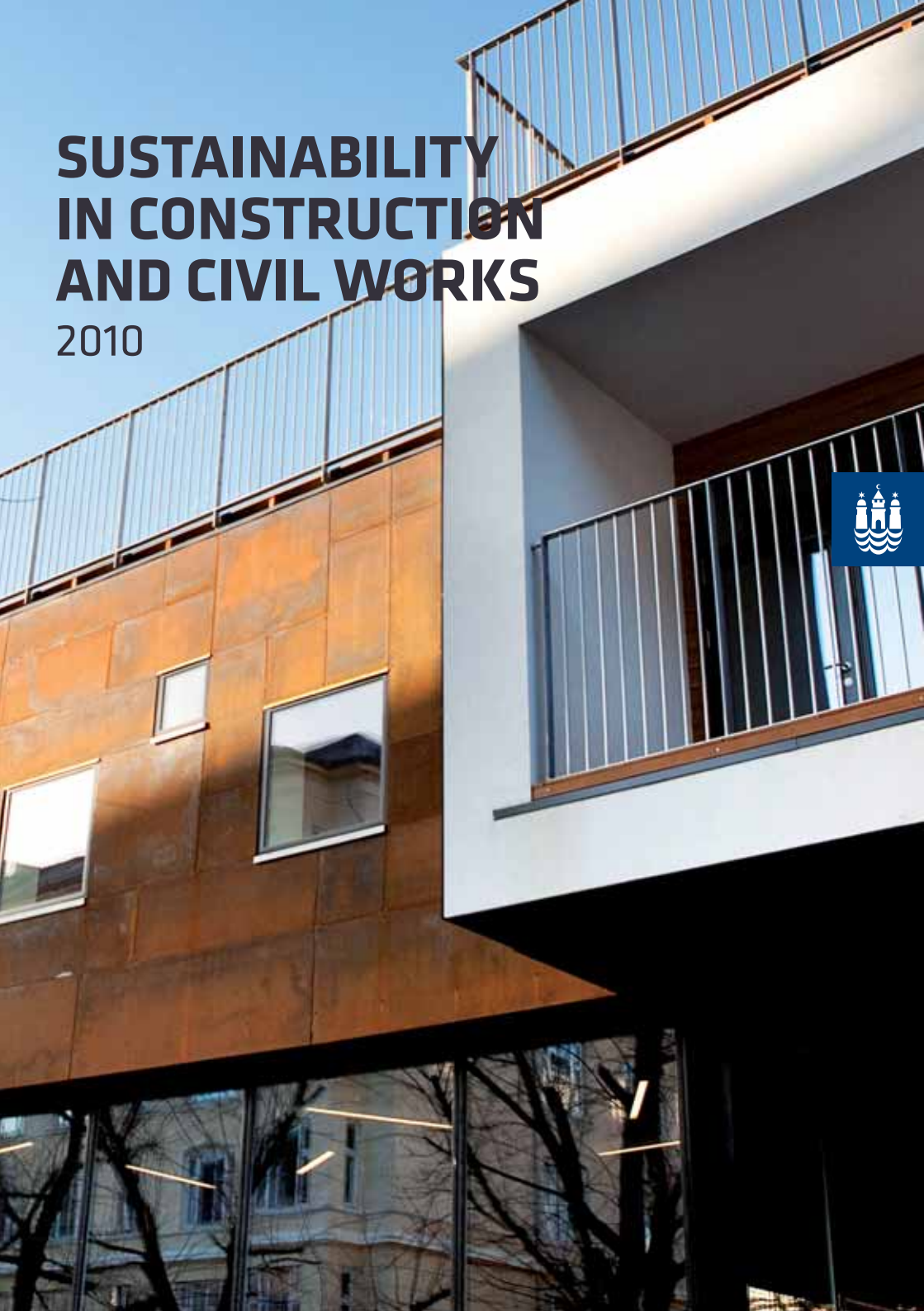
SUSTAINABILITY IN CONSTRUCTION AND CIVIL WORKS

2010



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The Universe, Meinungsgade, Nørrebro, City of Copenhagen, JJW Arkitekter, Ølgård Consulting Engineers, Contractor The Omega Group, 2009
After School Center is used for community activities and has facilities for playing music playing sports, and repairing your bike. It “floats” in the air in order for the neighbourhood playground to be retained. It has been designed according to The City of Copenhagen’ guidelines for sustainable construction and civil works.
The building is surrounded by trees; providing shade and cooling in the summer, and allowing the building to be warmed by the winter sun after defoliation. The construction meets the requirements of Low Energy Class 1 - the most stringent energy class of the Danish Building Code. Other sustainable features are a heat exchanger, maximisation of daylight, energy controlled lighting, and photovoltaics etc.

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Preface

The City of Copenhagen's climate plan ambitiously aims to reduce the city's CO_2 levels by 20 percent by 2015 compared to the levels in 2005. Copenhagen's vision is to be CO_2-neutral by 2025. If this ambition can be realised there is a lot of work that needs to be done and therefore started as soon as possible. Reduction of energy consumption and CO_2 emission in the municipalities own or other publically funded building projects is an important starting point in reaching the set goals.

Copenhagen has ambitious visions and objectives in relation to sustainability and environmentally friendly construction. *Sustainability in Construction and Civil Works 2010* is an important instrument in realising these aims.

One of *Copenhagen Municipal plan 2009*'s main visions is that Copenhagen should be the "thinking city", where development and consideration go hand in hand - sustainability and innovation should be part of the foundation for Copenhagen's future development.

Copenhagen has therefore developed the vision laid out in *Eco-metropolis*. Copenhagen wants to be the world's eco-metropolis by 2015 - the capital city with the best urban environment, thus demonstrating that environmental concern adds an extra dynamic to urban development. *Eco-metropolis* includes a list of specific objectives to be fulfilled by 2015.

Last but not least, is Copenhagen's vision *A Metropolis for people*, which contains specific aims related to city life in Copenhagen by 2015. Copenhagen should be the best city to live in, a sustainable city with urban spaces that invite a diverse spectrum of users and uses.

Sustainability in Construction and Civil Works 2010 is complimentary to the above mentioned publications. The new guidelines for sustainable construction shall help to achieve Copenhagen's ambitious objectives in environmental sustainability in the municipal construction and civil works, including publicly funded and supported projects. In this, the 4th generation of *Sustainability in Construction and Civil Works*, the demands have been intensified to live up to the ambitious visions for the cities future.

Bo Asmus Kjeldgaard
Mayor, Technical and Environmetal Administration

Introduction

In the development of a sustainable city it is important that use of resources and the environment are considered, together with the creation of healthy and good physical environments as parameters for sustainable construction. This is why the Copenhagen City Council adopted its first set of guidelines for *Sustainability in Construction and Civil Works 2010in 1998*. The guidelines have been updated regularly and are based on the premise that the City of Copenhagen should lead the way in environmentally sound construction and civil works.

The goal of this booklet
Sustainability in Construction and Civil Works 2010 is intended to promote a reduction in the impact on the environment – from for example the use of energy and resources, from waste and noise – in the municipality's construction, subsidized construction, urban renewal, and civil works. The guidelines are also intended to inspire private developers to focus more on the environment, a healthy indoor climate, and good urban surroundings. The guidelines can also serve as the basis for implementing front-line (housing) projects with respect to sustainability and energy use that can prove exemplary and provide inspiration both nationally and internationally.

The standards in this booklet are binding for construction, remodelling, renovation projects, and civil works that involve the City of Copenhagen as the developer or contractual user and for construction, remodelling, and renovation projects that are subsidized by the City under regulations on urban renewal and subsidized building or through municipal pools. The standards must be incorporated into the terms when tenders are invited for municipal construction and civil-works projects and when subsidies are approved for urban renewal and public construction.

The standards are accompanied by prominent examples of how measures that promote sustainability can be used as an integral part of architectural design. These examples are intended to serve as a source of inspiration for those in charge of projects in the City of Copenhagen, for external consultants, and for private developers.

Document guide
This document is divided into 9 themes, each of which is made up of a brief introduction and the standards and documentation that have to be met. The first theme is sustainable project design. This is important for ensuring that the other themes are incorporated into a project. The other themes (Chapters 2-9) must be considered on the basis of sustainable project design.

Introduction
The introduction presents the theme's main issues and goals.

The standards mainly incorporate functional environmental goals that can either be descriptive or given numerical form as norms. Standards can also specify materials, piping and wiring, work processes, etc. to be defined in greater detail that must always be used (or rejected). Calculations or descriptions, and possibly simulations or subsequent measurements, must document that these goals have been reached.

This new edition of *Sustainability in Construction and Civil Works 2010* thus formulates standards not only for the construction stage, but also for use, so that the goals of sustainable project design remain in force. Some of the themes consequently specify standards for a project's use, where relevant.

Documentation
Documentation must be presented that the projects design has met the standards set down in Sustainability in Construction and Civil Works. The developer or project owners must submit material that can serve as a basis for evaluating whether a project meets these standards. Work may not begin on a project before this material is submitted. When political approval is requested for a project, its description must show that the standards set down in *Sustainability in Construction and Civil Works 2010* have been met. When the project is delivered, or at the latest when the construction accounts are submitted, documentation must be submitted that the necessary measures have been carried out.

Managing documentation
For the City of Copenhagen's own projects, the project manager must ensure that the documentation meets the standards set down in Sustainability in Construction and Civil Works.

For external projects, for example subsidized construction or urban renewal, the developer must submit documentation to the City of Copenhagen, Urban Design Department, that the standards set down in *Sustainability in Construction and Civil Works 2010* have been met.

Collection of examples
The collection of examples contains pictures and a brief description of initiatives within the different themes, with focus on comprehensive solutions and the use of measures that promote sustainability as an integral part of the architecture.

Sustainable Project Design

Sustainable project design is a work method that is intended to ensure optimal results for the environment in construction and civil works. This method is used to map out, evaluate, and prioritize all significant environmental impacts. Goals are set for how much environmental improvements are intended to achieve. In addition, care is taken that the relevant measures to promote sustainability are used in keeping with these goals. The aim is environmental quality control, with the environmental standards and measures used to meet them are carried through consistently in the project during production/extraction, construction, use, maintenance, and finally removal.

Sustainable project design is an interdisciplinary method that is of decisive importance for implementing environmental considerations in construction and civil works. It is essential that all parties involved in construction focus on sustainability at an early stage in the project, and it is also important that environmental considerations be incorporated into the entire process.

Sustainable project design comprises a life-cycle perspective for materials, structures, piping and wiring, and the project as a whole, from extraction to removal.

Lærkehaven, Lystrup, Denmark, Herzog + Partner, 2008
This residential complex was the result of an international project competition, “Architecture and sustainability in Danish housing construction,” in 2003. Lærkehaven (50 low-energy houses) was designed with an emphasis on high-quality architecture, sustainability, and the incorporation of environmentally sound products and building techniques from the site plan to the detailing. The buildings are compact and well-insulated with an average blower-door test result of 0.8. FCS-certified wood is used for the larch cladding. The windows on the north have a U-value of 0.66, while others have a U-value of 1.18. Floor-to-ceiling windows optimize daylight, and there are manual shutters on the east, south, and west facades. District heating with piping under the buildings minimizes heat loss. There is LED lighting in kitchens, corridors, and bathrooms. PCM temperature regulating panels are used in the ceilings. An 80-sq. m. photo-voltaic panel system is installed on the site. The two-story units are low energy class 1. Rainwater is infiltrated via french drains or is channelled to the local stream.

Standards

Construction, large-scale remodelling, and civil works must be carried out through the use of sustainable project design. The design must be based on the City of Copenhagen's standards for sustainability in construction and civil works. These standards are found in Chapters 2-9 of this booklet.

Sustainable project design must include the following four elements:

1. **An environmental survey**
   The impact on the environment by construction or civil-works projects must be surveyed and evaluated systematically. The evaluation must be made on the basis of a comprehensive survey of environmental impacts and their derivative effects on the environment in conjunction with construction, use, and decomposition.

2. **Environmental priorities**
   A selection is made of 3-6 impacts on the environment that will be focus areas in the project, based on their environmental effects and the developer's environmental goals. A special effort will be made to reduce these impacts, which must moreover be prioritized.

3. **Environmental goals**
   Environmental goals must be formulated for impacts that have been prioritized in such a way as to be measurable, i.e. so that documentation can subsequently be provided on whether or not they have been met. The environmental goals for the project must be supported by the relevant standards described in the following eight chapters.

4. **Measures**
   Based on these environmental goals, a gross list of measures must be compiled that will contribute to meeting the environmental goals. When the final decisions are made on choosing measures, the total economic evaluations (explained below) of the individual solutions chosen must be taken into account. Measures should be chosen so as to achieve the greatest environmental advantage within the economic framework. Additional measures are chosen until the environmental goals are achieved. The higher the priority an environmental effect has, the more important it is to have it meet the environmental goals. The list of measures also notes who is responsible for implementing the individual measure. This might be the architect, the consulting engineer, the contractor, the developer himself, etc.

The project's overall economy must be considered in order to evaluate its costs and economic gains. This evaluation covers the project's economy in the entire process, from procurement, through use, to final removal. Any evaluation of individual measures is made in comparison with traditional solutions. Will the measure be more expensive or cheaper than a traditional solution? No precise calculations are made, only evaluations that will facilitate the selection of measures that will yield the greatest savings/fewest expenses and at the same time contribute to meeting goals. This makes it possible to choose a smaller number of measures that look promising with a view to both sustainability and the economy and to carry out more precise calculations, for example on payback times.

Documentation

The following documentation is required in conjunction with sustainable project design:

- Environmental surveys and priorities
- A sustainability program that contains environmental goals
- A list of measures with overall economic evaluations, possibly including payback times for selected measures

An environmental plan must be drawn up and updated regularly. The approved measures in the environmental plan must be incorporated into the project, and the results of the measures that are carried out must subsequently be documented.

The sustainability status must be determined at the end of the individual project stages in keeping with the sustainability plan's guidelines, with the aim of following up on the environmental plan and the measures that have been carried out. The results of this status must be documented.

When the project has been completed, a final evaluation must be made that describes the measures that were incorporated into the project. An evaluation must also be made of whether the goals were met and of any divergences from the standards set down in *Sustainability in Construction and Civil Works 2010*.

Energy and CO_2

Producing energy with fossil fuels emits CO_2, which is considered to be a major source of global climate change. Denmark has committed itself internationally to reduce its CO_2 emissions. The City of Copenhagen has there over drawn up an ambitious climate plan. Its goal is to reduce CO_2 emissions from energy production, transport, and waste management by 20% in 2015 from the 2005 level. The City of Copenhagen also aims to be CO_2 neutral in 2025.

Building use consumes considerable energy. This is why more stringent standards are set for optimizing energy in new municipal construction and renovation projects than those found in the Building Code.

The use of energy-efficient supplies and renewable energy can reduce the use of fossil fuels and thus CO_2 emissions.

› **Gemeindezentrum in Ludesch; Vorarlberg, Austria, Hermann Kaufmann, 2006**
This cultural and community centre was constructed so that it meets the standards for passive-energy houses. The outer walls and roof were insulated with cellulose/paper (30 cm) and sheep's wool (10 cm). The building is heated by a pellet furnace, fired with a bi-product from the local wood-processing industry. A geothermal system pumps air 35 meters down into the earth, where there is a constant temperature of 7 degrees. The air is heated in the winter and cooled in the summer and circulated in the building's heating/cooling system. Water is heated by a solar-heating unit installed on the roof of the building. Electricity is supplied from a 350-sq-m. photo voltaic units mounted on the plaza in front of the building.

‹ **Integrated photo voltaic panels on youth flats, Århus, Denmark**
The southern façade consists of 84 photo voltaic panels which produces approximately 12 kWh/per year. As well as functioning as a cladding system and electricity producer, the elements allow air intake with the possibility of preheating the air, when the sun is shining.

Standards

Energy consumption in buildings
New construction and expansions must be carried out in keeping with low-energy class 2015, as set down in the current Building Code.

For major renovation projects, all energy measures that have a payback time of less than 10 years must be carried out. An evaluation must be made for measures with a payback time of up to 20 years with a view to making a concrete decision on implementing them. For local facilities that produce renewable energy, the payback time may be longer than 20 years, though no longer than the facility's lifetime.

For renovation projects, existing windows in buildings worthy of preservation should be retained. The U-value can be improved by for example adding removable windows or using coupled frames with super thermo glazing.

The following standards have been set for U-values for new and renovated windows:

Single-pane windows
- 2-layer pane: U = 1.4 W/sq. m.K. For windows smaller than 1 sq. m., the U-value may not exceed 1.2 + 0.2/A W/ sq. m.K, where A is the area of the window. The U-value may not, however, exceed 1.8 W/ sq. m.K.
- 3-layer pane: U = 0.9 W/ sq. m.K. For windows smaller than 1 sq. m., the U-value may not exceed 0.7 + 0.2/A W/ sq. m.K, where A is the area of the window. The U-value may not, however, exceed 1.3 W/ sq. m.K.

Four-pane windows
- 2-layer panes or removable/coupled frames with one pane (1+1): 1.7 W/ sq. m.K.
- 3-layer panes or removable/coupled frames with 2-layer super thermo glazing (1+2): 1.3 W/ sq. m.K.

The glass must not give colour distortion.

Changes to an existing building envelope that are aimed at optimizing energy use or the installation of systems for renewable energy must harmonize with the architectural style of the building and its surroundings.

Energy meters (electricity, heat, and water) and energy control should be used on the one hand to make users aware of their electricity and heating consumption and on the other to enable effective management. A remote-reading system (for example CTS) should be installed in all new buildings and when large buildings undergo thorough renovation.

When ventilation and heating stems are installed or renovated, the systems must be optimized for energy use so that an effect of at least 85% is achieved.

Lighting
Lighting with the lowest energy use and the lowest environmental impact should be used based on an evaluation of what is technically possible and economically feasible. This applies both to the renewal of old structures and the building of new ones.

Outdoor lighting instillations should be environmentally friendly light sources with a high lm/W ratio, i.e. and a high luminous efficacy in relation to the light source's energy use. Incandescent bulbs may not be used.

Outdoor lighting must be controlled by twilight relays to meet actual requirements.

Equipment in buildings
Energy use by equipment in buildings (lighting, appliances, standby, etc.) should be limited as far as possible.

The stipulations found on the website of the Danish Electricity Saving Trust (www.elsparefonden.dk) must be followed for the installation of household appliances (refrigerators, freezers, ranges, ovens, fans, washing machines, etc.).

Low-energy washing machines with water-efficient programs should be used in communal laundries. A user or payment system must moreover be put in place to ensure that the machines are used optimally.

There must be facilities for line-drying laundry where communal laundries are installed in new residential buildings.

Existing communal laundries and the option of line-drying laundry should be retained when buildings are renovated.

Town gas
When urban renewal is carried out, gas piping for cooking and gas ranges should be retained and/or renovated. It must be possible to use gas for cooking in all dwellings.

New buildings must be linked up with the town-gas network if the building is inside or adjacent to the supply area. It must be possible to use gas for cooking in all dwellings.

In addition, gas must be used in institutional kitchens and for dryers and mangles installed in communal laundries, institutions, etc.

A dispensation can be granted from using town gas where there is a documented risk or especially low consumption.

Collective energy supplies
Buildings should as far as possible be connected to the district-heating network to exploit the effective energy produced by waste incineration and the use of biomass. Heating facilities should be designed to achieve the effective cooling of return circulation.

Use
When delivery is made, personnel and other relevant users must be ensured instruction/training with a view to regular energy optimization.

There must be systematic follow-up of use and settings (times, temperatures, air volumes, etc.) of heating and ventilations systems and equipment upon delivery and at the one-year inspection.

Documentation

Documentation on the following is required:

- Documentation that the required low-energy class has been implemented must be submitted to the City's project manager at the latest when the application is submitted to the authorities.
- Documentation that a blower-door test and a thermo photography analysis have been carried out in new construction projects. In projects concerning existing buildings documentation should be supplied to guarantee that the climate shield has been renovated. Both of these should always be reviewed in conjunction with delivery (and possibly again after any construction defects are corrected) by an impartial company approved by the developer. This procedure can serve as the basis for follow-up and decisions on placing accountability if defects are found on delivery.
- Documentation must be submitted that the standards set for U-values have been met.
- For major renovation projects, documentation must be provided on what possible energy measures have been considered, along with their payback time, and which measures were carried out. A survey must be presented of derived CO2 savings in relation to the minimum standards in the Building Code.
- In new and renovated buildings, meters must be installed that automatically transfer consumption data to the City's energy-registration systems, administered by Copenhagen City Properties.

Materials and Chemicals

The choice and use of materials in construction and civil works has a great importance for the subsequent use and maintenance as well as for the health of the users and people living in them.

Construction and civil works are among the sectors with the highest consumption of raw materials. Although there is an exceedingly high level of recycling of materials from the construction sector in Copenhagen, this largely involves the recycling of limited, non-renewable raw materials that also have a negative impact on the environment when they are extracted, transported, and processed.

By making a careful choice of materials, proportions, and structures, the consumption of resources and the negative impact on the environment and health can be reduced significantly in the production and transport of materials, during the construction stage, everyday use, maintenance, and finally removal/recycling.

St. Gerolds community house, Vorarlberg, Austria, Cukrowicz Nachbaur
The four storey community house consists of a day-care centre, convenience store, a multipurpose room, and the mayor's office. All the buildings structural components are made of solid wood, wood, mainly from forest owned by the municipality and it is not treated with any preservation. The compact volume helps keeping the energy consumption very low. The building is practically self-supplied with energy.

Standards

Structures and materials must be chosen that are appropriate for the building's expected lifetime, so that there is a limited need for maintenance and there are good prospects for sustainable use (including cleaning), and so that the majority of materials can be recycled after removal.

No building materials or structures may be used that will probably have to be put into landfills after their lifetime if there are other suitable alternatives.

Suitable recycled materials should be used, if of a sufficiently high quality, instead of new raw materials, for example brick, concrete, stone, wood, steel, glass, etc., for, for e.g. filling, stabilizing, surfacing, etc.

No roofing or facade panels may be used that is made of metals that pollute the rainwater above a recipient's limits (e.g. copper, zinc, etc.) unless these materials have been given a surface treatment. (The standards must also be met by gutters and downspouts.)

No products or materials may be used that contain substances on the list of unwanted substances compiled by the Danish Environmental Protection Agency or Green Cities' list of problematic substances (i.e. brominated flame-retardants, chlorinated paraffin's, chlorinated solvents, mineral oil, nonylphenols, phthalates), if suitable alternatives are available. (See the link at the back of this booklet.)

Eco-labelled (e.g. Dansk Indeklima Mærkning, Nordic Swan, EU Flower) substances, building materials, and cleaning agents must be used where possible.

The structural protection of wooden structures and surfaces must be used as far as possible. Heartwood must be used for external structures if Nordic wood is used, and the wood must not be impregnated.

An FSC certificate or corresponding documentation must be provided when tropical wood is purchased.

Asphalt products must be chosen that contain bitumen without solvents, such as fluxed bitumen or bitumen emulsion.

Materials that pose a high health risk and environmental hazard during manufacture, use, and removal must not be used.

Use
A Manual must be compiled on the use of materials and methods for use and maintenance (including cleaning) that will contribute to optimal sustainable use.

Documentation

The choice of materials, etc. must be specified in the invitation for tenders. Documentation that the materials described have been used before must be provided in the quality-control information that the project manager reviews.

If divergences are made from these standards, reasons for doing so must be explained in conjunction with the environmental status report (sustainable project design). This also applies to the choice of structures, materials, and products for which there are no suitable alternatives and when materials are used, that currently must be disposed of in a landfill.

Water and Drainage

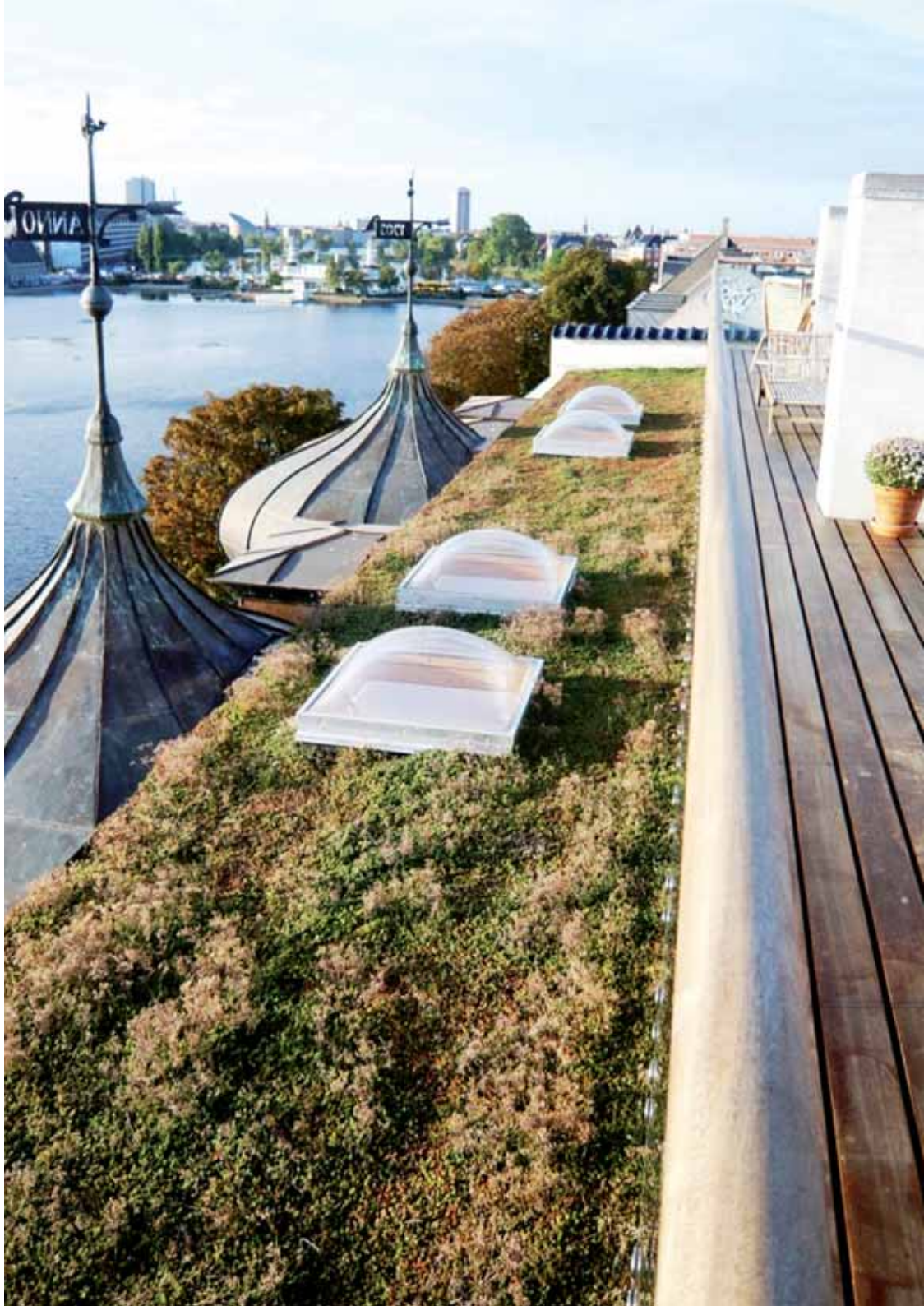
It is the City of Copenhagen's vision not to extract more drinking water than can be replenished. Water consumption must consequently be reduced. The goal is for average water consumption in 2012 not to exceed 90 litres per person per day in households and 30 litres per person per day in business and industry. By planning piping and choosing the right fixtures and equipment, lower-than-average consumption can be achieved in new construction and urban-renewal projects.

It is the City of Copenhagen's overall goal for rainwater to be discharged, channelled, and/or percolated locally in order to maintain the groundwater levels and qualities under the City that supplies it with drinking water and in order to augment the water in lakes and watercourses. (See the City of Copenhagen's wastewater plan, 2008.)

Climate changes and stricter environmental standards mean that in the future, sewers will be too small to accommodate the increased amount of rain. In order to prevent overloading the drainage system, the discharge of rainwater into the system must be reduced as much as possible. This will prevent bodies of water from being polluted by wastewater from storm-water releases and reduce the load on sewage-treatment plants. The City of Copenhagen has decided that these problems should be solved locally, so that rainwater is collected, used, evaporated, percolated, or discharged where it falls. Strategies of this type are called Sustainable Urban Drainage Systems SUDS (lokalafledning af regnvand (LAR) in Danish). The strategy will be used to adapt the City's discharge of rainwater to future climate changes as well as current conditions.

› **Peblinge Dosseringen 24; Copenhagen, Denmark, Byens Tegnestue, 2009**
A green roof was used for the first time on an historic multi-storey building in Copenhagen when a new roof terrace was added to it. There is a tradition in Denmark for using green roofs, but mostly on single family homes or small buildings. Now the technique has been developed so that mats are available with different plants. Some mats are so light that roofs do not need to be reinforced.

‹ **Augustenborg; Malmö, Sweden, Malmö Municipality, 2003**
3000 residents, 1800 units, 32 ha.
For many years, Augustenborg was plagued by flooded cellars sometimes as often as ten times a year. When the neighbourhood underwent community regeneration, the new landscaping included open channels, ditches, retaining pools, reeds and small lakes, through which rainwater runs, is delayed, collected, percolated, and eventually evapora-tes. These water elements and features allow rainwater to be used for recreation. Rain-water conducted in pipes under the asphalt ball court cools it in the summer and reduces energy consumption when it is transformed into an ice-hockey ring in the winter. The amount of rainwater lead to the sewage system has been reduced by 40%.



“8-tallet” The figure 8, Orestad South; Copenhagen, Denmark, BIG, 2010
The bowtie-shaped 61,000 m^2 mixed-use building of residential housing and 10,000 m^2 of retail and offices comprises Denmark’s largest private development ever undertaken. Budget EUR 92.000.000.

“8 House is a three-dimensional neighborhood ”. “8 House is our second realized example of architectural alchemy - the idea that by mixing traditional ingredients, retail, rowhouses and apartments in untraditional ways - you create added value if not gold. The mix allows the individual activities to find their way to the most ideal location within the common framework - the retail facing street, the offices towards northern light and the residences with sun and views to the open spaces. 8 House is a perimeter block that morphs into a knot, twisting and turning to maximize the life quality of its many inhabitants,” Bjarke Ingels, BIG

A continuous public path stretches from street level to the penthouses and allows people to bike all the way from the ground floor to the top (10th floor), moving alongside townhouses with gardens, winding through an urban perimeter block. Two sloping green roofs totaling 1,700 m^2 are strategically placed to reduce the urban heat island effect as well as providing the visual identity to the project and tying it back to the adjacent farmlands towards the south.
The roof also helps regulate and delay rainwater flow. The rainwater in Orestad which falls on roofs, facades and terrain is lead to the rural and the urban channels, basins and lakes, and finally ends in the wetlands south of Orestad. These wetlands constitute a large sanctuary for birds and wildlife.

Standards

Drinking water
In new buildings and in existing buildings where water pipes are replaced, individual water meters must be installed that can promote lower consumption and make it possible to set up green balance sheets. Individual water meters must be installed in existing buildings if the number of water meters can be limited to two per dwelling.

Communal laundries must use low-energy machines with water-saving programs. A user or payment system must be put in place to motivate the optimal use of the machines.

Pipes for both cold and hot water must be insulated and separated from heating pipes in service cores.

Piping must be installed so that leaks are visible and so that no more than 10 seconds elapse before a hot-water temperature of 55º C. is reached in the furthest hot-water tap in the building with a flow of 0.2 l/s. This is the best way to avoid wasting water.

Rainwater and drainage
Rainwater must be used to flush toilets and in washing machines in new buildings, though this is not permitted in hospitals, old-age homes, schools, hotels, or day-care institutions.

Unpolluted rainwater from roofs and impervious areas must be reused locally or, if possible, discharged into a natural or artificial body of water or percolated, in keeping with the principles laid down for SUDS in the municipal wastewater plan.

Rainwater that is used or discharged into bodies of water may not contain pollutant components in excess of the set limits for the recipient.

Polluted water from roads must be treated and discharged into bodies of water, where possible. Otherwise, this water must be conducted to the common sewer. The project must be approved by Copenhagen Energy's sewerage department.

Special standards for new buildings
For new buildings, the three-pipe system should be implemented as a possible SUDS principle. In this system, wastewater is conducted into three different pipes. Roof water must be used in buildings or else discharged into a natural or artificial body of water. Road water must be channelled into a local treatment unit for treatment before being discharged into a natural or artificial body of water. Gray water is conducted in a third pipe to the treatment plant.

For new buildings, SUDS standards must be met for all projects with a total area 300 sq. m. or more. A dispensation can only be granted if local conditions make it impossible to meet the standards.

Impervious areas must contribute to SUDS.

In urban-renewal or other subsidized projects, video cameras must be used to inspect the building's sewer system, to determine any need for renovation.

Before plastic water and drainage pipes are buried, information must be obtained from the Environmental Department on whether evidence of soil pollution has been found.

All indoor feeding pipes must be made of stainless steel. Outdoor pipes may be made of materials with a corresponding lifetime or longer.

New sewage systems must be dimensioned to take account of reduced water flow with the use of 2/4-liter combination flush toilets.

In new buildings, roofs with a slope of 30 degrees or less must be planted if reasonable conditions exist. When existing buildings are renovated, roofs must be planted if reasonable conditions exist (Green Roofs9.

The design that is chosen for roof areas must take account of other requirements for use as well as important technical and architectural considerations. An overall evaluation must also be made of all project measures aimed at the reuse of rainwater and sustainable urban rain-water systems.

Documentation

Drinking water
Water must be incorporated into the green balance sheet, to focus on the building's water consumption and allow the individual households to compare their consumption against the average.

Drainage
In cases where it is not possible to use the SUDS strategy and plant green roofs, the reasons for this must be documented and an in-depth study made of the consequences that this will have for the volume of the discharges and storm-water releases into the recipients. It might be necessary to delay the water on the property.

Townscape, City life and Nature

The spaces between buildings and the recreational areas, such as schoolyards, playgrounds, squares, plazas, parks, green areas, gardens, courtyards, gardens, roof tops, lakes, harbours, and coastal areas, are all of major significance for the city-dweller's quality of life and for people's understanding of their environment, and are a valuable resource for Copenhagen. The townscape must also promote sustainability by inviting to an exciting and diverse life in the city.

In urban renewal, renovation projects, and new construction, focus must be aimed at what the spaces will be used for, what is needed there, and how their use harmonizes with their surroundings. The aim is to optimize the use of every space.

It is important to develop and protect "green and blue values" in civil works and take them into account in the use of these spaces, for the benefit of Copenhagen's residents and visitors.

Sømærk, Teglværkshavnen; Copenhagen, Denmark, Vandkunsten, 2008
Sømærk in the South Harbour is one of the first residential projects in Copenhagen that takes an active approach to the harbour and water as a resource. The complex, with 120 units, consists of six long residential buildings, four of which stand on pillars in the water. This created three basins/gardens surrounded by jetties from which residents can safely take a swim. The buildings alternate between condominiums and public housing, but the residents share the parking and community centre.

Ecoboulevard, Madrid, Spain, [ecosistema urbano], 2007
The Ecoboulevard project in Madrid features a number of installations called “air trees,” which create shady areas that augment the boulevard’s trees until the saplings have grown big enough to provide shade. These artificial trees were designed as temporary structures that can easily be dismantled and moved elsewhere when they are no longer needed. The three “air tree” groups create cool outdoor spaces through natural ventilation by sucking air up through the structure. Photo voltaic units mounted on the roof provide them with energy. They give the area a distinctive identity and help create an active social space. When the boulevard’s trees are big enough, the “air trees” can be moved to another area and the space they had occupied appears to be like clearings in the boulevard’s forest of trees.

Krav

General
Sun, shade, wind, and turbulence must be studied during the planning stage.

When new buildings are planned and urban renewal is carried out, recreational facilities must be agreed upon at the same time as the building project. Decisions must be made at this stage on what green and blue areas will be incorporated into the project, and it must be ensured that new facilities harmonize with the City's overall green and blue structures.

An evaluation of the potential to promote good city life must be made for every project.

Outdoor, recreational areas and plazas must not be open to vehicular traffic or used for parking.

Bicycle racks and small buildings, for example sheds for refuse containers or bicycles must be integrated into new residential projects.

Lighting must help create a safe and secure everyday environment in Copenhagen. The standards set down in the City's strategy for lighting (www.kk.dk/byenslys) must be met for outdoor lighting in public areas and other places where the City is responsible for lighting.

Any contaminated soil that poses an environmental or health hazard must be removed as far as possible.

Where the landscape is altered by civil-works and renovation projects and where children, especially, can come in contact with the soil afterwards, the top half meter must consist of documented clean material. If play areas are designed with little hills, etc. that must withstand heavy use, they must be covered with one meter of documented clean material.

Earth fill and other fill materials must be documented as clean.

Nature
Green areas and structures must take into account preserving – and preferably expanding – the current biodiversity of flora and fauna and ensuring their optimal living and growth conditions. Links must be created between biotopes in surroundings areas.

Plants should be chosen so that they thrive under the given conditions and harmonize with the complex. Plans on how they will be cared for in the future must be incorporated as a parameter, to avoid excessive resource consumption. A large part of the greenery should be chosen from among trees and plants that are native to Denmark and suit the area in question. Plants should be chosen that reflect nature's cycle when they bloom, produce fruit, and change colour, and provide an attractive home for insects, birds, and other native wildlife.

Trees and plantings that are worthy of preservation are noted down by the City's experts. As a general rule, trees worthy of preservation are those that are more than 20 years old and can live at least 25 years longer. These trees may not be removed or pruned without permission from the City of Copenhagen, Parks and Nature Department. Soil around these trees may not be removed or replaced.

The growth conditions of trees worthy of preservation must be protected. No digging may be done in the trees' roots in the area under their drip zone, i.e. the area covered by the outermost rim of the crown.

The percentage of greenery compared with that of built and paved areas must as a minimum be maintained – and preferably increased – in the individual project.

Trees and flowerbeds must be protected against the harmful effects of environmentally hazardous substances. Trees and flowerbeds can be protected against salting by finishing the planting hole with a dense rim.

Trees in open soil beds and in closed paved areas must be planted in keeping with the City of Copenhagen's guidelines on planting trees. (The 2006 standards for landscape gardening must be met.)

Use
The City of Copenhagen does not use pesticides (approved by Dogme 2000 – Green Cities).

Weed control is carried out thermally (burning, steam), manually, mechanically, or by spreading weed-control fabric and wood chips.

The green area/biofactor and biodiversity must as a minimum be maintained – and preferably increased – in the management and maintenance of green areas.

The City must approve the articles of landowners' associations, courtyard associations, etc. in order to ensure the quality of use and maintenance.

Documentation

- The consultant and the developer must provide the necessary documentation that the relevant standards in this chapter have been met. This documentation must be submitted to the City's project manager at the latest when the project design has been drawn up and before an application has been submitted to the authorities or invitations for tenders have been sent out.
- Written documentation must be provided on how good growth conditions will be ensured. As a minimum, the latest revised norms for landscape gardening must be followed, including the norms for the size of plant holes and growth zones.

Waste

The City of Copenhagen wishes to reduce the impact on the environment among other things through sustainable waste management. The City also wants to ensure that its citizens are satisfied with how it handles waste management. Preventing unnecessary waste, recycling, increased sorting and innovative facilities in the townscape are important elements in meeting these goals.

The City of Copenhagen's waste plan for 2012 sets down the goals of future waste management and the waste-management system along with initiatives to be taken during the period covered by the plan. The plan also provides examples of measures to be taken in residential areas and what each individual can do.

For construction waste, see Chapter 9, The Construction Site. For waste in public areas, such as squares and parks, see the City of Copenhagen's website.

In the City of Copenhagen, 85% of construction waste is reused, 13% is incinerated, and 2% is land filled. Concrete is crushed and reused as aggregate for making new concrete or for road foundations, metals are separated and melted. Waste incineration supplies the city with 54% of its district heating. In addition, 13% of the city's electricity is provided by refuse incineration, biomass, and biogas.

Standards

Households
The necessary space must be set aside so that household waste can be sorted into a minimum of the following fractions:

- Food waste
- Paper (newspapers, direct advertising material, magazines, etc.)
- Cardboard
- Batteries
- Glass (bottles, jars, etc.)
- Garden waste
- Plastic packaging
- Metal
- Hazardous waste (leftover paint, etc.)
- Bulky waste (PVC, impregnated wood, electronic equipment,
- refrigerator/freezers, and other mixed bulky waste)

Bins for food waste must be placed inside buildings and paper must be collected in close proximity to residential stairwells. It would be most efficient to collect cardboard and batteries in the same place. The other fractions can best be collected for several buildings at a site within walking distance of all of them. Fractions that are not covered by the bulky-waste system, such as plastic, metal, and construction waste, can be transported from a common collection site to the waste station by the person responsible for waste management/janitor.

For hygienic reasons, the collection site for food waste should be placed further than five meters from windows on residential rooms or kitchens and should be located in the shade.

As a rule, 1/2 sq. m. per unit should be set aside for bulky waste, but an evaluation must be made each time, depending on the number of units, the condition of the site, etc.

Alternatives can be found, for example mobile suction, in small courtyards where special attention must be paid to recreational facilities or the work environment.

It must be possible to compost garden waste from recreational areas. Space must consequently be set aside for the purpose.

Use
Users must be given good and logical information on waste management. This can be provided by the janitor or another person responsible for waste management or through printed information and signs. Information can be obtained free of charge from the Environmental Department, either in person or by ordering it on the department's website. (See the link at the back of this booklet.)

Residents must be able to recycle directly and minimize waste at a "trading post" in the area set aside for bulky waste or e.g. using special shelves for recycling items.

Commercial and construction waste
Commercial waste must be sorted into all recyclable fractions, hazardous waste, incinerable waste, and waste to be land filled.

Permission must be obtained from the Environmental Department to recycle slightly contaminated surplus soil from a project on a building's own site. Clean surplus soil must be used in recycling before slightly contaminated soil.

The Environmental Department can require that special types of waste (e.g. slag from incineration) be recycled in large civil-works projects if use can take place under environmentally acceptable conditions.

Stone material must be crushed and reused on the site to the extent that the Environmental Department determines that this is acceptable considering the surroundings. Permission to do so will be granted by the Environmental Department.

The developer must ensure that the contractor sorts and minimizes the amount of construction waste and discarded materials through planning, building management, logistics, supervision, and quality control.

Buildings that have been demolished or renovated must be registered and a report compiled that confirms that environmentally hazardous materials and substances were sorted correctly. This registration must also cover waste that is directly recyclable.

All materials from construction or civil-works projects that involve demolition must be sorted and recycled as far as possible.

Optimal management and sorting of waste from construction and civil-works projects can be ensured by setting up a specific contract to manage waste and impacts on the environment.

Documentation

Documentation must be submitted along with the application to the authorities that the necessary space has been set aside for waste and that there is unimpeded access to permit waste to be collected without difficulty.

As noted above, the rule of thumb is for 1/2 sq. m. per unit to be set aside for bulky waste. The dimensions for bins for e.g. food waste and paper are found on the Environmental Department's website.

The waste solutions in buildings and housing close to a recycling waste station can be dimensioned differently. It must, however, be possible to reinstate the full sorting of all waste.

The environmental report and registration material must be submitted to the Environmental Department for approval.

Documentation must be submitted to the Environmental Department that the layout of the building site and organization of waste management ensure the optimal handling and sorting of waste from construction and civil-works projects.

Documentation must be provided for all forms of demolition work in accordance with the standards set by the demolition industry's control system in 1996.

Noise

Noise has a significant influence on our quality of life and our health. A leading goal of the City of Copenhagen is to reduce noise hazards as far as possible. External noise must be taken into consideration early in the planning stage.

For new construction, renovation projects, recreational areas, and in the conversion of existing buildings to other uses, care must be taken that buildings are located, organized, laid out, and constructed so that residents and users are protected against external noise from traffic and commercial activities.

The noise that arises from construction and civil-works projects must also be kept at a minimum.

Musée de Quai Branly, Paris, France, Jean Nouvel, 2006
Access to the Musée de Quai Branly is through a park that runs under the museum and up its facades, and thus becomes an integral part of the architecture. Jean Nouvel's transparent baffle wall forms the border between the Musée de Quai Branly's park and its bustling surroundings. The baffle wall provides a view of the park, so that it can be enjoyed by passers-by, but also shields it from traffic noise from the street.

Standards

In principle, when areas are converted for a new use and when new areas are incorporated into the urban space, functions sensitive to noise (housing, day-care institutions, schools, hospitals, recreational facilities, etc.) may not be placed in areas where the noise level is currently or is expected to exceed L_{den}58 dB from road traffic and L_{den}64 dB from railway traffic.

For public and private administration, the professions, etc. the noise may not exceed L_{den}63 dB from road traffic and L_{den}69 dB for railway traffic.

In new construction areas where the outdoor noise level will exceed these values, construction for functions sensitive to noise (housing etc) are permitted with a noise level up to L_{den}68 dB from road traffic, Care must be taken that buildings will be sited, noise walls be built, insulation be installed, units be designed, etc. to ensure that the indoor noise level from road traffic when the windows are open (0.35 sq. m.) does not exceed L_{den}46 dB in furnished bedrooms and living rooms. The corresponding level for noise from railways is L_{den}52 dB. All bedrooms and living rooms must have windows that can be opened yet meet these requirements at the same time. For urban-renewal and renovation projects in areas where the outdoor noise level will exceed these values and where it is deemed necessary, care must be taken that the indoor noise level meets these standards.

For infill, however, housing may be built where noise from traffic is up to L_{den}73 dB. It must, however, be possible to keep within these limits in outdoor recreational areas and indoors with partly open windows.

The noise level in outdoor recreational areas must not exceed L_{den}58 dB from road traffic and L_{den}64 dB from railway traffic. For housing with one or more outdoor recreational area directly adjacent to the unit, such as balconies, atria, terraces, etc., at least one of them may not exceed the limit value of L_{den}58 dB. Balconies with high noise levels are not taken into account in calculating recreational areas.

Institutions, schools, etc. must be built with secondary rooms along roads with heavy traffic, and their facades along these roads must be designed in such a way as to ensure that the indoor noise level with partly open windows is at most L_{den}46 dB. The limit applies to facades with teaching rooms, libraries, wards, etc. For outdoor areas, the limit of L_{den}58 dB is in force for schoolyards, playgrounds, etc. Higher noise levels are acceptable for football fields.

The corresponding standards for indoor noise levels with open windows in offices and hotels are L_{den}51 dB from road traffic and L_{den}57 dB for railway traffic. For offices, an assessment must be made of the necessity of having windows that can be opened or whether the necessary ventilation can be provided in other ways.

New traffic facilities must be located, designed, and if necessary screened off by noise walls so that the above standards can be met for buildings that are sensitive to noise and for recreational areas.

Dokumentation

In conjunction with the work of drawing up local plans and specific construction applications, the Environmental Department can itself assess the noise level, require that the developer make calculations, order the developer to take specific measurements and in special cases require that the developer carry out subsequent measurements, and calculations when the project is completed.

Indoor Climate

The indoor climate has a major impact on health and wellbeing because we spend much of our time indoors, at home and at work. The quality of our indoor climates depends on a variety of factors such as dust, gasses, noise, temperature, moisture, and light, which affect people differently, depending on their individual sensitivity. The indoor climate must consequently be given high priority in the design process and be evaluated considering the building's specific use.

Arkitema Head office, Aarhus, Denmark, Arkitema, 2003
The Arkitema building uses natural ventilation. Air comes in and is let out through openings in the roof. There is a mechanical backup system, which apparently has not yet been necessary. The advantage of taking the indoor climate into consideration from the beginning – and especially using natural ventilation – is that higher ceilings and better daylight are more feasible since the lowered ceilings and pipes required for mechanical ventilation are not needed. In addition, the roof can be used much better for a terrace, etc. when it is not cluttered with ventilation units.
Materials and acoustics were also taken into consideration. The floors in all transit areas are glazed concrete, while in the open working areas are covered with wooden blocks on end that muffle the sound of footsteps. The ceilings are wood wool/cement boards that hide an acoustic dampening system. The large atrium has a continuous acoustic dampening wall; a pressure chamber and acoustic cloth behind an upright plank wall. All these elements help dampen the hard sounds that are normally found in large areas with glass and concrete, making it possible for everyone to work and move around in the "same" space.

Standards

Since the indoor climate is given high priority in housing, day-care institutions, schools, etc., standards must be set for the relevant parameters for the indoor climate as part of sustainable project design. They can be based on the Danish Standards' class values for the indoor climate's qualities.

The following aspects must be reviewed and evaluated as part of sustainable project design:

- Orientation and layout
- Light, daylight, artificial lighting, glare
- Choice of materials, degassing, surfaces, colours
- Air quality, natural air exchange, and mechanical ventilation
- Sound, acoustics, noise
- The thermal indoor climate, type of heating, draft, thermal bridges, and chill (documented with thermo photography)
- Structures, air-tightness, radon

The following class values must not be exceeded:

- The CO_2 concentration must not exceed 700 ppm in housing, 1000 ppm in institutions, and 800 ppm in offices.
- Calculations of temperature conditions should show that the temperature is XºC +/- Y/ZºC. The operative temperature (ºC) in housing and offices must be 24.5 +/- 1.0 (summer) and 22.0 +/-1.0 (winter).
- Radon must not exceed 50 Bq/m^3 in housing, institutions, and offices.
- Formaldehyde must not exceed 0.15 mg/m^3.
- Wood-fired stoves may not be installed in living quarters because of particle pollution.
- Daylight must cover at least 11-20% of the glass area/floor space. Daylight must be >3% of the glass area/floor space of the workspace in large and complex rooms.
- Daylight must be provided for work and lounge areas, and suitable luminance conditions documented by calculating the daylight factor greater than 2.0 DF.
- The acoustics should at a minimum meet the standards in the Building Code. The reverberation time in classrooms and day-care institutions must be 0.4 seconds. The reverberation time in one-person cell offices must be 0.5 seconds. The absorption area in open-plan offices must be 1.1 x the floor space.

There must be individually adjustable thermostat-based temperature control of heating sources.

In new construction, soil or groundwater contamination must not give rise to problems with the indoor climate.

Potential problems with the indoor climate caused by underground contamination may as a rule not be alleviated through technical measures (membranes, ventilated drain pipes, or elevation on pillars). The contamination must be removed.

Materials and surfaces must be chosen so that they can be cleaned with agents and methods that do not have a negative impact on the indoor climate. They may not, for example, lower air quality.

Paint types and other surface treatment must be chosen that will give off the least possible amount of gas during the building's lifetime. Surface treatment must be diffusion-open and the MAL code must not exceed 00-1. A slightly higher MAL code may, however, be necessary with a view to durability or when restoration/renovation is carried out.

When new furnishings and equipment (TV, IT equipment, photocopiers, etc.) are purchased, special focus should be aimed at their effects on the indoor climate. Eco-labelled materials and cleaning agents or products that meet the same standards must be used.

Documentation

The above factors – orientation, light, choice of materials, air quality, thermal indoor climate, etc. – must be incorporated into sustainable project design and documented through it and in the form of the project description and drawings.

Construction Site

The construction and civil-works stage accounts for an important part of a project's total energy use and can result in a number of nuisances and inconveniences for the surroundings. Efforts should consequently be made to limit the use of energy and resources, decrease the amount of building waste, and minimize the nuisance from noise, vibration, and dust on and from the construction site. The environmentally sound management of construction sites can lead to significant environmental gains.

Specific standards must be set for the construction site in tender material for a given project. The developer's incentive for incorporating sustainable measures on the construction site is lower costs due to lower consumption.

London Olympics 2012
A building site creates a lot of waste/debris from demolishing, especially from a site of this magnitude. It has therefore been decided to recycle these materials. Another part of the Olympic project is the participation and involvement of the local community. Not only in the design itself, in creating jobs for the members of community, but especially with emphasis on how the area (quite a poor area) can benefit from this event in the years to come, from the housing for the athletes, parks, playgrounds, sports facilities , infrastructure and the event itself.

Standards

Planning construction
The developer must, in collaboration with the consultant and contractor, use construction-site planning and the choice of work methods, machinery, and the organization of the construction site to ensure that the surroundings are bothered as little as possible by noise, vibration, air pollution, dust, and odours from the construction site.

The contractor must be encouraged to minimize transport to and from the construction site.

The developer must give written notification to the surrounding households, institutions, etc. about the project's purpose, character, and time horizon. A proper information strategy must be devised for major and protracted construction/renovation projects that will ensure that contact with neighbours is made in advance and maintained throughout the construction and civil-works stages.

All construction and civil-works projects that produce noise and dust must be notified to the Environmental Department at least 14 days before commencement. See:
http://www.kk.dk/Erhverv/LoveOgRegler/ForsyningOgMiljoe/-edia/4ACB096AC7474EC3AA03669F7E6403.ashx

Noisy construction and civil-works projects may only be carried out on weekdays between 7 a.m. and 6 p.m. The Environmental Department can, in special cases, grant a dispensation for work outside this time period when construction and civil-works projects cannot be carried out within this time frame for reasons of safety, traffic conditions, or technical considerations.

Safeguarding against pollution
Diesel-powered vehicles weighing over 3.5 tons must be outfitted with certified particulate filters. Work machines with an effect of over 75 kW must be outfitted with filters of the same efficiency. Vehicles with motors approved in keeping with the Euro IV or Euro V standard are exempted from this requirement.

The current guidelines, instructions, and permits from the Environmental Department must be followed in handling soil and groundwater in construction and civil-works projects.

Protecting plantings
Fencing around the construction site must be at a distance from tree trunks that corresponds to the size of the crown when trees stand in a soil bed.

Space that will be used for green areas must be protected e.g. by setting aside construction, work, and protection zones so that the natural permeability and structure of the mulch are retained.

Growth conditions must be ensured by watering during the construction period.

Documentation

For construction and civil-works projects, the developer, in collaboration with the contractor, must provide documentation on the following in construction-site plans:

- How transport, energy use, and pollution can be minimized when materials and soil are conveyed to and from the site
- How the use of energy, water, and fuels can be reduced
- What information strategy has been chosen

The developer must document how planting worthy of preservation will be protected during the construction period.

The developer must be aware that the documentation – i.e. all of the points listed above – can be written into the project's invitation for tenders as competition parameters.

List of legislation and regulations

Lov om byfornyelse og udvikling af byer, lov nr. 1234 af 27-12-2003 med senere ændringer, lovb. 523 af 06-06-2007, lovb. 436 af 29-05-2008 og lovb. af 09-09-2008

Lov om almene boliger m.v., lovb. 1000 af 09-10-2008

Lov om ældreboliger, lovb. 907 af 26-09-2005

Lov om miljøbeskyttelse, lovb. 1757 af 22-12-2006

Byggelov, lovb. 452 af 24-06-1998

Lov om planlægning, lovb. 1027 af 20-10-2008

Lov om forurenet jord, lovb. 282 af 22-03-2007

Jordflytningsbekendtgørelsen nr. 1479 af 12-12-2007
(Bekendtgørelse om anmeldelse og dokumentation i forbindelse med flytning af jord)

Affaldsbekendtgørelsen nr. 1634 af 13-12-2006
(Bekendtgørelse om affald)

Genanvendelsesbekendtgørelsen nr. 1480 af 12-12-2007
(Bekendtgørelse om genanvendelse af restprodukter og jord til bygge- og anlægsarbejder)

Lov om bygningsfredning og bevaring af bygninger, lovb. 1088 af 29-08-2007

Lov om fremme af energibesparelser i bygninger, lov nr. 585 af 24-06-2005

Kvalitetssikring af byggearbejder, lovb. 169 af 15-03-2004

Lov om afgift af affald og råstoffer, lovb. 1165 af 27-11-2006

Lov om CO_2-kvoter, lovb. 348 af 09-05-2008

Lov om betalingsregler for spildevandsanlæg, lovb. 281 af 22-03-2007

Lov om vandkvalitet og tilsyn med vandforsyningsanlæg, lovb. 1449 af 11-12-2007

Lov om individuel måling af el, gas, vand og varme, lovb. 565 af 01-07-1997

Varmeforsyningsloven, cirkulære nr. 5020 af 30-11-1988
www.retsinfo.dk

Bygningsreglement BR08
www.ebst.dk/bygningsreglement

SBI-anvisning nr. 216 – anvisning om bygningsreglement 2008

SBI-anvisning nr. 196 – Indeklimahåndbogen

SBI-anvisning nr. 219 – Dagslys i rum og bygninger
www.sbi.dk

Normer og vejledninger for anlægsgartnerarbejde 2005
www.danskeanlaegsgartnere.dk

Affaldsdirektiv 2008 (EU-direktiv)

Regeringens affaldsstrategi 2009-2012 1. del af 19-11-2008

Gasreglementet 2005, Sikringsstyrelsen
www.sik.dk

Regulativ for husholdningsaffald, senest revideret 30-11-2006
www.kk.dk/affald

Regulativ for erhvervsaffald, senest revideret 25-05-2000
www.kk.dk/affald

Regulativ for forurenet jord i København 01-04-2008
www.kk.dk/erhvervsaffald

Bestemmelser for levering af vandforsyning fra Københavns Vandforsyning 01-01-2007
www.ke.dk

Arbejdstilsynets At vejledning D.2.24 om indretning og brug af dagrenovationssystemer

Arbejdstilsynets anvisning af implementering af støjstrategien ved bygge- og anlægsopgaver
www.at.dk

Vejledning i håndtering af forurenet jord på Sjælland, juli 2001 med senere ændringer

Miljøstyrelsens Vejledning nr. 5/1984 Tabel I-III (ekstern støj)
Vejstøjsvejledning nr. 4/2007
(støjdæmpende asfalt, nedsættelse af farten og støjisolerende vinduer)

Tropisk træ – miljøvejledning 2003, Skov- og Naturstyrelsen

Miljøstyrelsens skrivelse af 27. marts 1990 om anvendelse af rent, sorteret bygningsaffald til bygge- og anlægsformål

Anvendelse af opbrudt asfalt til vejbygningsformål m.v.
Cirkulæreskrivelse af 15-07-1985
(genanvendelsesbekendtgørelsen)

Links

Sustainability in Construction and Civil Works 2010
www.kk.dk/MBA2010

Environmental management
Standards and regulations for various environmental aspects like construction sites, restaurant, cooling and ventilation plants etc.
www.kk.dk.miljoehaandtering

Green Cities' list of problematic substances
www.dogme2000.dk

Sustainable Urban Drainage Systems (SUDS)
SUDS methods and solutions
www.kk.dk/lar

Lightning in the city
www.kk.dk/byenslys

New projects by the City
www.kk.dk/borger/byog trafik/anlaegsprojekter.aspx

Waste
www.kk.dk/affald

The construction site
www.kk.dk/byggeplads

Sustainable Construction
www.danskbyokologi.dk

Dansk Standard
www.ds.dk

Sustainable Cities
www.sustainablecities.dk

Illustrations

The samples has been collected by Centre of Industrial Architecture and the City of Copenhagen, Urban Design Department, Environmental Department and Parks and Nature Department

page	site	photographer/copyright
Front-page	Universet (the Universe), Meinungsgade Copenhagen, Denmark	JJW Arkitekter
12-13 og 15	Lystrup Aarhus, Denmark	Jens V. Nielsen
20-21	Silkeborgvej Aarhus, Denmark	Jens V. Nielsen
23	Ludesch Vorarlberg, Austria	Bruno Klomfar
28-29 og 31	Vorarlberg Austria	Gustavo Ribeiro
34-35	Augustenborg Malmö, Sweden	Jan Burgdorf Nielsen
37	Peblinge Dosseringen 24 Copenhagen, Denmark	Jens Harild
39	The figure 8 Orestad South, Copenhagen, Denmark	BIG Jens Lindhe

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44-45 og 47	Teglværkshavnen Copenhagen, Denmark	Tøger Nis Thomsen og City of Copenhagen
49	Ecoboulevard, Madrid, Spain	[ecosistema urbano]
54-55 og 57	Margretheholm (demolition), Amagerforbrændingen, Copenhagen, Denmark	City of Copenhagen
62-63 og 65	Quai Branly Paris, France	Centre of Industrial Architecture
68-69 og 71	Arkitema office Aarhus, Denmark	Arkitema
76-77 og 79	Olympic Stadium London, England	London 2012

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