de sub placă, într-un beci. 2. Alimentarea cu aer din

3. Construct a “tight” building shell to facilitate achieving a slightly positive pressure in the building. 4. Seal slab, wall, and foundation entry points , especially in areas of the building planned to be under negative pressure by design (such as rest rooms, janitor’s closets, laboratoriess, torage closets, gymnasiums, shops, kitchen areas). 5. Ensure proper training and retraining of the HVAC system operators, together with an adequate budget, so that the system is properly operated and maintained. (This appears to be a major area of neglect in existing school buildings.) 6. In areas with large exhaust fans, supply more outdoor air than air exhaustedif possible.	2. Suministrar aire exterior. 3. Construir un edificio con una envolvente “hermética” que facilite el logro de una presión ligeramente positiva en el edificio. 4. Sellar suelos, muros y puntos de entrada de cimientos, especialmente en zonas del edificio que están bajo presión negativa por diseño (como baños, porterías, laboratorios, armarios de almacenaje, gimnasios, tiendas, cocinas) 5. Garantizar la formación adecuada y continua de los profesionales de los sistemas HVAC, con un presupuesto adecuado, así el sistema estará adecuadamente instalado y mantenido. (Esto es de gran importancia en edificios escolares) 6. En las zonas con grandes ventiladores de extracción, suministrar mayor capacidad de aire del exterior que la expulsada.	exterior 3. Etanşeizați casa pentru a facilita obținerea unei uşoare presiuni în clădire. 4. Placa se etanşare, peretele şi punctele de intrare din fundație, în special în zonele clădirii planificate a fi sub presiune negativă prin proiectare (cum ar fi camerele de odihnă, debara portar, laboratoare, debara de depozitare ,săli de sport, magazine, bucătarii). 5. Asigurarea de un pregătire şi o repregatire profesională a operatorilor de sisteme HVAC, împreună cu un buget adecvat, astfel încât sistemul să fie operat corect şi menținut (Acest lucru pară a fi neglijat în interioul şcolilor). 6. În zonele cu largi ventilatoare de evacuare, alimentați cu mai mult aer din exterior decât cu aer evacuat dacă este posibil.
Sealing Radon Entry Routes Because the greatest source of indoor radon is almost always radon-containing soil gas that enters the building through cracks and openings in the slab and substructures, a good place to begin when building a radon-resistant building is to make the slab and substructure as radon-resistant as economically feasible.	**Sellado de las vías de entrada de radón.** Debido a que la mayor fuente interna de radón es casi siempre el radón que contiene el gas de la tierra, que entra en el edificio a través de grietas y aberturas en suelos y subestructuras, una buena forma de construir un edificio resistente a radón es haciendo el suelo y subestructura resistentes al radón, siendo así más factible económicamente.	**Astuparea intrărilor de radon** Deoarece cea mai mare sursa de radon în interiorul clădirii este conținutul gazos din sol ce intră în clădire prin crăpături, deschideri în placă, infrastructura, un loc lucru pentru începerea construirii unei clădiri rezistente împotriva radonului este construirea plăcii şi a infrastructurii rezistente la pătrunderea radonului, ceea ce rezultă şi cel mai economic posibil.
Steps	**Pasos:**	**Paşi:**
Radon entry routes that should be sealed are:	Las vías de entrada de radón que deben ser selladas son:	Căile de intrare ale radonului ce ar trebui să fie sigilate

Floor/wall crack and other expansion joints. Where code permits, replace expansion joints with pour joints and/or control saw joints because they are more easily and effectively sealed. Areas around all piping systems that penetrate the slab or oundation walls below grade (utility trench, electrical conduits, plumbing penetrations, etc.). Masonry basement walls.	Grietas en suelos y paredes y juntas de dilatación. Cuando la normativa lo permita, reemplace las juntas de dilatación por juntas de servicio y/o juntas de control, porque son más fáciles y efectivamente selladas. Las áreas alrededor de los sistemas de tuberías que penetran en el suelo o paredes de los cimientos (zanjas, conductos eléctricos, tuberías, etc.) Las mampostería de las paredes del sótano	sunt: Fisurile din podea/perete şi alte rosturi de dilatare. în cazul în care normativele permit, înlocuiți rosturile de dilatare cu rosturi de turnare şi/său control pentru că sunt mai uşor şi mai eficient de sigilat. Zonele din jurul sistemului de conducte care penetrează placa sau pereții fundației sub nivelul solului (şanțuri de utilitate, conducte electrice, penetrări sanitare, etc.) Pereți de zidărie subsol.