Hilti sustainability checklist for green building

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Vision

Hilti Corporation intends to construct future-oriented new buildings, refurbish or convert buildings and build extensions to plant facilities according to sustainability fundamentals. Hilti thus wishes to play an exemplary role in this field as well. Consequently, forthcoming construction projects shall embody the values Hilti lives by, regarding the environment, its employees and society. The aim is to construct buildings that provide ecological and economic benefits over their entire life cycle.

Methodology

The Hilti "green building" standard presented here, applicable to new buildings, refurbished or converted buildings and extensions to plant facilities, is based on two company-internal documents ("Competition for the design of the Hilti Corporation Innovation Center", managed by Edgar Nacken von Rudzinski and "P4plus Sustainability Masterplan Requirements", the result of an outstanding initiative put forward by Eugen Tschaan. After viewing the documents, an analysis of their content was carried out with the objective of identifying the sustainability core factors repeatedly presented and to extract these with a view to creating a Hilti standard. The resulting sustainability checklist was supplemented by material from other external sources of information (see list in the annex) and with the addition of further points ("green building as a future trend").

The Hilti sustainability checklist presented here does not differentiate between various types of buildings in terms of sustainability. The checklist contains sustainability factors that are to be taken into account in the planning of new buildings, in reconstruction or conversion and in extensions to existing buildings. Fulfillment criteria have also been added to each of the sustainability factors with a view to ensuring that sustainability conformance can be ensured. Further information and details of its source has been added where relevant and where available.

Use of the sustainability checklist and its purpose

The checklist is to be taken into account during the early phase of the building project (conceptual and planning phase). On looking through the checklist it will be found that the core points to be given consideration in the subsequent procedure are as follows:

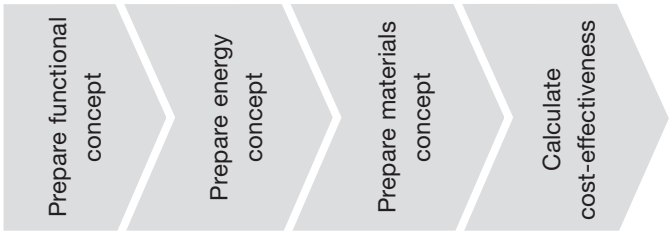
- The acceptance criteria for each of the points are to be established within the scope of the detailed planning. The applicable guide values or, respectively, the checking procedures to be used, will be added to this document at a later date.
- The ecological requirements, the technical quality and the checking procedures must be defined precisely in the invitation for tenders (invitation for green building tenders).
- The building project management team must ensure that materials, products and designs meet quality assurance requirements. Safety data sheets, product descriptions, certificates, eco-labels and documents providing verification of inspection etc. are to be checked at random and a record kept of the results.
- Features contributing to protection of the environment are to be assessed in ecological and economical terms.
  - Ecological assessment of the current status compared with the state of the art (building engineering regulations).
  - Costs
    - Please refer to the checklist point on cost effectiveness.
    - Where additional costs per item or system are high, possible variants must be worked out and the decision then taken by the local project steering committee.
- We wish to obtain an Energy Pass in accordance with the EC directive "The Energy Performance of Buildings" 2006 (obtain quote).
- National legislation and incentive guidelines must be observed as there may be serious deviations to be taken into account (stricter legal requirements in Liechtenstein and Switzerland, higher incentives for green building in Austria).

Basic recommendations for the approach to be taken

The sequence of the individual concepts is a decisive efficiency factor.

1. Preparation of the functional concept.
2. Preparation of the energy concept.
3. Preparation of the materials concept.
4. Calculation of cost-effectiveness.

With a view to achieving an effective energy concept, it is of great advantage when a master plan for the entire location is prepared and the rough structure of the functional concept already exists. The energy streams or, respectively, the energy requirements for the entire location can then be considered on this basis, and the dynamics of the situation taken into account for the future.



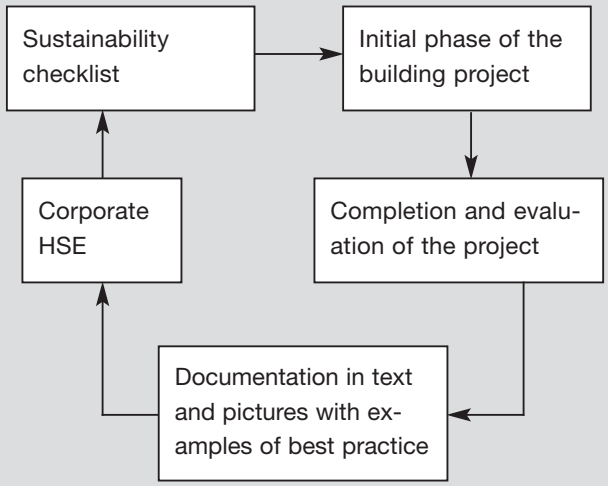
After completion of the building project, any additional sustainability criteria which have been identified as important must be forwarded to Corporate HSE. In addition, project managers are urged to document 1-3 interesting HSE topics from the building project, complete with photos (best practice – reduction of negative effects on the environment, energy savings, etc.). The documentation should be quantitative (e.g. figures, tables, evidence of the savings achieved) as well as qualitative (explanation of the savings or improvements made). A standardized form for this purpose can be found in the annex. This feedback function is intended to ensure that the sustainability checklist remains up to date. The project manager is responsible for providing this feedback after completion of the building project.

How the sustainability checklist should be used

This sustainability checklist does not lay down the law. It should be seen as a source of advice for the early phases of projects for the construction of new buildings, building conversions and extensions. Application of the Hilti sustainability checklist should ensure that consideration is given to ecological (and social) aspects of the building project at an early stage. Due to project-specific differences (type of building as well as local requirements and conditions), the standards cannot always be applied to the same degree. It should thus be stressed, once again, that this document should be regarded as a guideline and not as a mandatory, all-encompassing and generally applicable directive (with emphasis on the subsidiarity principle).

The next step is the differentiation of the checklist in terms of the various requirements applicable to different types of buildings (offices, workshops, manufacturing plants, Hilti centers, warehouses and training centers).

Use of the sustainability checklist:



Checklist

Category	Sustainability factor	Fulfillment criteria	Checked
Environment	Nature and countryside	• Economic and careful approach in use of building land and green areas. • Conservation of valuable natural areas (forest) and the countryside (e.g. heath or moorland). • Conservation of soil function. • Natural layout or landscaping of company grounds (e.g. planting of grass etc. on flat roofs).	
	Ground water and hydrologic balance	• Amount of sealed ground area is to be minimized (e.g. by using green areas, ponds, etc.). • Minimization of use of drinking water. • Rain water not to be fed into the sewerage system (ground seepage). • Green areas where possible – reduces load on sewerage system at peak flow times (also improves indoor climate). • Ground seepage of surface water where possible. • Special precautions applicable to potential ground water pollutants.	
	Noise emissions and pollutants	• Impact on the local environment (neighbours and employees) to be minimized: Noise limit industry by day: 70 dBA Noise limit industry by night: 60 dBA Noise limit for neighbours by day (residential/commercial): 55 dBA Noise limit for neighbours by night (residential/commercial): 55 dBA • Emission control concept for the building or facility in terms of MAK values, electromagnetic fields (Tesla), etc.	
Architecture and building services engineering	Building structure, interior finish and adaptability	• Qualitative assessment of adaptability – key word: scalable extension.	
	Statics and structural analysis	• Qualitative assessment of functional suitability and structural engineering design.	
	Suitability for deconstruction	• Disposal of various construction materials from structures where there are concerns about possible risks or difficulties.	
	External envelope of the building and surface materials	• Qualitative assessment of the external envelope of the building in terms of durability and maintenance. • Qualitative assessment of interior surface material quality in terms of usage, maintenance and aging. • Avoidance of excessive summer temperature rise through structural measures. • Avoidance of thermal bridging (with focus on renovation).	

Category	Sustainability factor	Fulfillment criteria	Checked
Architecture and building services engineering	Building services engineering in harmony with architecture	• The necessary building services engineering is to be kept to a minimum through architectural measures, planning of building services engineering to ensure greatest possible flexibility for future changes of use.	
	Building services engineering, including communications	• Qualitative assessment of concept for shafts and ducts (vertical and horizontal installation areas for pipes and cables).	
	Doors and entrances	• All permanently-used exterior entrances/exits to take the form of door systems (lifting doors, automatic doors, wind breaking double/rotating doors).	
Operating energy	Heating energy requirements	• Minimization of the use of fossil fuels and electrical energy. • Operating energy consumption minimized through use of thermally optimized building design. • Interiors to be heated through utilization of waste heat. • Storage of process heat for weekend use. • Use of alternative energy sources (geothermal energy, ground water, utility-supplied district heating). • Estimation of heating energy requirements in accordance with SIA380/1 etc. (compare with other national standards).	
	Cooling requirements	• Cooling energy needs kept to a minimum through architectural measures. Cooling mainly achieved by use of alternative energy systems/ techniques such as overnight cooling.	
	Building services engineering (further information)	• Optimization of warm water storage – thermal insulation at least 15 cm: requirements are considered fulfilled when the thickness of thermal insulation (thermal conductivity of 0.04 W/mK) for the warm water storage system is at least 15 cm all round. • Optimization of distribution system: requirements are considered fulfilled when pipes are insulated in accordance with the table (pg 13). • Use of waste heat and solar systems for warm water heating to be given consideration. • In view of the excess heat produced, the effectiveness or need for a solar system must be questioned, i.e. whether the extra heat is actually required. • Photovoltaic system: The effectiveness or need is to be questioned. The efficiency of systems of this kind is low (approx. 15 to 20%). These systems are not cost effective without a financial incentive (e.g. government subsidy).	

Category	Sustainability factor	Fulfillment criteria	Checked
	Building services engineering (continued)	• Ventilation with heat recuperation: If heating and cooling is by way of a structural surface heating and cooling system (e.g. concrete core temperature control, underfloor heating etc.), the ventilation system is only required to provide the air exchange necessary to meet hygienic requirements. • Building services control systems: Provision to be made for control of heating, air conditioning, ventilation, lighting, blinds, etc. according to requirements.	
Construction materials and the environment		• Qualitative assessment of the resources used and the “gray” energy.	
	Avoidance of HF(C)FC	• Avoidance of HF(C)FC: building materials are to be checked for HF(C)FC. • Avoidance of HF(C)FC in thermal insulation for buildings and building services engineering. • Deconstruction where thermal insulation containing HF(C)FC is involved: disposal concept to be prepared at an early stage.	
	Avoidance of PVC	• Avoidance of PVC to be ensured during the early planning phase.	
	Avoidance of polyurethane	• Avoidance of polyurethane in thermal insulation to be ensured during the early planning phase.	
	Details	• Thermal insulation of joints with backfilling/stuffing material, sealing strips: the requirement is considered to be fulfilled when all window frame, door frame and stairway joints are finished in this way. • Plaster/rendering with max. 6% synthetic content, use of cement-based adhesive.	
	Paint and coatings	• Facade paintwork to be free of solvents and biocides. • Wall / ceiling paintwork and adhesives to be free of solvents, biocides and plasticizers. • Paint or coatings applied to wood or metal to contain max. 5% solvents and be free from aromatic hydrocarbons. • Bitumen coatings to be free of solvents.	
	Floor surface finishes	• The solvent content of floor surface coatings such as on wood or parquet etc. (lacquer, oil, wax) must not exceed 8% by weight.	
	Sourcing	• Timber from the region: The requirement is considered fulfilled when timber from forests in the region is used exclusively.	

Category	Sustainability factor	Fulfillment criteria	Checked
Well-being and health	Interior climate	• The building to be constructed must be conducive to the well-being and health of its users. The materials used must emit no harmful substances and must help to achieve a good interior climate.	
	Ventilation	• Very high priority must be given to an adequate ventilation concept that ensures very good air quality at all times without causing unpleasant air movements (draughts).	
	Daylight and lighting	• Optimum daylight and good lighting as well as a good balance between these light sources are prerequisite for personal well-being and a productive working environment.	
	Acoustics and noise control	• Qualitative assessment of acoustics and noise control in office areas and testing halls / workshops etc.	
	Protection against summer heat	• Qualitative assessment of measures providing protection from summer heat.	
	Access and usability	• Buildings and surroundings must be free of obstacles and suitable for use by disabled persons.	
Social contact	Well-being	• The encouragement of social contact forms an integral part of sustainable building and should be made possible and actively inspired by the establishment of meeting places conducive to communication.	
	Appearance	Important guidelines for design drafts: • The health and well-being of the employees has top priority. • “Product leadership” to be made perceptible and a first-hand experience through visible use of Hilti products for the new building. • Illustration of Hilti processes and structures. • Attractive interior design. • Relation to the landscape or countryside (depending on possibilities – type of building).	
Cost-effectiveness		• Quantitative estimation of building costs: operating and maintenance costs are to be taken into account in the form of the previously-mentioned criteria: building services engineering, external envelope, materials used for surfaces, heating energy requirements.	

Green building as a future trend

Characteristics

The building shall become a part of the natural materials cycle. Consideration must be given, above all, to the deconstruction and disposal of the building when it reaches the end of its life-cycle. The building must also make careful and economic use of resources during the time it is in use. The following points are of great importance:

- Ecological location (infrastructure, access to road, rail and public transport networks, minimization of impact on the landscape or countryside).
- Use of building materials that ensure an environmentally-friendly raw material extraction process and ultimate use, materials that ideally are biological degradable and, as far as possible, can be produced with minimum use of energy and transport resources (sourcing of local materials).
- Avoidance of biologically questionable or toxic substances.
- Low energy consumption during use of the building on a renewable resources basis (solar architecture).
- Minimization of sealed surface areas (concrete, asphalt, built-up) and/or planting of greenery on buildings.
- Sustainable surface drainage system, possibly through separation of drinking water and service water, to provide water for washing or the watering of plants etc. (precipitation storage tank).
- Separation of the drinking water network form the service water network. The drinking water network within the building should be kept as short as possible. Drinking points should be on short pipe runs in order to avoid the formation of harmful bacteria (legionella).

In addition to residential buildings, there are many examples of “green” office and commercial buildings already in use.

Specific features

If green building is the objective, it is necessary to scrutinize each product to be used in the building with regard to its ecological characteristics or properties. Examples of important decisions to be made for a green building project are:

- Natural building materials (clay, brick, natural stone from the region).
- Natural, renewable insulation materials (soft wood fibers, flax, hemp, sheep’s wool, straw bales).
- Installation of very good thermal insulation.
- Natural paints, varnishes and adhesives on a vegetable basis, containing no solvents.
- Multiple-glazed windows made from local timber instead of plastics.
- As far as possible, comprehensive use of natural daylight for illumination of the building (light guidance systems, i.e. a system of ducts and mirrors, can be used to transfer light to areas where no windows are possible).
- Natural floor coverings (cork, wood parquet from locally grown timber).
- Warm water heated by thermal solar systems, supplemented by alternative heating systems where necessary (e.g. geothermal energy, wood pellet burners).
- Where local conditions permit: construction of a biological sewage treatment / purification system using growing plants, use of the biomass as fertilizer in company gardens. Alternatively, a (small) sewage treatment system of this kind could be built in a joint project with several neighbours.
- Creation of possibilities for waste / garbage separation, provision of covered bicycle parking areas.

Annex

Nature and countryside

Experience has shown that close-to-nature building design and layout is not only of value in terms of nature conservancy, it also increases the well-being of the employees and significantly reduces upkeep and maintenance costs (compared to the usual sealed surface areas, trimmed lawns, exotic plants, etc.).

Rainwater

More information on the subject of rainwater and various requirements for specific types of buildings can be found at: http://www.bve.be.ch/site/bve_gsa_dok_infogsa_Kap9_2_2003d.pdf

Noise emissions

The given noise limits are specified by the building authority for the city of Zurich (building biology/ecology) http://www.laerm.zh.ch/fals/3-wissen/vortraege/pdf/gesundheit_im_innenraum_laerm_nov2006.pdf).

Emission control concept for MAK values and electromagnetic fields

The maximum workplace concentration (MAK value) indicates the maximum permissible concentration of a substance as a gas, vapor or suspended particles in the air breathed at a workplace without expecting damage to the health, even when a person is normally exposed to the concentration for 8 hours per day, max. 40 (42) hours per week (in a shift working system). A comprehensive list of MAK values can be found at: https://wwwsapp1.suva.ch/sap/public/bc/its/mimes/zwaswo/99/pdf/01903_d.pdf

More information on the subject of electromagnetic fields can be found at: http://www.datadiwan.de/netzwerk/index.htm?/esmog/es_002d_.htm

Building structure, interior finish and adaptability

The requirements to be met by the building are the result of the dynamic effect of many future processes and projects leading to the necessity for unhindered communication and cooperation between widely varying groups and functional units. The needs of the employees are also of great importance. It is to be expected that continuous changes of use will place great demands on the versatility of the building, which is required to meet a great variety of needs in terms of the uses and accommodation it provides.

Statics and structural analysis

A highly versatile building structure is to be developed – a structure that ensures loads are taken up efficiently while making optimum use of the materials used, reduces building costs and the material-dependent environmental impact, and allows easy future changes of use. Where possible, use is to be made of components that allow easy deconstruction.

Suitability for deconstruction

Even during the construction phase, attention must already be paid to the subject of easy disposal at the end of the building's useful life. Composite materials and the permanent bonding of materials that will ultimately require separate disposal are to be avoided.

The additional information given here is based to a great extent on the following individual documents:

- Residential construction incentives in Vorarlberg, Austria: Förderung Ökologischer Wohnbau: Ausgewählte Kriterien http://www.energieinstitut.at/HP/Upload/Dateien/OeWBF_2008_2_Erlaeuterungen.pdf
- Design competition for the Hilti Corporation Innovation Center
- DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND COUNCIL on the energy performance of buildings
- Sustainability criteria for buildings in accordance with SIA 112.1
- Explanatory notes on sustainability criteria for buildings in accordance with SIA 112.1
- Green building – building construction. Supplement to the model presented in SIA 112 (http://www.sia.ch/produktevoransicht/i112-1_2005_d.pdf)
- SIA energy efficiency path D 0216
- SIA 181: Noise control in building construction
- SIA documentation D 0123: Building construction – ecological aspects

External envelope of the building and surface materials

Calculated over the entire lifetime of the building, the operating, maintenance and renovation costs are higher than the cost of its construction. There is always some connection between these costs and materials with environmental impact. The cost of operation and maintenance can be reduced through use of a durable means of construction that allows easy maintainance and repairs. Components with various lifetimes should be separated as far as possible. The quality and life expectancy of the chosen materials should be designed to meet the demands of the use to which they are put. Regarding the materials used for floor and wall coverings, attention must be paid to high durability and ease of cleaning.

Avoidance of thermal bridging

A thermal bridge is an area where heat flows away to the exterior of the building more quickly than in parts where no thermal bridging occurs. Lower temperatures thus result on the inside of the area affected. This leads to:

- Higher energy consumption.
- Problems with dampness (condensation or even mildew).
- Risk of damage to the structural fabric of the building.

More information on the subject can be found at: http://www.energiesparhaus.at/gebaeudehuelle/waerme-bruecken.htm

Building services engineering in harmony with the architecture

The necessity for building services engineering is to be minimized by architectural measures. The necessary building services are to be designed for maximum flexibility in the event of future changes of use to allow adaptation, at minimum cost and effort, to changes in the way the building is used.

Building services engineering, including communications

Taking into account the demanding requirements in terms of interior climate and services, vertical and horizontal installation areas are to be provided for all pipes and cables and their adequacy verified. The installations are to be logically and consistently separated from the structure of the building. Pipes and cables are to be laid in such a way that renewal in the long term or the laying of additional pipes and cables is easily possible. Pipe and cable runs shall be kept as short and simple as possible by ensuring that building services rooms and installation zones are positioned optimally. Due to their relatively short expected lifespan, building services must be easily extendible and replaceable (provision to be made for the installation and de-installation of ventilation systems). Allowance must be made for the supply lines and connection points required in the workshops, testing halls and laboratory areas in accordance with the interior layout plan. The same also applies to specifications for the system integration of building services, security systems and automation systems.

Heating energy requirements

Climatic change and limited energy resources will determine future global energy policy. Not least because of this, Hilti has decided that its buildings are to be climate-friendly and operated with particular attention to energy efficiency. In a new building, heating energy requirements can be significantly reduced compared to existing buildings. In order to achieve this reduction, adequate thermal insulation, a well-sealed external building envelope and ventilation system incorporating heat recuperation is required. Passive heat gain can also contribute toward reducing heating energy requirements. Buildings with a less compact form tend suffer higher energy losses through their external envelope. This must be compensated by use of improved thermal insulation.

Waste heat from production processes

The use of waste heat from production processes is a key topic in the energy concept. The potential this offers becomes obvious after taking a look at the energy flow diagrams for each of the manufacturing plants. At Plant 4 there is, in theory, sufficient waste heat available to heat the entire building complex, including the administration building. In summer however, this waste heat presents a comfort problem because a conventional cooling system would use as much additional energy as would be saved in winter for heating. The waste heat should therefore be drawn off as close as possible to the machines or systems (heat source). This energy can then be combined with low-temperature heating systems such as concrete core temperature control or surface (underfloor) heating systems, geothermal loops or ground water cooling systems and heat pumps for heating or cooling support. When suitably regulated, the same system can be used for cooling in summer and heating in winter. Additional measures are always required where recuperation from the air in interiors is employed (air exchange, heat pumps) and there is the problem of overheating in the manufacturing area.

The higher the temperature of usable waste heat, the more uses it has without need for application of additional energy:
- Preheating of incoming air (20 – 30°C).
- Heating of interiors by way of low-temperature heating systems (25 – 40°C).
- Warm water heating (60°C and above).

Use of the available waste heat not only saves energy, it also saves space and avoids the need for financial investment in separate building services. The financial investment in the systems proposed here should not differ substantially from the investment required for conventional heating / cooling by an air-conditioning system and should lead to considerable cost savings when the system life cycle is taken into account.

Information about estimation of heating energy requirements in accordance with SIA 380/1 can be found at: http://www.energie.zh.ch/internet/bd/awel/energie/de/SIA_380-1.html

Cooling requirements

The need for cooling due to external factors (e.g. the heat of the sun) can be minimized by the appropriate orientation of glazed surfaces of the building, by making use of an effective automatically controlled shading system and through adequate thermal insulation. In addition, high ceilings in rooms allow warm air to rise and collect above the area where a comfortable temperature is required. The effective mass of the building should also be great enough to provide compensation during periods of peak high temperatures. Shade provided by trees, green areas or areas of water on the company grounds also reduce the effect of the heat induced by the rays of the sun or surrounding air. This thus ensures that no additional cooling is required to balance the effect of the sun's rays or warm air which would add to the already high level of waste heat in the interior of the building. In the new OIB guideline (http://www.oib.or. at/), the limiting value for non-residential buildings is given as 3 kWh/m. For an ambitious building project, a value of 0 kWk/m can be demanded without being unreasonable. The waste heat from manufacturing processes should be drawn off by way of passive cooling techniques as far as possible.
Suitable passive cooling techniques are, for example:
- Direct extraction of the heat at its source: As far as possible, the waste heat should be drawn off directly at the machines by a cooling circuit or similar system. This allows direct cooling in summer, using ground water for example, and the waste heat can be used in winter for heating.
- Air / geothermal heat exchanger for the fresh air supply.
- Ventilation shafts or openings in the roof area to support the natural flow of air in summer (to be closed when heating, so that exhaust air can be fed to the heat recuperation system).
- Overnight cooling by way of natural air circulation as far as possible (see above). This feature requires an additional means of cooling.
- Concrete core cooling (floors, walls) combined with a ground water cooling system or geothermal loops.

If these methods don't adequately achieve the required temperature, in addition to concrete core cooling, a solar cooling system or, for peak periods, a mechanical cooling system (heat pump) can be switched on to support the process.

Building services engineering (further information)

Distribution network

Insulation:	Pipes:
30 mm	DN/NPS15 – DN/NPS32
50 mm	DN/NPS40 – DN/NPS50
80 mm	DN/NPS 65 – DN/NPS80
100 mm	DN/NPS 100 and above

Pipe insulation of the sectional semi-rigid type is to be PVC-free.

Warm water heating

The advantages of a central warm water heating system using waste heat or solar systems must be weighed against the disadvantages of the resulting long pipe runs. A central system makes sense where the consumption of warm water is high, in changing rooms, shower rooms or kitchens for example, or where warm water is required for operational purposes. Decentralized systems, i.e. small concealed electric boilers are suitable where consumption is low, such as in toilets in office buildings, where the energy losses through long pipe runs would be greater than the savings achieved by a central system.

Solar system

This is the case, for example, when the waste heat temperature is not high enough to be used to produce warm water, or when it is decided that surrounding buildings are also to be supplied with heat.

Ventilation with heat recuperation

Ventilation systems with heat recuperation and preheating of fresh air by way of a geothermal loop minimize the amount of heat required for heating purposes. An air volume regulation system is required in order to ensure good indoor air quality. All filters and filter materials used are to be specified by Hilti for reasons of standardization.

Building services control systems

Lighting: The need for artificial lighting is to be minimized through effective use of daylight. In order to take advantage of this potential, the lighting should be automatically controlled according to the brightness of available natural light and actual light requirements (light control system). Basic points to be observed are:

- The color of walls, ceilings and floors has a very significant influence on light requirements. Light colors are to be given preference over dark colors.
- Light fixtures with surface-coated reflectors achieve better reflection than those with simple white-painted reflectors.
- Gas-discharge lamps are efficient light sources for large halls. Many different types are available (consult a professional lighting systems planning specialist).
- Where fluorescent tubes are used, electronic control is a must. These systems not only achieve 30 – 80 % energy savings, they also allow infinitely variable control of light output, make the tubes last longer and eliminate unpleasant flickering caused by the low operating frequency of electromagnetic starters.
- Attention must be paid to ease of cleaning and replacement of the light fixtures.
- High-efficiency, controllable exterior lighting should be used, e.g. sodium vapor lamps, with separate control circuits to allow control according to requirements.

Building materials and the environment

The environmental impact of the production of the building materials used to construct an energy-efficient building forms a significant share of the total environmental impact of the building over its entire life. Reduction of so-called “gray energy” (the energy consumed in the manufacturing of building materials) and the upstream environmental impact of the manufacturing of building materials on the whole, is thus a subject to which the corresponding attention should be paid.

The consumption of resources must be reduced by employing compact building systems, using renewable raw materials from the region with short transport distances and generally by using materials with low manufacturing energy requirements. Further information about “gray energy” in the construction of buildings can be found, as required, in SIA document D0123 and the document KBOK “Empfehlung Nachhaltiges Bauen: Ökobilanzen im Baubereich 2007/1”.

The ecological quality of the materials is assessed automatically during the course of the calculation of the heating energy requirements. The ecological quality of the materials is assessed according to the Ecoindex 3 (OI3) in terms of:

- Primary energy content (PEIne) – non-renewable manufacturing energy.
- Global warming potential (GWP) – global warming caused by greenhouse gases.
- Acid potential (AP) – with regional effect on the ground, forests, rivers, etc.

In doing so, each of these is given a weighting of 1/3. In accordance with the OIB guideline, the Ecoindex 3 refers to the gross area of each floor. The basic data is managed by “öbox” in Vorarlberg, Austria (www.oebox.at). The evaluation process is described in the OI3 guideline issued by the “Institut für Baubiologie und Bauökologie” (IBO), of Vienna, Austria.

Avoidance of HF(C)FC

This applies to the deconstruction and correct disposal of materials containing HF(C)FC, i.e. insulation (polyurethane, extruded polystyrene foam sheets), seals, semi-rigid pipe insulation, foil-backed foam and installation aids used on externally-insulated roofs, perimeter insulation, facade and floor panels, including the correct disposal of materials from existing buildings.

Avoidance of PVC

- **Windows, doors, roller blinds, light shafts**
  This applies to all applications, also to door and window seals.
- **Waste water pipes and wall penetrations below ground level**
  This applies to seepage water, water tanks in the ground, geothermal heat exchangers for ventilation systems and heat pumps.
- **Water and waste water pipes, air intake and exhaust ducts in the building**
  Roof drainage systems (all components PVC-free), pipe sheaths, e.g. for thermal insulation, must be PVC-free.
- **Surface sealing materials in roll/sheet form**
  This also applies to all waterproof foils and sheeting (e.g. for flat roofs).

- **Floors, skirting**
  This applies not only to PVC as a basic material but also as a composite in other floor coverings: Underlays, coatings (e.g. cork tiles), carpet backing. Only carpets with the GUT approval mark are permissible.
- **PVC and halogen-free electrical installations – pipes, conduits, switch fittings**
  This applies to all electrical installations. For small parts, a low PVC content is permissible so long as no suitable alternative is available (e.g. ground fault circuit interrupter switches in distribution cabinets). Conduits designed to withstand high loads or wear and tear are exempt from this.

Avoidance of polyurethane

This applies to all thermal insulation for the building (insulation sheets, window frames) and to building services engineering (semi-rigid pipe insulation, insulation of water tanks).

Plaster and rendering

This applies to all plasterwork in interiors and to cement-rendered exterior surfaces. The synthetic content of plaster and cement render must not exceed 6% by weight. Cement-based adhesives are to be used. The synthetic content of woven reinforcing/backing material is exempted.

Paint and varnish

Facade paintwork

This applies to all exterior facade surfaces but does not apply to wooden windows, wooden doors and railings. The surface treatment of metal components (steel parts) with chromate and lead-free coatings containing max. 8 % solvents is permissible.

Paintwork on walls and ceilings, adhesives

This requirement is taken to be fulfilled when the specifications of the Austrian eco-label applicable to biocide, plasticizer and formaldehyde are adhered to (www.umweltzeichen.at). The applicable product may contain max. 600 ppm of solvents, max. 100 ppm of which may be aromatics. This applies to all paintwork in interiors, including the use of latex paints.

Paintwork on metal and wood

This requirement is taken to be fulfilled when a solvent content of max. 5% by weight is not exceeded for all interior paintwork. This does not apply to windows and floors. Aromatic hydrocarbons are not permissible. The limits specified by the Austrian eco-label (www.umweltzeichen.at) also apply.

Bitumen coatings

Bitumen undercoating and sealing mastics: only solvent-free products on an emulsion basis are permissible.

Floor coatings

As a general principle, concrete and screed floors are to be sealed only with solvent-free coatings. Aromatic hydrocarbons are not permissible. Factory-applied finishes are not taken into account. Ready-to-lay parquet (UV-hardened) meets the requirements. Only carpets with the GUT approval mark are permissible.

Well-being and health

Interior climate

The temperature recommended for office activities is 21 to 23° C. When outdoor temperatures are high, an indoor temperature of 26° C should not be exceeded.

Important requirements for inclusion in the draft

- When outdoor temperatures are high, an indoor temperature of 26° C should not be exceeded.

Ventilation

Special attention must be paid to the situation regarding exhaust air from the manufacturing facilities (oil-cooled systems, heat treatment systems, testing cubicles, cooling lubricant systems, washing systems). A healthy interior climate with adequate ventilation must be ensured in all meeting rooms, even when fully occupied. Provision is to be made in all offices for natural ventilation. Employees must be able to open windows. The target value for relative air humidity is between 45 and 65 %. High values help to avoid electrostatic discharge. An air speed of 0.1 to 0.15 m/s is considered comfortable and is thus the figure to be specified. Values above 0.2 m/s are to be avoided. Ventilation systems in meeting rooms are to be designed in such a way

that, according to the size of the room and the number of seats, a higher air-exchange rate is achieved without causing draughts.

Important requirements for inclusion in the draft
A pleasant interior climate is to be ensured (temperature, air humidity, air speed, shade from the sun). The users must be able to open the windows. Higher air-exchange rate in meeting rooms.

Daylight and lighting

Dazzling light or glare and great differences in brightness in the field of view from the workplace make concentration difficult and lead to fatigue. Ideally, blinds should still allow visual contact with the outside. This also promotes the feeling of well-being. Please also refer to the points listed in the section "Building services control systems".

Important requirements for inclusion in the draft
- Office workplaces preferably close to windows.
- Visual contact with the outside.
- Adjustable exterior sun shade / blind system.
- Artificial light without glare.
- Brightness of 500 lux (horizontal) at the workplace.
- Ability to adjust lighting individually within typical modular areas (basis: standard occupancy rate of 4 workplaces).

Acoustics and noise control

Noise and vibration have a negative effect on the employees' feeling of well-being, their ability to concentrate and on their productivity. Especially in open areas where communication takes place, the creation of an acoustically agreeable environment, where low noise levels aid working concentration, is essential. All partitions in office areas must meet very high noise control requirements. The necessary conceptual and structural measures must be taken into account right at the early planning stage. Suitable noise absorption measures are to be employed to keep reverberation time within the range of the values specified in the SIA 181 standard. "Network offices" are to be equipped with noise-absorbing materials on floors, ceilings and walls in order to reduce noise transmission and reflection.

Important requirements for inclusion in the draft
- Very good acoustics in office areas.
- A noise level rating of below 45 dB (A) is to be aimed for (office buildings).
- Reverberation time in accordance with SIA 181 standard.

Protection against summer heat

With a view to keeping the excessive heat of the sun out of the building, an effective system of exterior shades / blinds is to be provided. This is to be combined with additional interior blinds that allow use to be made of the heat of the sun during the winter months. Preference is to be given to small blind segments that allow individual control by the various occupants of the room. Control of such blind segments should be possible for the modular areas mentioned above, with a standard occupancy of 4 workplaces. Protection from summer heat is to be achieved primarily by structural measures. The most important measures toward this goal are glass areas of appropriate dimensions combined with effective shades/blinds, thermal insulation of roof areas in particular and use of the balancing effect of the mass of the building during periods of peak temperatures. Cooling by way of additional technical installations should be kept to a minimum.

In buildings with a high level of internally-produced waste heat, e.g. manufacturing areas, the measures described above are necessary, but will not be adequate to guarantee comfort during the summer months. Waste heat from manufacturing processes in the interior must be removed by additional means. In order to achieve this with minimum energy consumption, use should be made of the passive cooling methods described under "Cooling requirements".

Important requirements for inclusion in the draft
- Exterior blinds/shades with provision for individual control and adjustment for typical modular areas (basis: standard occupancy rate of 4 workplaces).

Access and usability

Daily activities such as cleaning and the transport of large objects as well as access by physically disabled employees are aided by a design and layout that ensures no obstacles. The requirements listed in the Swiss SN 521 500 standard apply in particular. The building is to be equipped with a side entrance for use by cleaning staff and tradesmen etc. This entrance must provide direct access to the goods elevator. Likewise, the storeroom for the utensils used by the cleaning staff must be located close to the goods elevator. This room must be equipped with a water connection to be used for filling cleaning machines and an adequately-sized drainage point for emptying the machines.

Social contact

Well-being

In addition to providing the functional necessities to a very high standard, the building shall offer employees a working environment that is conducive to their health and well-being on a sustainable basis. The working environment shall be a visible expression of Hilti's high regard for its employees.

Important requirements for inclusion in the draft

- Comprehensive measures to ensure the health and well-being of the employees.
- Flexible, transparent office structures that facilitate communication.
- Visual and spatial interlinking of individual office units.
- Provision for temporary, individual workplaces that allow high mental concentration (in office buildings).
- "Development zones" with jointly-used functional areas.
- Management and associated assistants immediately adjoining.
- Project areas for dynamically growing or shrinking project teams.

It must be stressed that optimum fulfillment of the requirements for interior acoustics, interior climate and lighting is to be given utmost priority.

Appearance

With a view to ensuring that employees identify themselves with their working environment and continue to do so:

- Hilti products are to be used and remain visible, as far as possible, in a new building as a functional and visual reminder of our claim to technological leadership.
- An attractive and varied interior design concept that allows the individual design and differentiation of "home areas" is to be prepared.
- The building shall blend with the landscape while integrating as much as possible of the surroundings in the building concept (views, outdoor areas, etc.).
- The claim to being "A great place to work" shall be expressed by the appropriate additional features offered by the building and the surrounding company grounds (depending on the type of building: covered area for bicycle stands and motorcycle parking, first aid and rest room, doctor's room, changing rooms and showers for cyclists and sports enthusiasts etc. a fitness room, attractive outdoor areas, roof patios, interior courtyards, quiet room for restful moments, e.g. in combination with a library and a spiritual room).

Cost effectiveness

The cost effectiveness of the building over it's entire life cycle is of great significance. Solutions and concepts expected to achieve favorable values in terms of building costs as well as operating and maintenance costs are to be chosen. Compact building forms, which tend to be less expensive to construct and incur lower operating energy costs, are what is required.

Project report with practical examples

Please use this form to document HSE-relevant solutions within the building project (quantitative and qualitative, with photos that illustrate the points well):

Name of the project:

Description of the project:

Size of investments:	Photos illustrating relevant environmental solutions:

Main impacts or effects on the environment:

Improvements relating to the content of the checklist:

Hilti. Outperform. Outlast.

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