CHECKLIST HEALTHY HOUSING FOR TENANTS AND HOME OWNERS

Author: Evert Hasselaar

1OTB Research Institute for Housing, Urban and Mobility Studies, Delft University of Technology, The Netherlands

Corresponding author: Evert Hasselaar (e.hasselaar@otb.tudelft.nl)

Abstract

Problem Statement
Housing and health are interconnected. By measuring the health performance of housing, risks can be identified and measures to improve the health potential can be taken. A Checklist Ventilation Quality, published by the National Tenant Organization, has been a successful “action” promoting tool in The Netherlands. The tool gives insight in the technical quality of ventilation services and also in the quality of use. The tool improves the communication about ventilation, in relation to moisture, smell and mould problems. A spin-off is the development of the Checklist Healthy Housing, with a much broader focus than ventilation. What are the requirements of a tool that can be used both by tenants and home owners or housing institutions? How can this tool support better communication about health risks of housing and how can it promote remediation?

Objective
The objective of the study is to determine in what situations and how a Checklist Healthy Housing can identify health risks and promote better communication about health related technical features and occupant behavior.

Method
Performance evaluation requires the selection of a limited set of simple and robust performance indicators. These indicators must support both tenants and landlords to come up with the same results. To study health performance indicators, field data were collected in 325 dwellings. The indicators are selected by developing and validating models on high concentration and high exposure to house dust mite, mould, noise, nuisance and drinking water contamination.

Results
The Checklist Healthy Housing has been developed, ready for use in pilots. The checklist includes a protocol to inspect the house and the user patterns of the occupants on the basis of a set of indicators. The inspection does not require expert testing or measurements. The two important moments to use the tool is when people move out and into a different house or when complaining about maintenance and indoor environment.

Conclusion
The study of the relation between occupancy patterns, building features and health risk in dwellings resulted in a set of robust indicators that support a relatively simple diagnosis of health risk in housing. Because both occupant behavior and technical aspects are included, the tool has a potential to improve the communication between tenants and landlords about healthy housing.
Introduction
This paper describes the development of an instrument to evaluate the health performance of houses and of occupancy.

The healthy house is a dwelling, which is free from building-related risk of illness and discomfort, while supporting well-being: enjoyment of comfort and safety, free choice of life styles in a social supportive environment. The dwelling and the occupants interact. The quality of the healthy house must be measured by the health condition and perception of the occupant. For that reason the research focuses on the house including occupancy. Housing and health are interconnected. By measuring the health performance of housing, risks can be identified and measures to improve the health potential can be taken. Health performance evaluation is defined as the inspection, quality evaluation and communication about housing and health.

An expert panel of WHO (WHO, 2000) quoted Ranson, saying: “Housing and health is not, and never will be, an exact science”. The relationship between indoor environment and health is complex, and the knowledge thereof is incomplete. Most environmental health problems can also have other causes, such as hereditary predisposition, life-style, social situation, eating habits, smoking or factors related to (mis)use of the building. Some causal relationships between the building environment and ill-health are, however, well-proven, some are connected with reasonable evidence and some are expected to have health effects. The WHO panel divided the various influences on health into three groups, to which one more (nr 4) group is added, to show a specific field of interest:

Influences concerned with:
1.  the structure of the buildings, e.g. sanitary and cooking facilities, radon, asbestos;
2.  the internal environment, e.g. damp, humidity, temperature, air quality, pests;
3.  the lifestyle of the inhabitants, e.g. tobacco smoke (ETS), noise, overcrowding;
4.  the relation between the design and use of building services, e.g. user friendliness of controls, understanding the effect of exhaust set-points and the use of inlet openings.

Context of the Checklist Healthy Housing
Many indoor environmental problems originate from building and maintenance defects. Yet the occupant is blamed for bad smell, moisture problems like mold or condensation and poor comfort due to cold draughts in the winter. The occupant should heat and ventilate better: “look at your neighbors: the house is the same but they have no problems”. Many health risks in housing are not resolved because of a grey area between the responsibility of the home owner and the occupant. No clear distinction is made between individual problems and structural collective problems. A housing institution tends to focus on individual problems, because it is easy and cheap to satisfy the individual tenant with visits and some (trial) improvement. Only a very dedicated tenant will organize other tenants with similar problems. Many complaints stop after some kind of remediation, whether it works or not: the inconvenience is being accepted. This is why 15% of the Dutch houses have a mechanical ventilation system that is not used, because it does not work and makes too much noise. While 35% of newly built houses is equipped with a balanced flow ventilation system that hardly anyone uses the way it is intended, nothing “collective” has happened so far in the last years, since this problem was recognized. When we find tenant groups, who organized themselves in a committee and were successful in claiming attention and remedial measures, it has taken these groups up to five years to receive recognition for the validity of the complaints and that collective measures instead of individual measures must follow. An example of a process that took 12,5 years altogether can be found in Amsterdam (Hasselaar, 2003).

The design of the Checklist Healthy Housing originated from social action, from promoting the interests of tenant groups. It is very useful to know what arguments are used both by tenants and housing institutions when they discuss complaints. The Dutch Tenant Organization (Woonbond) discovered that ventilation and moisture problems are among the top 10 complaints by tenants. Several brochures and leaflets were distributed to inform the tenants about the relationship between moisture problems, the building features and occupancy. A new product, that helped tenants to check the ventilation quality on the basis of a simple inspection, became successful. It was a tool for do-it-yourself assessment of the ventilation quality. The Checklist Ventilation made a simple distinction between good and bad, while the quality evaluation was
based on visible features that everyone can understand. A questionnaire (n=850) among the first users showed that tenants were more critical of the quality of the ventilation services after using the checklist. They were more motivated to take action, both to contact the home owner and ask for maintenance or improvements, and also to use the ventilation services better. This result indicated that doing-it-yourself supports better insight in quality and promotes action and change of behavior. Some professionals criticized the “brutality” of the simplified quality judgments, but more and more housing institutions started promoting the tool, followed by the adaptation of the Checklist by the Association of individual home-owners (VEH) and the Dutch Asthma Foundation (Astmafonds).

This Checklist Ventilation provided the blueprint for the Checklist Healthy Housing. The quality requirements for the Checklist Healthy Housing that were copied from the Checklist Ventilation are:

- easy to understand and user-friendly for tenants and individual home-owners;
- an evaluation protocol that does not require instruments or sophisticated knowledge;
- related to maintenance policies by housing institutions and home owners;
- promotion of action, both improvement of the house and change of user behavior;
- supporting communication between occupants and professionals, by making it easy for tenants to choose remediation measures and easy for professionals to comment on user behavior, both based on the same tool;
- no black box but supporting better understanding of opportunities for improvement.

In the development process of the Checklist Healthy Housing the following extra quality requirements were added:

- supporting a good match between the needs of a household and their (new) house;
- separate evaluation of the empty house and occupancy.

For the problem of “matching” a simple label of the performance quality was chosen.

The development process resulted in a Checklist with 78 questions about the house, 50 questions about occupancy and some 35 general questions about the building. Quite a long list, but shorter would make the questions more abstract or the results more shallow.

Position of health performance evaluation in housing policy

In Europe several instruments are available to assess the health conditions of houses. England developed the Housing health and safety rating system (HHSRS). France follows the HHSRS. In The Netherlands some tools have been available for more than 10 years, but the impact was low as indoor environment was a minor issue until 2002. In 2002 the Parliament in The Netherlands accepted the action plan for health and buildings. The action plan resulted in projects on large and small scales:

1. national survey of 1200 houses, with monitoring, detailed inspection and comparison to official standards, to be used for policy making on national level;
2. design of an assessment protocol that results in a health status report made up by professionals, results to be used for policy making by housing institutions on the level of local markets;
3. design of a simplified tool to assess the quality of the dwelling and to select measures to improve the health performance, results to be used for maintenance and renovation purposes on the level of blocks;
4. design of a simplified tool to evaluate exposure risks for occupants, results to be used for communication about complaints and for individual improvements on the scale of the individual house.

These tools differ in cost and complexity of the assessment protocol. From 1 - 4 the cost of obtaining results per house range from € 1500, € 800, € 300 and € 150 per inspection respectively. The Checklist Healthy Housing can be grouped under 4), implicating that the cost target is € 150 for an individual house. As the evaluation of 5 houses is sufficient for one block, the tool can be used for level 3 as well and the cost per average house will then range from € 4 - € 7.50, with zero cost if the Checklist is used by tenants.
Research questions
A tool to assess healthy housing that includes occupancy refers by definition to existing houses. A tool that can be used by professionals and occupants as well must focus on robust and simple indicators that can be assessed without the use of sophisticated instruments and knowledge. The challenge is to develop this simple tool without loss of detail and depth. The strategy for simplification is to select a small set of indicators that mark the relation between housing and exposure to health risk. The distinctive qualities of the Checklist Healthy House are: focus on exposure risk, on communication, on individual dwellings and on the occupied situation. To achieve these qualities the following questions have to be answered:

- what major sources of agents, hazards and nuisance cause housing related health risks;
- what are robust indicators of health risks for each room of the house;
- how to explain quality requirements to non-professionals;
- what inspection protocol will provide essential information;
- how to analyse and evaluate the quality of the house and of occupancy and behaviour;
- how to report the results and facilitate communication and improvements?

Methods
- The development of the Checklist is based on:
  - an inventory of sources of agents, hazards and nuisance with health related risks
  - a selection of indicators of health risks in different rooms of the house
  - the definition of quality requirements
  - the design of a protocol for inspection and interview
  - the design of an evaluation procedure of the quality
  - the selection of methods to report results of the evaluation procedure.

The evaluation of health performance is structured according to these steps:

- source + emission + transport = concentration
- concentration and exposure + special needs = exposure risk
- remediation and adaptation by those responsible results in healthier housing.

![Figure 1: the relation of source and concentration, in which transport is ventilation and cleaning](image1)

![Figure 2. the role of indicators](image2)
Figure 2. shows the role of indicators in defining the health effects and in choosing corrective actions. Figure 3 shows for indoor air quality the steps that lead to the risk evaluation and the selection of remediation measures. Figure 3 is the main model for the development of the Checklist Healthy Housing.

<table>
<thead>
<tr>
<th>IAQ</th>
<th>sources of agents</th>
<th>transport/removal</th>
<th>concentration</th>
<th>exposure</th>
<th>risk evaluation</th>
<th>remediation</th>
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<tbody>
<tr>
<td></td>
<td>environment</td>
<td>building</td>
<td>users</td>
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**Figure 3. Strategy: from concentration to evaluation and remediation measures**

Field work since 1995 resulted in a collection of empirical data on the performance of housing and of user patterns in 500 houses all over The Netherlands. Some 333 houses are documented in a dataset. An interview- and inspection protocol developed over the period 1995-2004. Indicators were selected on the basis of correlations between variables in the dataset, using SPSS. Indicators that could not be analysed via the dataset (private injuries and ergonomic quality) were derived from literature.

**Results**

The sources of agents, hazards and nuisance include: outdoor and indoor air pollutants of chemical and biological origin including bad smell, noise, radon and radiation, pollution of drinking water, extreme temperatures (too cold, overheating), poor daylight and artificial lighting levels, lack of privacy and security, lack of support when in need of help and hazards, risk of personal injury.

The indicators of exposure risks for each room of the house can be found in the evaluation pages both for the houses and the occupancy (see figure 5 and 6). The information to evaluate these indicators can be collected through an inspection tour of the house and by an interview. Quite a large number of 163 questions have to be answered. Answering will be made easy by using a pocket computer that automatically jumps to the right questions and allows easy reporting.

The quality evaluation is made accessible to non-professionals by testing if the house meets the needs associated with five different qualities. The inspector compares the house with the ideal performance for these five qualities:

1. allergen free, to protect against airway irritation by biological allergens;
2. airy and emission free, to protect against chemical irritants and radiation;
3. quiet, to protect against noise;
4. ergonomic, to “able” a house for the disabled, for persons with impaired mobility and also to protect against personal injuries;
5. socially secure, safe from intrusion of privacy and promoting social support.

The healthy house is a theoretical optimum for these five qualities: free from allergens and hazardous emissions, well designed for optimal functionality and safety, user friendly in case of disability and sickness, protected against noise and trespassing and providing good privacy and comfort and providing opportunities inside and outside to socialise. A household chooses a house that performs well on the specific qualities that support their needs, while other qualities may not be so critical for the needs. A household with an asthmatic child will match with a house that scores good on allergen free, airy and emission free. A very old person still living independently will need a socially secure quality. Each question of the Checklist presents detailed examples of which quality is suitable, non-suitable or when the example has an almost certain health effect. Both the quality of the house and the occupancy load and user patterns are compared with the ideal conditions. The optimal conditions for these five qualities are explained in the next section (in short). Figure 5 gives an example of some questions. The qualities relate both to the houses as a built structure and to the occupancy, but these qualities are evaluated separately.
Allergy free quality

- Allergies of biological origin are caused by proteins from the excreta of pets (cats, birds etc), insects, house dust mite and cockroaches and particles from mould and pollen.
- The allergy free qualities can be seen as indicators. The qualities are:
  - Low occupancy load: number of occupants/number of rooms is smaller than 1
  - The house is free from nesting birds (like pigeons) and plagues of pests
  - Outdoor space (private and public) allows physical exercise and socialising
  - The house has a separated and ventilated kitchen-annex or storage room for storage and “smelly” cooking and cleaning jobs
  - The occupied spaces are isolated from the crawlspace, collective shafts and sewers
  - There is no heater, stove, a fire place that can emit exhaust gases in indoor air
  - The house is completely free of mould, also from hidden mould in cavities
  - Cold floors have a smooth surface layer that can be cleaned easily
  - The ventilation system allows for three well controlled functions: basic air exchange for fresh air after a period not spent at home, permanent ventilation while at home and airing during cooking, bathing and other extreme conditions. Each room can be aired, disregarding the type of ventilation system.
  - The capacity of the ventilation is well controlled and maintained, interval < 5 years
  - The use of the permanent ventilation services (at norm capacities) is not limited by noise levels from outside or from fans and dampers
  - Hot surfaces can be cleaned well and settled dust cannot burn and produce aerosols
  - All surface layers in the bathroom can be dry-stripped or cleaned from mould.
  - The allergy free qualities of occupancy
  - The house is smoke free, without air fresheners, perfumed candles and wood burning stove, fire place or heater without flue gas exhaust
  - No pets with hairs and feathers allowed, no excreta of other pets in the house
  - Laundry drying outside or with direct outside exhaust of air, never inside the house
  - Permanent ventilation is used at norm capacity, with airing during peaks
  - Flooring is hard, with washable carpets only, interior decoration is dust free
  - The airway sensitive person sleeps in a well ventilated and large bedroom, sunlit side
  - Mould is removed and surfaces cleaned when mould is visible
  - Bed and soft furnishings are aired regularly, mattresses are younger than 5 years.

Airy and free of chemical emissions

Irritating substances, e.g. tobacco smoke, vehicle exhaust fumes, fumes from glues, emission from building products, perfumes etc. can cause problems for everyone, including persons that are allergic to chemical substances. For that reason, the emission free quality differs from the allergen free quality. As it is often not possible to clear the house of all emission sources, the best way to reduce exposure is to ventilate very well.
Qualities of the empty dwelling are:

- The house is not located in large urbanised areas or large cities
- Location is not next to roads with heavy traffic
- It is possible to sit outside in the sun and with enough privacy and free of noise
- A user friendly annex space is for polluting activities: frying and for laundry drying
- There is no water heater, stove, furnace or room heater without exhaust of flue gas
- Construction materials and surface layers do not emit smelly or toxic gases
- No smell or dust emits from chinks and seams connected to cavities in construction
- Water conduits are not made of lead
- Dust particles cannot get burned on hot surfaces (except hot cooking plates)
- The rooms have large inlet openings, to be used permanently, also when not at home
- The rooms have a door or large window that can be used for airing and cooling
- Mechanical ventilation is well maintained by cleaning fans and dampers and by adjusting the capacity
- Hot water from a tank that is used for shower and bath is heated completely every week up to 60 °C
- The airy and emission free qualities of occupancy are:
  - No smoking inside and no use of air fresheners, incense and perfumed candles
  - Laundry drying outside or in a machine with exhaust to outside
  - Permanent use of the inlet and exhaust of ventilation air, airing during peaks
  - Interior decoration with low-emissive products, other emission sources removed
  - Baking, grilling in kitchen annex or outside
  - All surfaces easy to clean and actually kept clean
  - Do-it-yourself construction and decoration jobs not with someone at home, or with pregnant woman or young child: the house is then open to air for some weeks.

Ergonomical

Many people suffer from impaired mobility. The risk that falling results in extreme health effects increases as people get older. The ergonomic quality facilitates the house for disabled persons: the house “ables” the disabled.

Ergonomic qualities of the empty house are:

- It is easy to get from the sidewalk or parking to the main entrance with a wheelchair
- The vehicle for persons with reduced mobility can be parked near the main entrance
- Steps or a ramp and other obstacles to get indoors have a supporting bar
- Staircases indoors are not steep or with open steps and have supporting bars
- The main entrance door can be controlled and opened by remote control
- The bathroom is on the floor of the living or can be reached with elevator or stair-lift
- Good daylighting, especially in circulation areas
- The kitchen and bathroom are large enough for use in a wheelchair (dimensions allow a circle of 150 cm or l and w > 220 cm)
- Ventilation, heating and lighting can be controlled from the position of a wheelchair
- High toilet level and bars to support getting up and down
- The bathroom or kitchen floor does not get slippery when wet
- A fall accident cannot lead to serious cuts from breaking glass or pointed obstacles
- Smoke alarm is working and within hearing distance, emergency exit is accessible.
- Ergonomic qualities of occupancy:
  - It is easy to clean the house for someone with impaired mobility
  - Obstacles and smooth rugs that may cause fall accidents have been removed
  - The bed allows easy access from both sides
  - Cooking system without flames, utensils not located over or behind hot pans
  - Thermostat on hot water taps of bathroom to prevent scalding
  - Work tables are well lit, large and easy to access
  - The stairs, electrical plugs are safe for children.
**Acoustic quality**
The silent house can be located in a quiet environment, or has good acoustic insulation in a noisy location. An average location may have noise from the street or playing children, from neighbours and from inside sources. The qualities in this location are:
- Noise levels from outdoors cause no nuisance when inside the house
- Noise levels from neighbours cause no nuisance (talking, music, slamming doors)
- Mechanical ventilation does not cause nuisance when using the set-point meant for occupation periods
- Sleep is not being disturbed by noise during permanent ventilation (7 dm³/sec.pp)
- Sleep is not being disturbed by noise from pumps, motorised valves and ticking pipes
- Quiet occupancy:
- Interior decorations absorb noise
- Noise sensitive functions of the house are situated at the quiet side of the house
- Social contact with neighbours allows for agreement on noisy or quiet periods.

**Socially secure**
The socially secure quality supports people in need of care and attention. This quality allows people in need of help to live longer in their house. The social surroundings provide safe and varied opportunities for children to play. The qualities are:
- The home offers good privacy
- The neighbourhood offers social cohesion and control against intimidation
- It is possible to sit outside in the sun and with enough privacy and free of noise
- Social alarm is available for persons who need daily attention (help within 15 min.)
- A spy or window in the main entrance door permits a view on callers at the door
- It is possible to watch small children playing outside form within the house
- The main entrance door can be controlled from the living room.
- Socially secure occupancy
- Social alarm gives a reaction in short notice
- The occupants sustain a social network in the neighbourhood

**The health quality label**
The resulting quality is assessed on the basis of figure 5 and 6. The quality label is not calculated on the basis of points, does not result from a computer program, like emerging from a black box. Each user of the Checklist must understand the impact of the features that were inspected. The quality of the house has five scores: for allergen free, for airy and emission free, for acoustic quality, ergonomics and social security. Also, a list of tips and suggestions is added. These tips indicate how far the quality is away from the optimal quality and promote communication about the qualities and the needs of occupants.
For each topic: add all outcomes after multiplication

Divide result by the following number:

<table>
<thead>
<tr>
<th>Quality of the house for each topic (+2 tot -2)</th>
<th>allergy free</th>
<th>airy</th>
<th>Ergonomical</th>
<th>silent</th>
<th>socially secure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of smell, small particles and allergens from outside</td>
<td>3x</td>
<td>3x</td>
<td>1x</td>
<td>3x</td>
<td>3x</td>
</tr>
<tr>
<td>Quality of privacy, social security of neighbourhood</td>
<td>1x</td>
<td>1x</td>
<td>3x</td>
<td>3x</td>
<td>3x</td>
</tr>
<tr>
<td>Acoustic level from sources outside</td>
<td>3x</td>
<td>3x</td>
<td>1x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acoustic level from neighbours</td>
<td>3x</td>
<td>3x</td>
<td>1x</td>
<td></td>
<td></td>
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<tr>
<td>Acoustic level from sources inside</td>
<td>3x</td>
<td>3x</td>
<td>1x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ease of cleaning surfaces with dirt and mould</td>
<td>3x</td>
<td>3x</td>
<td>1x</td>
<td></td>
<td></td>
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<tr>
<td>Quality of removal air pollutants by ventilation</td>
<td>3x</td>
<td>3x</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Exposure to aerosols / fine dust from sources inside</td>
<td>3x</td>
<td>3x</td>
<td></td>
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<tr>
<td>Growth conditions of house dust mite</td>
<td>3x</td>
<td>1x</td>
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<tr>
<td>Presence of pets and pests in the house</td>
<td>3x</td>
<td>3x</td>
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<tr>
<td>Visible mould and suspected mould (mouldy smell)</td>
<td>3x</td>
<td>1x</td>
<td></td>
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<tr>
<td>Air quality inside: smell, smoke, chemical emissions</td>
<td>2x</td>
<td>3x</td>
<td></td>
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<tr>
<td>Radon based on ventilation, materials and influence crawlspace</td>
<td>1x</td>
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<tr>
<td>Quality of drinking water: bacteria (legionella), lead</td>
<td>3x</td>
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<tr>
<td>Periods with extreme indoor temperatures (cold, hot)</td>
<td>2x</td>
<td></td>
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<tr>
<td>Quality of (day)lighting</td>
<td>1x</td>
<td>1x</td>
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<td></td>
<td></td>
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<tr>
<td>Maintenance and functional quality of services</td>
<td>3x</td>
<td>1x</td>
<td></td>
<td></td>
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<tr>
<td>Hazard risk level: falls, burns, cuts, suffocation</td>
<td>2x</td>
<td>1x</td>
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</tbody>
</table>

Figure 5. Evaluation of the house: the house quality label

Conclusions

The study of the relation between occupancy patterns, building features and health risk in dwellings resulted in a set of indicators that support a relatively simple diagnosis of health risk in housing. Because occupant behaviour and technical aspects are included, the tool has a potential to improve the communication between tenants and landlords about healthy housing. The do-it-yourself health risk evaluation is believed to work.
Quality of occupancy

- Allergy free
- Airy
- Ergonomical
- Silent
- Socially secure

Quality of the house for each topic (+2 tot -2)

Allergy free | Airy | Ergonomical | Silent | Socially secure
---|---|---|---|---
22 | 24 | 9 | 15 | 15

Fill columns with resulting number.

Positive score is contribution to healthy housing.
Negative score indicates health risk.
Also: draw the results in the five-star in the heading.

Answer the following questions and give suggestions.

Does the house meet all basis requirements?
Give tips, suggestions and measures to improve all aspects with negative score into positive or neutral score.
Give tips, suggestions and measures to improve aspects with neutral score into positive score.

Pilots have shown that the Checklist has many eye-openers for the users, and provides many ideas about how to improve the health performance of the house. The list is too long. Further study of the indicators must help to select a smaller set of indicators.

Acknowledgements

The Checklist Healthy Housing is supported by the Building Research Foundation (SBR) with guidance from a team of experts from SBR, the housing institutions Staedion and Kristal and the tenant organization Woonbond (including VEH and Astmafonds).
References


