

# GREEN ROOFS **COPENHAGEN**



This Congress booklet has been produced by The Technical and Environmental Administration in City of Copenhagen. Chapters in this booklet have been undertaken by a team lead by M.Sc. Biologist Dorthe Rømø, Project Manager of Green Roofs Copenhagen, with a special thanks to Rachels Mary MacIntyre, Architect MAA, LEED AP BD + C and all colleagues involved.

# GREEN ROOFS **COPENHAGEN**

# FOREWORD



Green roofs are on the agenda worldwide as part of a growing effort to meet the challenges that we face, including climate change, more dense cities and the need for healthier neighbourhoods. Green roofs are unique as a green infrastructure element. They can bring about a multitude of benefits in a single location without reducing development space. Green roofs cool our cities, enhance biodiversity and reduce the rain-water runoff. They also bring beauty to what otherwise can be very grey places.

Copenhagen has been inspired by the world’s leading cities and has since 2008 focused on integrating green roofs as part of urban development. This process has involved learning from and sharing with colleagues throughout the world and it has been extremely worthwhile.

The City of Copenhagen has mandated green roofs in most new local plans since 2010. Green roofs are an important part of our city’s strategy to meet the challenges of climate change, to enhance biodiversity and to create a greener city.

Strolling through Copenhagen you will encounter green roofs of all scales, from cycle shelters, to schools and mixed use buildings to landscapes above underground garages. This Congress booklet includes a few of these many projects and describes some of the local plans that mandate green roofs.

**MAYOR OF THE TECHNICAL AND ENVIROMENT ADMINISTRATION**  
*Ayfer Baykal*

A stylized signature in grey ink.

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# BENEFITS OF GREEN ROOFS

## **GREEN ROOFS – SUSTAINABLE, CLIMATE-ADAPTED URBAN DESIGN**

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Ever more dense cities, climate changes and a sustainable future call for innovation in the way in which we structure our cities.

Green roofs provide us with a unique chance to transform thousands of traditional roof surfaces to green life-giving oases.

Green roofs support biodiversity. They lead to larger quantities of rainwater being absorbed in a sustainable way and can curb the rise in temperatures at the same time. Green roofs are therefore part of the City of Copenhagen's Climate Plan and Climate Adaptation Plan. Green roofs also create habitats for animals and plants and in this way support biodiversity. For these reasons, they have become integrated in the City of Copenhagen's Strategy for Biodiversity.

### **Urban design of the future**

Green roofs are the seeds of future urban design with a potential for creating desirable buildings, cities with high standards of living, and cities in several levels which are braced for the challenges of the future. We can increase the roof space ratio and the amenity value by transforming the roofs to utilized spaces, such as for instance green parks, vegetable gardens, or beautiful green vistas.

## WHAT IS A GREEN ROOF?

Green roofs are covered with vegetation such as stonecrops, mosses, perennials, shrubs, or trees.

### From soil to green roofs

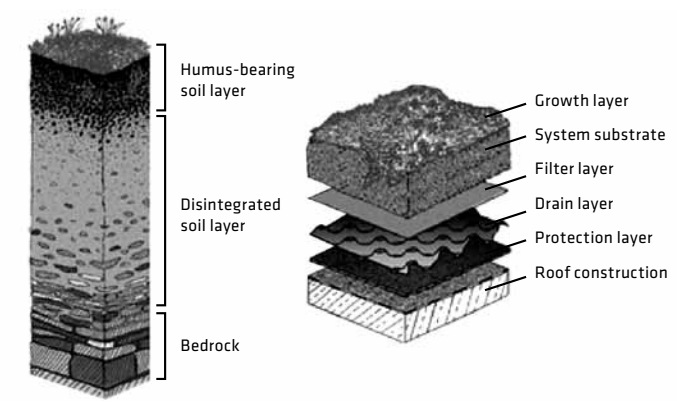


Illustration of how a green roof construction may look, [www.igra-world.com](http://www.igra-world.com)  
The choice of vegetation determines the thickness and thereby the weight of the green roof, and different degrees of maintenance are required, depending on the vegetation.

Type of green roofs	Extensive	Semi-intensive	Intensive
Use	Environmen- tal landscape	Gardens/ environmen- tal landscape	Gardens/ parks
Type af vegetation	Mosses, herbs, grass	Grass, herbs, shrubs	Lawn, peren- nial plants, shrubs, trees
Watering	None	Periodically	Regularly
Depth of substrate	60-200 mm	120-250 mm	150-400 mm
Weight	60-150 kg/m	120-200 kg/m	180-500 kg/m
Costs	Low	Middle	High

The choice of plants, thickness, weight, and maintenance are connected.

## GREEN ROOFS CREATE HABITATS FOR ANIMALS AND PLANTS

Green roofs transform traditional roofs to life-giving green oases. They provide habitats for animals and plants.

If you aim explicitly at making a green roof which supports biodiversity, you should choose different growth media and depth on the roof as well as indigenous species, and add some stones and old twigs on which the insects can live.

Green roofs are part of the City of Copenhagen's Strategy for Biodiversity.

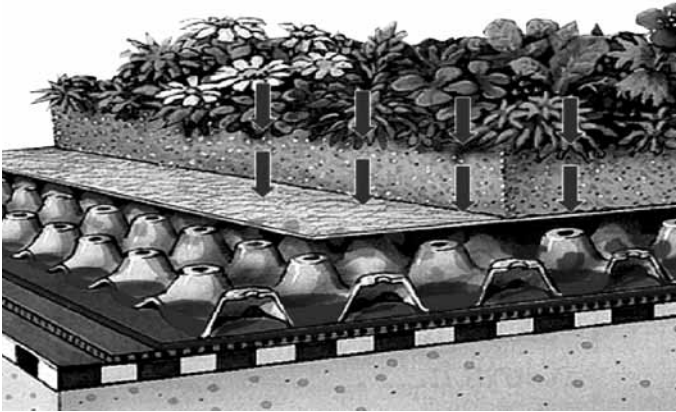


## GREEN ROOFS ABSORB RAINWATER

Green roofs absorb the rainwater, and some of it evaporates. The roofs can absorb between 50 and 80 % of the annual rainfall.

If it rains a lot, the green roofs delay the water on its way to the sewers. This means that rainwater which would otherwise have an adverse impact on the sewers does not reach the sewers until there is enough space for it.

For this reason, green roofs form part of the Climate Plan and the Climate Adaptation Plan of the City of Copenhagen.



Green roofs and rainwater treatment. Illustration from [www.igra-world.com](http://www.igra-world.com)

## GREEN ROOFS REDUCE TEMPERATURES IN CITIES

Green roofs help reduce the Urban Heat Island effect in built-up areas which are notably warmer than the surrounding areas.

By transforming the black heat-absorbing surfaces of the cities to surfaces with vegetation we can reduce the temperatures in the cities a couple of degrees.

Green roofs also contribute to reducing the temperature in buildings during the summer, and thanks to this the indoor environment is improved.

## GREEN ROOFS INCREASE THE FUNCTIONALITY OF BUILDINGS AND CITIES

If we turn our eyes towards the sky, we will see several thousands of square metres of unexploited potential on the cities' roofs – in other words, a vast potential for transforming our traditional cities to green life-giving oases. Here lie the seeds of future urban design.

### Cities with high standard og living

Green roofs provide us with a possibility of creating desirable buildings, cities with high standards of living, and cities in several levels which are braced for the challenges of the future.

We can add increased value to the building industry and our cities by transforming the roofs to recreational areas, such as for instance running tracks in green surroundings, green parks, vegetable gardens, etc.



# DESIGN, SPECIFICATION, INSTALLATION, AND MAINTENANCE

## Step 1 / Correct design

- Decide the scope of the green roof
- Check the climate-dependent factors
- Check the construction of the building, the load capacity, and the pitch of the roof
- Plant-dependent factors

## Step 2 / Correct specification

- You get what you ask for
- Define which needs the roof must fulfill, and which landscape you want
- Specify which growth medium you want

## Step 3 / Correct installation

- Use specialists

## Step 4 / Correct maintenance

- The key to consistent success is correct maintenance
- Check drainage conditions once or twice a year
- Remove unwanted growth



Green roof on the exhibition hall in Basel. The green roof is designed to support biodiversity



# GREEN ROOFS POLICY AND PLANNING IN COPENHAGEN

Back in 2008 the City of Copenhagen began focusing on alternative ways to handle rainwater and the Wastewater Plan 2008 became the first plan document that included approaches in that direction. In 2009 Denmark was in charge of the UN Climate Change Conference COP15 which defined the framework for the strategies that could be implemented to meet the challenges of climate change. During that period, the focus on green roofs intensified setting a goal for urban design with green roofs in the Climate Plan of the City of Copenhagen. Since then Green Roofs have become integrated in different guidelines such as the guidelines for Sustainability in constructions and Civil works, which mandates green roofs for all the Municipalities buildings. Green roofs are also a part of the city's Strategy for Biodiversity.

Since 2010 green roofs are mandated in most new local plans. A calculation based on approved new local plans mandating green roofs gives a total of 200.000 m<sup>2</sup> of green roofs to be installed.

Today The City of Copenhagen has more than 40 green roofs. Some of these projects and local plans are described in the following pages.



# PROJECTS CASES

## RESIDENTIAL

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# 8 - HOUSE

## Significance to Copenhagen

With spectacular views towards the Copenhagen Canal and over Kalvebod Fælled’s protected, open spaces, 8 House will not only be offering residences to people in all of life’s stages as well as office spaces to the city’s business and trade - it will also serve as a house that allows people to bike all the way from the ground floor to the top, moving alongside townhouses with gardens winding through an urban perimeter block.

Two sloping green roofs totalling 1,700 m² at the 8 House 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 roofs play with contrasts between nature and architecture, as do the planted balconies. The large sloping sedum roofs seem to pull the fields of the nature reserve over the building, cloaking it in an air of biodiversity. These extend down almost to ground level from the twelfth floor on a gentle 30 degree incline, adding drama and appeal to the development but also reducing its visual impact at the sensitive south edge where Ørestad ends abruptly at the nature reserve. The dipping of the wings of the building allows views of the drainage canal, grazing cows and reed beds beyond from the residential courtyard.



**NAME** 8 House **ADDRESS** Richard Mortensens vej 81 **ROOF AREA** 1700 m² of extensive roof and 1 m² x 100 semiintensive gardens  
**BUILD COST** EUR 92 000 000 **CLIENT NAME** St. Frederikslund Holding **DEVELOPMENT TYPE** Mixed Use residential building  
**DATE COMPLETED** December 2010 **ARCHITECT** BIG – Bjarke Ingels Group **LANDSCAPE ARCHITECTS** KLAR **STRUCTURAL ENGINEER** MOE & BRØDSGAARD **SYSTEM SUPPLIER** Veg Tech A/S, P. Malmos A/S

# BIRKEGADE PENTHOUSES AND ROOFTOP TERRACE

## Key Drivers

Optimization and utilization of the city roof Elmegade district is probably one of the most densely populated areas of inner Nørrebro, CPH. Especially the triangular block between Birkegade / Egegade / Elmegade has a very high density, which is reflected in very narrow courtyards.

And it is precisely around the cramped courtyard that the concept for BIR originates. The driving concept is to create the 'missing garden' at the top of the existing housing block in association with 3 new penthouses, so all residents gain access to a genuine outdoor garden.

In order to qualify 'the missing garden', JDSA took inspiration from the Copenhagen gardens, which characteristically has an associated functionality. Therefore, a rooftop garden is designed as a space of functions and an associated materiality.

This is reflected in a playground with shock-absorbing surface and a playful suspension bridge, a green hill with varying accommodation backed by real grass and durant vegetation, a viewing platform, an outdoor kitchen and barbecue, and a more quiet wood deck.

The concept for the BIR, is to optimize and fully exploit the situations the site has to offer, and thereby design a potential for the future exploitation of the roof to the delight of all the co-op's residents. It is a concept which is not limited to establish the 3 new apartments, but a concept which both creates a useful roof garden as well as a beautiful landscape for the co-op's neighbours and city residents in general.

Usually a roof defines a final measure of any construction – closure. In the near future the Birkegade roof will open up for a versatile stay and experience.



**NAME** Birkegade Rooftop Penthouses **ADDRESS** Birkegade 4-6 **ROOF AREA** 900 m<sup>2</sup> **BUILD COST** 950 000 EUR (7 000 000 DKK) **DEVELOPMENT TYPE** Commission for A/B Birkegade for a rooftop terrace and penthouses on a historic residential building **DATE COMPLETED** Completed 2011 **ARCHITECTURAL COLLABORATION** PLOT=JDS+BIG, EKJ **SYSTEM SUPPLIER** Veg Tech A/S

# NØRREBROGADE 184

### Key Drivers

To promote and support many of Copenhagen City’s strategies including; strategy for biological diversity, Copenhagen’s Climate Plan 2025, Climate Adaption Plan, A Greener Copenhagen and the strategy for Sustainable Urban Renewal.

### Development benefits

Increase biodiversity locally, reduce water runoff, and create an aesthetically pleasing roof for the neighbouring buildings.

### Significance to Copenhagen

The green roof is a pilot-project for Copenhagen’s Building Renewal which provides a platform for further research on how to incorporate a bio diverse green roof on an existing roof and how to incorporate it into historic heritage buildings.

### Planning Authority

Copenhagen City



**NAME** Nørrebrogade 184 **ADRESS** Nørrebrogade 184 **ROOF AREA** 100m<sup>2</sup> **CLIENT NAME** Pecunia Miim Anpartsselskab  
**DEVELOPMENT TYPE** Renovation of a historically listed residential and commercial rental property **DATE COMPLETED** July 2012  
**ARCHITECT** SBS Rådgivning A/S in partnership with Centre for Urban Design and Centre for Park and Nature, Copenhagen City  
**LANDSCAPE ARCHITECTS** SBS Rådgivning A/S **SYSTEM SUPPLIER** P. Malmos A/S

# ROOF OF A WAREHOUSE, NORDRE TOLDBOD

### Key Drivers

To open up a new recreational area to the public and many visitors on Langelinje.

### Development benefits

The green roof is also a part of the climate adaption process, where the plants and soil restrain the water. It also improves the climate in the underlying warehouse building. Less rain-water in the sewer system means less pollution by sewage in the water.

### Significance to Copenhagen

Langelinje is a place visited by many people, and it is important to show environmentally friendly solutions to some of the grave challenges we face in the form of adapting to the coming climate changes.

### Planning Authority

Copenhagen City



**NAME** Warehouse **ADRESS** Nordre Toldbod 24, behind Gefion Fountain **ROOF AREA** 1900 m<sup>2</sup> **CLIENT NAME** By & Havn/ cph City & Port **DEVELOPMENT TYPE** Renovating the flat rooftop area of an old warehouse and opening it up for public access. The roof was secured, insulated and partly planted with sedum. **DATE COMPLETED** 1. of November 2009 **ARCHITECT** Einar Madvig / Tine Mouritsen **STRUCTURAL ENGINEER** Orbicon **SYSTEM SUPPLIER** Byggros A/S / Nykilde ApS

# THE CITY DUNE - ACCLIMATIZED URBAN SPACE IN COPENHAGEN

## Key Drivers

The demands and the programme for the urban space were many and apparently mutually exclusive: The urban space is privately owned by SEB Bank & Pension, but was (by the request of the bank) to be fully open for the general public; it should rise 7 meters up to the coming high line, but also be of use at street level; it should incorporate needs as different as parking spaces, recreational spots for employees and guests, full accessibility for the walking impaired, provide the SEB Bank & Pension with a distinctive urban brand, and, most importantly, it had to be fully sustainable and 100 percent acclimatized with regards to the handling of rainwater. All in all the demands to SLA were to create a privately owned but fully open quality urban space in a central part of Copenhagen that at the same time should handle all the different demands and needs of the programme.

## Development benefits

The City Dune is Copenhagen’s first fully acclimatized urban space, transforming the challenges of climate change into urban amenities such as the recreational use of rain water and the natural cooling of temperature rises. But most importantly, the City Dune is a model example of the democratization of privately owned space in our cities: By demonstrating the corporate value for the SEB Bank & Pension in investing in public urban spaces, The City Dune shows how private corporations and municipalities can cooperate in creating open urban space of high value to the public as well as the private land owners.

## Significance to Copenhagen

The City Dune and the new SEB Bank Head Quarter has won several prizes: The RIBA Award, The Danish Arne Jacobsen Prize, and The Copenhagen Municipality Award for Beautiful Urban Spaces. But the most important ‘prize’ is that the Copenhageners have taken the new urban space to their hearts as a green, democratic and recreational urban space in the middle of the city. Thus The City Dune provides not only sustainability, infrastructure and transit; it also gives a much needed green recreational value to a part of Copenhagen long neglected by city planners.

## Planning Authority

Copenhagen City



**NAME** The City Dune – SEB Bank Copenhagen **ADRESS** Bernstorffgade 50 **ROOF AREA** 7.300 m<sup>2</sup> **BUILD COST** 35 millions  
**CLIENT NAME** SE Bank & Pension **DEVELOPMENT TYPE** New headquarters for SE Bank in Copenhagen **DATE COMPLETED**  
July 2010 **LANDSCAPE ARCHITECTS** SLA **STRUCTURAL ENGINEER** Rambøll **SYSTEM SUPPLIER** Skælskør Anlægsgartnere  
**FURTHER INFORMATION** [www.sla.dk](http://www.sla.dk)

# THE NEW NATIONAL ARCHIVES

### Project description

The roof terrace of the Danish State Archives is a part of the future elevated pedestrian passage, accessible to the public, which will connect two areas in the Centre of Copenhagen. The roof terrace has an area of approximately 220 x 30 m. The area is defined by two large record storage buildings on one side and the façade of an older building, containing offices for the Danish National Railway (DSB) on the other. The roof terrace of the State Archives is the first from among, at least four other sections of the passageway to be realized. In the coming years, the planned elevated passage will be completed, stretching approximately 900 m in total.

The primary purpose of the roof garden is to provide a pedestrian passage for the public, and to create a quiet garden in a central area of Copenhagen, close to the Port of Copenhagen and the Central Station. The objectives were to create a sustainable urban park by optimizing on the environmental conditions. These objectives influenced the visual design by minimizing the areas with hard surfaces and by using a wide range of different plant species. Technically the roof garden has been constructed in a way that leads all precipitation water through the growth media and the reservoir plates, before the excess water reaches the drainage system. These technical solutions optimize the reservoir effect and hold back up to 70 % of the water on an annual basis and increase natural evaporation.

### Development benefits

The greenways adds a recreational and landscape space between the area’s large buildings. The roof garden increases biodiversity, collects rainwater and helps stabilize the temperature of the archive buildings.

### Significance to Copenhagen

Brings landscape and publicly accessible space into an area characterized by large building volumes with an industrial character, and creates a functional garden with a delicate connection to the brickwork of the National Archives storage facility.

### Planning Authority

Copenhagen City



**NAME** The new national archives **ADRESS** Kalvebod Brygge 32 **ROOF AREA** ca. 7.000 m<sup>2</sup> **CLIENT NAME** OPP Pihl Arkivet A/S  
**DEVELOPMENT TYPE** Construction of a new storage facility for the National Archives building and rebuilding of DSB’s former Freight Terminal with construction of new offices on the lower floors **DATE COMPLETED** 2009 **ARCHITECT** PLH Arkitekter  
**LANDSCAPE ARCHITECTS** Schønherr A/S **STRUCTURAL ENGINEER** Grontmij **SYSTEM SUPPLIER** P. Malmos A/S

# TCC – HOTEL AND PUBLIC ROOF GARDEN

### Key Drivers

To create a lush roof landscape that is both beneficial to hotel guests and locals. A landscape that is fully accessible to all types of users, and a landscape that supports Copenhagen’s sustainable strategy.

### Development benefits

To create a large roof area with great diversity - large trees and a fertile bottom vegetation. All rainwater is collected and reused for watering plants, thus supporting the city’s sewer system.

### Significance to Copenhagen

TCCs landscape is a new park in Copenhagen - a park that is lifted up to second floor. Where there is light, air, a view of Copenhagen’s skyline, harbor, railway land and a good case study for the green development of Copenhagen.

### Planning Authority

Copenhagen City



**NAME** TCC – Tivoli congress centre **ADRESS** Arni Magnussons Gade 2 **ROOF AREA** 7.000 m<sup>2</sup> **BUILD COST** 18 millions **CLIENT** ARP-HANSEN HOTEL GROUP **DEVELOPMENT TYPE** New hotel in Copenhagen **DATE COMPLETED** May 2010 **LANDSCAPE ARCHITECT** SLA **STRUCTURAL ENGINEER** EKJ **SYSTEM SUPPLIER** P. Malmos

# HENKEL / CARL JACOBSENS VEJ, VALBY

### Key Drivers

Copenhagen Municipality’s Local Plan for the area requires green roofs on planned new buildings and the local diversion of rainwater within the area of private ground. Since this is a renovation, there was no requirement for green roofs, but the decision was made to install the green roof as it would benefit the site by alleviating drainage problems and also lower the temperature inside the building by 1 degree, it was also the best option in the choice of roofing material.

### Development benefits

Reduce water runoff, and create an aesthetically pleasing roof for the neighbouring buildings. Architecturally the building makes a clear statement demonstrating how heritage buildings and sustainability form a new typology.

### Significance to Copenhagen

This is a prime example of how to incorporate a bio-diverse green roof on an existing roof and how to incorporate it into historic heritage buildings.

### Planning Authority

Copenhagen City



**NAME** Henkel **ADRESS** Carl Jacobsens Vej 29-37 **ROOF AREA** ca. 3.000 m<sup>2</sup> **CLIENT NAME** Søtofttegård Sjælland A/S and St. Frederikslund **DEVELOPMENT TYPE** Renovation and conversion of an old soap factory into offices and for commercial use. The building falls under the 110 industrial buildings categorised as landmark buildings in Denmark. **DATE COMPLETED** 2011 **ARCHITECT** Arkitema Architects **LANDSCAPE ARCHITECTS** Arkitema Architects **STRUCTURAL ENGINEER** Esbensen Civil Engineer and Sloth Møller Civil Engineer

# TAGENSBO SKOLE – MULTIFUNCTIONAL HALL

### Key Drivers/ Motivators

The primary intent has been to create an exciting recreational area for children in a densely populated area of Copenhagen and simultaneously further various planning-strategies of Copenhagen City such as: “Strategy for biological diversity”, “Copenhagen Climate plan 2025”, “Climate adaptation plan” and “A greener Copenhagen”

### Development benefits

The main benefits of a multifunctional roof are the added out-door facilities for the school and neighbors to use and enjoy. The green roof space adds an airy atmosphere to the density of the city and offers aesthetically pleasing views to the residents in the neighboring buildings. The roof also acts as a bio-agent as it is a retainer for surface water.

### Significance to Copenhagen

The green multifunctional roof offers a meeting point for neighbors and users of the school. The creation of new green areas encourages future development of a greener and more sustainable cityscape to the benefit of the residents. In view of future climate changes the green roof area acts as a retainer for surface water and subsequently reduces the strain on the City drainage system.

### Planning Authority

Copenhagen City



**NAME** Tagensbo skole **ADRESS** Bernstorffgade 50– Magistervej 2-4 **ROOF AREA** Multi-functional Roof 2.200 m<sup>2</sup> - green area ca 1.200 m<sup>2</sup> **CLIENT NAME** KEjd – Københavns Ejendomme **DEVELOPMENT TYPE** Udvidelse af eksisterende skolefunktioner **DATE COMPLETED** August 2012 **ARCHITECT** Kjaer & Richter **LANDSCAPE ARCHITECTS** Wad/GHB **SYSTEM SUPPLIER** BG Byggros A/S **FURTHER INFORMATION** [www.kjaerrichter.dk/index.php?id=43&gid=1346&sp=2](http://www.kjaerrichter.dk/index.php?id=43&gid=1346&sp=2)

# THE LIBRARY / BISPEBJERG KULTURHUS

### Key Drivers

The Library is an extension of an existing culture house in Copenhagen’s northwest. The extension fulfills four main functions: a children’s library, a youth library, a library for adults and a concert hall. The buildings unique design is comprised of four golden “boxes” stacked on top of one another, each containing one of the building’s four functions. Deliberately designed to resemble a stack of books, the building’s floors each contain a world of their own, including individually staged scenography.

Green roofs are used for rainwater harvesting on all top surfaces. Besides increasing the biodiversity locally, the green roofs also create aesthetically impressive surfaces.

### Development benefits

Increase biodiversity locally, reduce water runoff, and create an aesthetically pleasing roof for the neighbouring buildings.

### Significance to Copenhagen

This green roof is visible from both the inside of the building and from the streetscape surrounding this public building, which is situated in a densely developed area. The green roof works well as a show case locally to promote the ways green roofs can transform otherwise disregarded spaces and provide an aesthetic variation.

### Planning Authority

Copenhagen Municipality



**NAME** The blibrary / Bispebjerg kulturhus **ADRESS** Rentemestervej 72 **AREA** Existing 1.150 m<sup>2</sup>, extension 2.000 m<sup>2</sup> **BUILD COST** DDK 42 m. **CLIENT NAME** Copenhagen Municipality **DEVELOPMENT TYPE** Renovation and extension of existing culture house **DATE COMPLETED** June 2011 **ARCHITECT** COBE and Transform **LANDSCAPE ARCHITECTS** Schönherr **STRUCTURAL ENGINEER** Wessberg **SYSTEM SUPPLIER** Veg Tech A/S

# GYLDENRISPARKEN

### Key Drivers

Roof top project signals the new turn for the entire development of Gyldenrisparken as a sustainable urban development area. The roof top garden contains a playground and green house, which the surrounding area did not provide room for.

### Development benefits

The roof top project provides new facilities for children and employers, new opportunities for play and working with green /sustainable development.

### Significance to Copenhagen

There is an imminent need for more Day Care Centers in Copenhagen, in this context this project shows how you can develop alternative ways of creating outside space, where Day Care Centers in the city might lack outside area.

### Planning Authority

Copenhagen City



**NAME** Børnehus **ADRESS** Gyldenrisparken blok 31, Playhouse with Day Care Center and afterschool Center **ROOF AREA** approx. 1000 m<sup>2</sup> **BUILD COST** ca. 60 million Danish kroner **CLIENT NAME** Lejerbo, Gl. Køge Landevej 26, 2500 Valby **DEVELOPMENT TYPE** Conversion of Red Cross residential home for elderly people into Day Care Center and Afterschool Center **DATE COMPLETED** Spring 2013 **ARCHITECT** The project group Gyldendenrisparken v/ WITRAZ, VANDKUNSTEN og Wissenberg **LANDSCAPE ARCHITECTS** Algren og Bruun Landskabsarkitekter **STRUCTURAL ENGINEER** Wissenberg **FURTHER INFORMATION** www.witraz.dk

# KORSGADEHALLEN

### Key Drivers

To create a sports hall, while preserving the “inner city common greenspace” as a recreational area for the residents.

### Development benefits

The densely populated area of Nørrebro, where there is very little vacant land, benefits from a new sports facilities, without removing the recreational green areas.

### Significance to Copenhagen

The building provides a method of constructing new public buildings without dismantling and removing green recreational areas.

### Planning Authority

Copenhagen City



**NAME** Korsgadehallen **ADRESS** Amagerbrogade 262 **ROOF AREA** 3000 m<sup>2</sup> **BUILD COST** 65 mio dk **CLIENT NAME** City of Copenhagen with support from Lokale- & Anlægsfonden **DEVELOPMENT TYPE** Public building **DATE COMPLETED** 2007 **ARCHITECT** BBP Arkitekter **LANDSCAPE ARCHITECTS** Henrik Jørgensen Landskab **STRUCTURAL ENGINEER** Lemming & Eriksson A/S

# ZERO-ENERGY ENVIRONMENTAL CENTRE

### Master Plan description

The local plan is located in Copenhagen's North Harbour and comprises non-registered land areas on land and sea territory, whereby the land environment is designated for harbour purposes.

District Plan 443 " Expansion of North Harbour and the New Cruise Ship Terminal" was declared on the 17th February 2012 and forms the basis of reclamation of a water area in connection with North Harbour. The environmental centre is part of the expansion of the North Harbour.

### The Project

The zigzag shaped building incorporates solar panels and photovoltaic cells in its distinct architecture. Merging with its surrounding nature, through a grass meadow covered roof sloping to the ground. Approximately 35 members of staff and administration will have their daily workplace at the centre. The Environmental centre is placed in the Northern part of Copenhagen, a developing area which is to be build as an innovative sustainable green new area.

### Sustainability

As part of the concept of sustainable development of North Harbour sustainable solutions are integrated in the actual design of the environmental centre.

The building produces energy through the 10m<sup>2</sup> solar panels and 140 m<sup>2</sup> of photovoltaic cells, combined with heat storage and thermo active covering the energy needs meaning the building will be.

### Rain water harvesting

Rainwater from the roof will be collected and utilised on the property for watering, recreational purposes or similar, while rainwater from certain areas is directed to the sewage system given that it is badly polluted.

### Ambitions

To set a new standard for sustainable climate adapted city development.

### Key Drivers

To promote and support various Copenhagen City strategies including; Strategy for Biodiversity, Climate Plan 2025, Climate Adaption Plan, A Greener Copenhagen and the strategy for Sustainable Urban Renewal.

### Significance to Copenhagen

Contribute to the goal of building green roofs in urban development areas.

### Planning Authority

Copenhagen City

### Development benefits

Increase biodiversity locally, reduce water runoff, create attractive buildings that are both welcoming for guests of environmental centre and to also send a signal that Copenhagen is a green city.



**NAME** Zero-energy Environmental Centre **ADRESS** North Harbour **LOCAL PLAN** Addendum nr. 1 to Local Plan 443 " Expansion of North Harbour and the New Cruise Ship Terminal" **ROOF AREA** 1600 m<sup>2</sup> min semi intensiv **BUILD COST** Tender Autumn 2012 **CLIENT NAME** By & Havn **DEVELOPMENT TYPE** Establishing a Zero-energy Environmental Centre **DATE COMPLETED** 2013 **ARCHITECT** Christensen & Co arkitekter a/s **LANDSCAPE ARCHITECTS** Christensen & Co arkitekter a/s **STRUCTURAL ENGINEER** Grontmij



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# KALVEBOD BRYGGE VEST

### Master Plan description

The master plan for “Kalvebod Brygge West” is a continuation of the raised landscape that starts at Bernstorffsgade and when the plan is complete will finish at Otto Busses Vej. The local plan allows for the construction of 115.000 m<sup>2</sup> commercial space placed in a raised and undulating landscape which snakes its way between the buildings. The construction beneath the landscape will be used to house parking, services and rainwater reservoirs. It is the intention of the new master plan to create an urban park and a landscape which varies in urbanity and in the intensity of vegetation. Kalvebod Park will create a green oasis for employees to enjoy during their lunch break and for the inhabitants of the dense district of Vesterbro to use in their free time and it will also create a green corridor accessible to the public to walk and cycle through connecting two separate areas of the city.

### Ambitions

Rainwater harvesting is an integral aspect in the concept of this development. Local rain water from the buildings and the park will be absorbed or collected and reused. The inclusion of holding tanks in the construction are planned to be able to store and delay excess water from both the surrounding areas and the development itself from contributing to the overloading of the sewers in heavy rain.



**DISTRICT** Kalvebod Brygge **LOCAL PLAN** Kalvebod Brygge Vest **YEAR** 2008 **LOCATION** Between Vesterbro and the harbour **AREA** 8 ha **ARCHITECTS** SLA and Holscher Architects **FURTHER INFORMATION** [www.kk.dk/PolitikOgIndflydelse/Byudvikling/Byplanlaegning/Lokalplaner/Lokalplanforslag/KalvebodBryggeVest.aspx](http://www.kk.dk/PolitikOgIndflydelse/Byudvikling/Byplanlaegning/Lokalplaner/Lokalplanforslag/KalvebodBryggeVest.aspx)

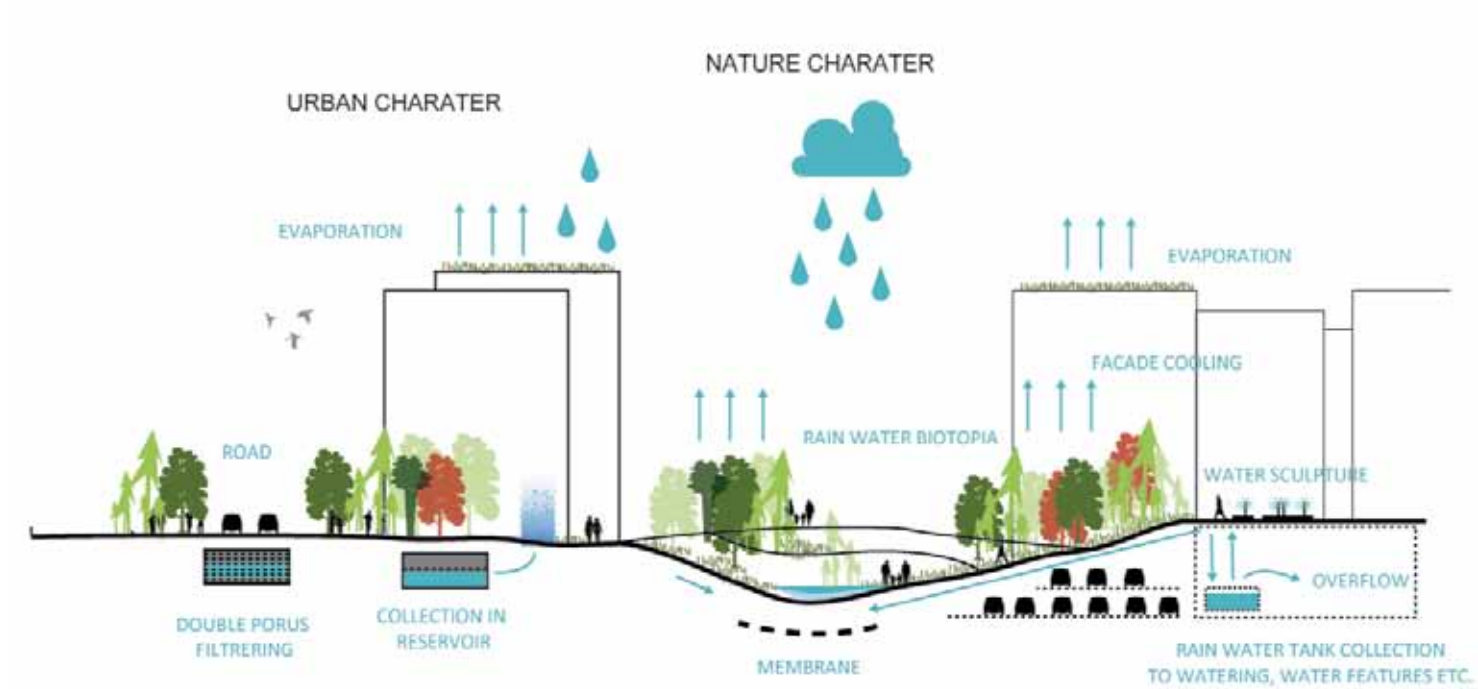


Illustration of sustainable water management

# CASE STUDY LOCAL PLAN FOR CARLSBERG II

### Master Plan description

The Carlsberg Brewery production has moved from the site, but from the outset the cultural heritage gives the area a very strong identity.

The old industrial environment will be developed with modern and sustainable architecture for the areas 6,500 new residents. The development plan is based on the classical city's block structure with small streets, squares and plazas. The city district area is dense with a mixture of residential, cultural and commercial functions that will provide a foundation for active urban life and a varied quarter with many different offerings, impressions and experiences.

Rainwater harvesting from roofs will be used in recreational water elements. Flat roofs on the new buildings will be constructed as green roofs and/or with a pitch suitable for the installation of photovoltaic as much as possible.

Certain open areas will be landscaped with pervious paving, in order for rainwater to be absorbed locally and suitable facades on new buildings will be configured for the installation of photovoltaics. Façade materials will primarily be chosen with natural and/or recyclable properties.

The green roofs will be highly visible from the areas planned high rise buildings and will serve as an example of how the renewed Carlsberg area's sustainable profile is integrated in to the modern architectural expression.

### Ambitions

To have and emphasis on social, environmental and economic sustainability.

### Further Information

[www.carlsbergbyen.dk/](http://www.carlsbergbyen.dk/)  
[www.voresby.com/submissions/039/67811\\_booklet.pdf](http://www.voresby.com/submissions/039/67811_booklet.pdf)  
[dac.dk/da/dac-life/copenhagen-x-galleri/opfoerte-projekter/carlsberg/](http://dac.dk/da/dac-life/copenhagen-x-galleri/opfoerte-projekter/carlsberg/)  
[www.solarcitycopenhagen.dk/Solpris-2007.477.aspx](http://www.solarcitycopenhagen.dk/Solpris-2007.477.aspx)



Illustration from local plan

**DISTRICT** Local Plan for Carlsberg II **LOCAL PLAN** First local plan for the area **YEAR** 2007-2009 **LOCATION** Vesterbro and Valby **AREA** 33 ha **ARCHITECTS** Entasis **CONSULTING ENGINEERS** Esbensen Civil Engineer a/s responsible for the development of the energy and sustainability strategy

# ÅRHUSGADEKVARTERET

## Master Plan description

A new district of North Harbour’s old harbour is to be developed. The Århusgade district is the first phase of the development plan in the North Harbour expansion, which is considered one of Europe’s largest urban development projects.

One of the key elements of the local plan is its proximity to the water. Århusgade district takes account of the existing port structure, excavating a new channel and creating a large island in one of the basins.

Another significant element will be to maintain a number of the existing built-up areas and local environments, which will positively contribute to a distinctive identity for Århusgade quarter. The existing buildings will retain clear references to the port’s history and heritage, thereby underpinning the area’s uniqueness. By combining this potential with the use of the existing buildings superstructures, several new opportunities for expansion will be created.

There is a special focus on urban spaces in the local plan. The development plan includes a network of squares, parks, promenades and streets, each offering something unique. Activities in the ground floors will help to strengthen the feeling and intensity of urban life.

The whole neighborhood is designated as a low-energy district and is connected to the district heating system and other energy supply systems based on renewable energy sources.

Roofs on new buildings should be primarily flat roofs and roof surfaces must be green throughout, for example with grass or herbs or stones performed as roof terraces with a distinct green flavor.

The starting point for the new premises in Århusgade district is that the buildings are constructed with flat roofs and at varying heights. Roofing gradients should ensure suitability for green roofs, so the roof can retain rainwater. Also there may be established solar cells on the roof or construction above the roof surface.

## Ambitions

A CO2 neutral area of the city that appears as the first part of ‘The Sustainable City of the Future’ and will be a show-case for sustainable urban development in Denmark.



Illustration from master plan

**DISTRICT** Århusgadekvarteret **LOCAL PLAN** N/A **YEAR** 2011-2012 (first local plan) **LOCATION** Østerbro **AREA** 26,5 ha  
**ARCHITECTS** COBE/SLETH/POLYFORM + RAMBØLL

# CASE STUDY

## SKELBÆKGADE

### Master Plan description

The plan for Skelbækgade is included in the continuing regeneration of Vesterbro, where the locality to the train station will be optimised for providing jobs and locating housing. This supports the desire to create dense, integrated urban areas, which supports the use of cycling and public transport and hence the sustainable city.

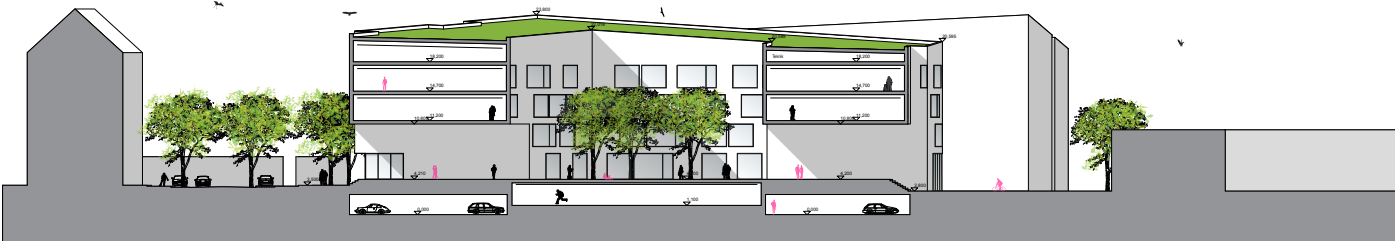
The new building will contribute to the architectural and urban space in terms of a qualitative boost to the neighbourhood and must include an architectural interaction with the environment. Special consideration and interaction for the listed ‘White Meat City’ must be given as this area of the meatpacking district is designated as a national industrial heritage site and should be safeguarded. In this area there are preserving worthy buildings as well.

The buildings are designed as two blocks with one-sided sloping roof surfaces that cut to opposite sides. Roof surfaces will be formed as green roofs and in addition to delaying and collecting rain water they will also be a distinctive feature of the functionalist inspired buildings. Roof surfaces will be visible from the surrounding buildings and will help to promote an urban environment in the existing city, which can be modern, friendly and sustainable.

Rainwater will not be diverted locally in the surrounding spaces as the land is contaminated, but will be delayed or used for recreational purposes. New buildings will be built as low energy buildings.

### Ambitions

The development aims to emphasize the social, environmental and economic aspects of sustainability.



**DISTRICT** Skelbækgade – Plan for new development with green roofs. **LOCAL PLAN** Skelbækgade, Local Plan nr. 459 **YEAR** 2010/2011 **LOCATION** Skelbækgade 1, Vesterbro **AREA** 25.000 m<sup>2</sup> new development **ARCHITECTS** Danielsen Architecture **LANDSCAPE ARCHITECTS** Schønherr A/S

# GRØNTTORVSOMRÅDET

## – THE PRODUCE MARKET

### Master Plan description

The plans for the transformation of the existing produce markets in Valby, Copenhagen started in 2006, when the market announced it was moving to Høje Taastrup. The market together with a group of developers and in consultation with the municipality announced an ambitious competition for the area where 5 international teams were selected to compete. Bolles & Wilson won the completion with a master plan which divided the area up into smaller communities and used the existing market halls footprint as the cultural and retail centre of the new city area. The master plan has an average density of 185 %, where there are very dense and high developments towards the train lines placed in a green park band which both functions as a noise barrier and a recreative space for the areas inhabitants and visitors. All buildings in the area, with a roof under 30 degrees must be planted or used sustainably and local rain water disposal should be integrated in the design of the areas developments and urban spaces.



### Ambitions

A sustainable brown field development that connects and integrates the surrounding housing, business and park areas.

**DISTRICT** Grønttorvsområdet, The Produce Market **LOCAL PLAN** Grønttorvsområdet no. 462 **YEAR** 2011 **LOCATION** Valby **AREA** 320.000 m<sup>2</sup> **ARCHITECTS** Bolles & Wilson and Juul + Frost

# NEW CRUISE SHIP TERMINAL NORTH HARBOUR

## Master Plan description

The local plan is located in Copenhagen's North Harbour and comprises non-registered land areas on land and sea territory, whereby the land environment is designated for harbour purposes. The local plan dictates that the cruise terminal acts as a publicly accessible area but during the cruise season public access is limited.

## The Project

By & Havn (City & Harbour) wish to establish a 1100m long and 70m wide cruise ship terminal with terminal facilities. The entire area encompasses in all 78,400m<sup>2</sup> and the terminal buildings in all will be approx. 10,000m<sup>2</sup>. As the cruise terminals are placed in the outer North Harbour, it is expected that it will take some time before residential areas are established near the terminals. Therefore, it is important that the terminals appear as a simple and sober solution on the quay.

The goal of the new terminal buildings is to have an appearance with a distinctive nautical expression that is proportional to the terminal's importance as a showcase for Copenhagen, which also supports Denmark's brand as a design nation. The terminals must appear as sculptural and luminous objects on the quay.

The facades will be built with bright plastic and glass that break up the façade in varying cubic forms. Through the transparent and translucent surfaces the terminals will be lit up in the evening, brightly welcoming passengers and visitors to the quay at the entrance to Copenhagen. Green sedum roofs

with varied slopes, allow the terminals to rise asymmetrically against the quayside. Terminals must include waiting and living areas, reception, café, shop, toilets and luggage storage. Outside the season the baggage handling area is used for other purposes of a temporary nature eg. for concerts, lectures, fashion shows or similar events.

## Sustainability

As part of the concept of sustainable development of the North Harbour, sustainable solutions are integrated in the actual design of the terminals. The new cruise ship quay will be prepared for future area development with channels for power cables installed under the surface. The terminal buildings will be naturally ventilated as they are primarily active during the summer months.

Heating of the terminals is scheduled as sustainable CO<sub>2</sub> neutral heating. Rainwater from the roof will be collected and utilised on the property for watering, recreational purposes or similar, while rainwater from certain areas is directed to the sewage system given that it is badly polluted. Solar panels will also be placed on the south facing roof surfaces.

## Ambitions

To set a new standard for sustainable climate adapted city development.

## Key Drivers

To promote and support various Copenhagen City strategies including; Strategy for Biodiversity, Climate Plan 2025, Climate Adaption Plan, A Greener Copenhagen and the strategy for Sustainable Urban Renewal.

## Development benefits

Increase biodiversity locally, reduce water runoff, create attractive buildings that are both welcoming for cruise ship guests and to also send a signal that Copenhagen is a green city.

## Significance to Copenhagen

Contribute to the goal of building green roofs in urban development areas.

## Planning Authority

Copenhagen City



**NAME** New Cruise Ship Terminal North Harbour **LOCAL PLAN** Addendum nr. 1 to Local Plan 443 " Expansion of North Harbour and the New Cruise Ship Terminal" **ROOF AREA** 10.000 m<sup>2</sup> min. **BUILD COST** Tender Autumn 2012 **CLIENT NAME** By & Havn **DEVELOPMENT TYPE** Establishing a new cruise ship quay and the construction of three terminal buildings to service cruise ship passengers. **DATE COMPLETED** 2014 **ARCHITECT** Christensen & Co arkitekter a/s **LANDSCAPE ARCHITECTS** Christensen & Co arkitekter a/s **STRUCTURAL ENGINEER** Grontmij

# DISTRICT

## SANKT KJELDS

### Key drivers

The prognosis estimates that it will rain 30 percent more over the next 100 years. The current sewerage system does not have the sufficient capacity to handle this. Therefore, in order to meet the requirements of the Climate Adaption Plan, areas are needed to test and prove how to handle, this large increase in surface rainwater. In combination with this, Copenhagen wishes to promote the green and blue qualities in as many spaces as possible in Copenhagen.

### Master plan description

The City of Copenhagen has several projects contained in the Integrated Urban Renewal of Sankt Kjelds, where all kinds of local diversion of rainwater, including green roofs, will be an integrated part of the solution. The projects include the renewal of streets, squares, backyards and historic heritage buildings.

The main idea is to have a green site that mitigates the water in the wide streets, which then leads the rainwater into the harbour. All squares and backyards will be designed to handle as much water on the surface as possible, by using the delay and storage of water, with an overflow to the green channel. With this main green and blue structure the bio-diversity of the neighbourhood will also increase in comparison to today.

### Ambitions

To encourage all the inhabitants in the neighbourhood to start their own small projects of climate adaption in the streets, backyards and buildings. This is a pilot project and the idea is to use these solutions in other parts of Copenhagen – ‘The Copenhagen Solutions’.



**DISTRICT** Integrated Urban Renewal in Sankt Kjelds – a pilot project of a climate adapted neighbourhood **NAME** Climate neighbourhood Sankt Kjelds **LOCATION** Between Lersø Park Allé, the railway, Østerbrogade and Jagtvej **AREA** 1.5 ha **BUILD COST** Approximately 400-500 mio. DKK when finished **DEVELOPMENT TYPE** Integrated Urban Renewal **DATE COMPLETED** 2016, the Integrated Urban Renewal project in Sankt Kjelds closes, but will hopefully continue through private initiatives **LANDSCAPE ARCHITECT** Tredje Natur (phase of master plan) **FURTHER INFORMATION** [www.klimakvarter.dk](http://www.klimakvarter.dk)



# POLICY APPROACHES IN **OTHER CITIES**

# GREEN ROOFS PLANNING AND POLICY WORLDWIDE

## AUSTRALIA

### Sydney and Melbourne

Neither Sydney or Melbourne has no direct or indirect requirement for green roofs. Sydney has commissioned a Green Roof Resource Manual and the city has more than 60 green roofs or walls.

**LINK** [www.melbourne.vic.gov.au/Environment/WhatCouncil-isDoing/Pages/Greenroofs.aspx](http://www.melbourne.vic.gov.au/Environment/WhatCouncil-isDoing/Pages/Greenroofs.aspx)

**LINK** [www.cityofsydney.nsw.gov.au/environment/biodiversity/GreenRoofs.asp](http://www.cityofsydney.nsw.gov.au/environment/biodiversity/GreenRoofs.asp)

## CANADA

### Toronto

Regulatory requirements in Toronto adopted in 2009 claiming green roofs on new commercial, institutional and residential buildings with a minimum gross floor area of 2,000 m<sup>2</sup> requirements are valid from January 31, 2010. Since April 30th 2012, requires green roofs on new industrial buildings.

**Industrial buildings are under Toronto's policy required to ensure the following:**

A green roof that covers at least 10 percent of the available roof area or 2,000 m<sup>2</sup> or a roof that uses cool roofing materials on 100% of the available roof area and comply with the stormwater requirements specified in the approval process of the use of the site, Site Plan Approval . Where such a specific site approval, Site Plan Approval is not required, the first 5mm from each precipitation or 50% of annual rainfall volume falling on the roof withheld or collected for recycling at least in systems involving roof.

Toronto is running a program that provides \$ 50 per. m<sup>2</sup> grants up to a certain limit.

**LINK** [www.toronto.ca/greenroofs/overview.htm](http://www.toronto.ca/greenroofs/overview.htm)

**LINK** [www.toronto.ca/legdocs/2006/agendas/committees/pof/pof060123/agenda.pdf](http://www.toronto.ca/legdocs/2006/agendas/committees/pof/pof060123/agenda.pdf)

## CHINA



### Shanghai

Shanghai has since 2003 been running a campaign for green roofs and in 2008 was up to 500,000 sqf green roofs

### Beijing

Beijing has various policies and programs that promote green roofs. In 2008 the city had 1 million. m<sup>2</sup> of green roofs. About 100,000 m<sup>2</sup> established annually.

Application of Green Roof Techniques in Beijing, China, Zhang Yajun; Xu Ping, Wang Huizhen; Feng Cuimin; Yang Haiyan; Dept. of Environ. Eng., Tianjin Univ, Beijing, China

## ENGLAND



### London

Mayor of London Boris Johnson's Climate Change Adaptation Strategy sets requirements for green roofs (and where it is technically possible cold roofs) in new buildings in London's Central Activities Zone policy area - consisting of the City of London, most of Westminster and the innermost part

of Camden, Islington, Hackney, Tower Hamlets, Southwark, Lambeth and Kensington and Chelsea. The ambition is to establish minimum 100.000 m<sup>2</sup> new green roofs in 2012.

**LINK** [www.london.gov.uk/priorities/environment/greening-london/urban-greening/green-roofs-walls](http://www.london.gov.uk/priorities/environment/greening-london/urban-greening/green-roofs-walls)

Mayor of London and urban design had produced a technical report on green roofs and walls, Living roofs and walls - Technical report, Supporting London Plan policy.

**LINK** [static.london.gov.uk/mayor/strategies/sds/docs/living-roofs.pdf](http://static.london.gov.uk/mayor/strategies/sds/docs/living-roofs.pdf)

The New London Plan contains the following policy positions:

**LINK** [www.london.gov.uk/thelondonplan/thelondonplan.jsp](http://www.london.gov.uk/thelondonplan/thelondonplan.jsp)

## GERMANY

At least 48 German cities provide financial support for green roofs. Approximately 35% of all cities have integrated green roofs as part of their regulation. Today, Germany has established around 86 million m<sup>2</sup> of green roofs accounting for 14% of Germany's total roof area.

Since 1998, the German construction law with § 9 (1) no.25a (The German Federal Building Code) provided a clear opportunity to set requirements for green roofs, which are used widely in Germany.

**LINK** [ec.europa.eu/environment/soil/pdf/sealing/Soil%20sealing%20-%20Final%20Report.pdf](http://ec.europa.eu/environment/soil/pdf/sealing/Soil%20sealing%20-%20Final%20Report.pdf)

Düsseldorf

As a result of urban development plans and support programs, Düsseldorf has more than 730,000 m² of green roofs similar to 100 football fields. Düsseldorf offers reduction of stormwater drainage if green roofs are a part of the construction. Since January 1st 2010 Düsseldorf offers 50% reduction in stormwater tax for green roofs.

LINK [www.duesseldorf.de/umweltamt/luft/stadtklima/dachbegruenung.shtml](http://www.duesseldorf.de/umweltamt/luft/stadtklima/dachbegruenung.shtml)

Berlin

Berlin use biofactor and indirect tax / duty regulations tools that promote green roofs.

Green roofs have a biofactor value of 0.7.

Berlin has a long tradition of planning of green areas in densely populated areas. In the 80s and 90s the city promoted a green urban development through financial aid programs.

The Courtyard Greening Programme (1983-1996), aimed to provide green space in the form of green roofs, green facades and backyards in the most densely populated areas of the city. The goal was to improve the urban climate, quality of life for residents and the urban amenity.

There was an average for each square meter of green space provided financial support equivalent to € 19.10, which included separate amounts for construction and design. Under the program, the 54 hectares of yards and roofs were greened and 32.5 ha facades were greened. A total value of support € 16.5 million.

As a result of this initiative it has succeed to increase the green areas in the city.

Approximately 65,750 m² green roofs have been supported.

Residents were given an allowance of about half (25-60 € / m²) of their expenditures for the construction of green roofs.

LINK [www.grabs-eu.org/membersArea/files/berlin.pdf](http://www.grabs-eu.org/membersArea/files/berlin.pdf)

Stuttgart

With more than 2 mio. m² green roofs Stuttgart is one of the leading green roofs cities in the world .

Stuttgart has since 1986 been running a financial support program for green roofs and has set requirements for all new roofs below 12 degree slope must have green roofs. The claim is based on the need to prepare for climate and ecological conditions. There is coverage for 50% of costs for the installation of green roofs, max 17.9 euro's per m². Since 1993, all new buildings have been greened under § 8 of the Federal Nature Conservation Act, as a compensation for the loss of valuable nature / landscape.

Munich

The Bavarian local Building Act sets with § 3 requirements for flat roofs for all buildings over 100 m² with the possibility of using parts of the land for other purposes.

Munich is running a program that provides financial support for green roofs in areas lacking green space equivalent to 30 euro/m².

Buildings with less than 10 cm building green roof and a slope of less than 15 degrees will pay only 30% of drainage charges against the levy of impermeable surfaces.

SINGAPORE

Singapore has introduced Skyrise Greenery Incentive Scheme (SGIS) in the period 2009 -2015. The scheme will finance up to 50% of installation costs of green roofs and green walls. Singapore has focused on that as the broader urban development in the city wants to make sure that soil is not lost. This is supported by Singapore's "City in the garden" dream.

The incentive scheme has provided the following objectives: First Support installation of Skyrise green on the existing buildings of Singapore.

Second create a distinctive image of the city in the tropical climate through extensive fantastic green facades and Skyrise green gardens,

Third Promoting environmental benefits such as reducing the Urban Heat Island effect and improve air quality through plant transpiration and filtration of dust particles.

LINK [www.skyrisegreenery.com/index.php/home/incentive\\_scheme/about/](http://www.skyrisegreenery.com/index.php/home/incentive_scheme/about/)

In addition, Singapore's Urban Redevelopment Authority's program, LUSH (Landscaping for Urban Spaces and High Rises) which consists of four parts; - Landscape Replacement Policy for Strategic Areas; Outdoor Refreshment Area on Landscaped Roof tops; GFA Exemption for Communal Sky Terraces; and Landscaped Deck . The Programme is intended to consolidate existing and new green initiatives and create synergies.

LINK [www.uragov.sg/circulars/text/lushprogramme.htm](http://www.uragov.sg/circulars/text/lushprogramme.htm)

Finally, Singapore in 2005 launched the BCA Green Mark Certification and Incentive Scheme, an initiative to manage Singapore's construction industry towards more environmentally friendly buildings. Several points in the scoring system can be achieved by installing green roofs and walls.

LINK [www.bca.gov.sg/greenmark/green\\_mark\\_buildings.html](http://www.bca.gov.sg/greenmark/green_mark_buildings.html)

SWITZERLAND

Basel, Zurich and Lucerne have requirements for green roofs.

Basel

The results from several years of research have led to a change in the building and construction laws in Basel. Swiss regulation of land use, has determined that an interference with the natural environment is kept to a minimum and that the land should be used in a sustainable manner. Federal law on the conservation of natural and cultural heritage requires that endangered species be protected. In accordance with these rules the canton of Basel mandates the design and use of substrates for extensive green roofs as part of its current biodiversity strategy. In general, green roofs built in all new buildings with flat roofs (Nature and Landscape Conservation Act § 9, Building and Planning Law § 72). On roofs surfaces over 500m², the substrates consist of appropriate natural soil from the surrounding region, and be of varying depths.

LINK [urbanhabitats.org/v04n01/wildlife\\_full.html](http://urbanhabitats.org/v04n01/wildlife_full.html)

## USA

### Chicago

The previous mayor, Richard M. Daley was a strong advocate of urban development with green roofs. He had a vision to create a green city. In Chicago the motivating factors for developing green roofs is the concern for Urban Heat Island (UHI) effect, air quality and its effects on public health, storm water management and aesthetics improvements.

#### Chicago has for the last 6-7 years been running various programs

The 2001 Regulation called the Energy Conservation Code This Code requires that all new and retrofit roofs should meet minimum standards for solar reflection (0.25 reflectance).

Chicago's Bureau of the Environment deemed that green roofs are an acceptable way to lower roof reflectivity, mitigate UHI and improve air quality.

#### Adding green to urban design

Today green roofs are a part of the city's sustainability plan:

**LINK** [www.cityofchicago.org/content/dam/city/depts/zlup/Sustainable\\_Development/Publications/Green\\_Urban\\_Design/GUD\\_booklet.pdf](http://www.cityofchicago.org/content/dam/city/depts/zlup/Sustainable_Development/Publications/Green_Urban_Design/GUD_booklet.pdf)

#### Building Green / Green Roof Matrix

A policy which applies to construction projects receiving public assistance or certain projects are subject to review by the Department of Planning and Development. Through this policy, the City of Chicago grants a density bonus option to developers whose buildings have a minimum vegetative coverage on the roof of 50% or 186 m<sup>2</sup> (whichever is greater), usually in the form of a green roof.

#### Storm Water Ordinance 2008 program

Performance control of construction projects over 700 SFT. They must respond to an increased permeability of 15% or record 1.25 cm of rain.

**LINK** [www.cityofchicago.org/content/dam/city/depts/doe/general/GreenBldgRoofsHomes/2003GreenRoofReport.pdf](http://www.cityofchicago.org/content/dam/city/depts/doe/general/GreenBldgRoofsHomes/2003GreenRoofReport.pdf)

#### Green Permit Program

Project meets the criteria for sustainable construction will build processing time by half and costs reduced. Green roofs are a green element to comply with Green Permit program.

**LINK** [www.cityofchicago.org/city/en/depts/bldgs/supp\\_info/overview\\_of\\_the\\_greenpermitprogram.html](http://www.cityofchicago.org/city/en/depts/bldgs/supp_info/overview_of_the_greenpermitprogram.html)

#### The result of the efforts so far

359 green roofs  
508,130m<sup>2</sup> of green roofs

#### Effect

The green roofs in Chicago absorb approx. 470,000 m<sup>3</sup> of rainwater per year.

### Portland, Oregon

Portland runs an eco roof program which provides financial support for green roofs, equivalent to \$ 5 per. square foot green roof. In Portland's green roofs is a part of the city's storm water management.

**LINK** [www.portlandonline.com/bps/index.cfm?water.epa.gov/polwaste/nps/stormwater/upload/2003\\_03\\_26\\_NPS\\_natlstormwater03\\_20Liptan.pdf](http://www.portlandonline.com/bps/index.cfm?water.epa.gov/polwaste/nps/stormwater/upload/2003_03_26_NPS_natlstormwater03_20Liptan.pdf)

### New York

In NY is 1-year reduction in property tax equivalent to \$ 4.50 per square foot green roof, maximum reduction in property tax: \$ 100.000. To get the reduction in tax is a set of criteria for the green roof must be met such as the green area at least 50% of the total roof area.

**LINK** [www.nyc.gov/html/dob/downloads/pdf/green\\_roof\\_tax\\_abatement\\_info.pdf](http://www.nyc.gov/html/dob/downloads/pdf/green_roof_tax_abatement_info.pdf)

### Philadelphia

Philadelphia has set aside \$ 3 billion for green stormwater infrastructure for a period exceeding 25 years. The program called Green city and clean water. The city defines a green area for stormwater management as a green space that can control the first 2.54 cm rain.



**LINK** [www.phillywatersheds.org/what\\_were\\_doing/documents\\_and\\_data/cso\\_long\\_term\\_control\\_plan](http://www.phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_control_plan)

### Seattle

In Seattle, has been used Green Factor since 2007 as part of their landscape strategies. The aim is to increase flexibility in development projects while enhancing the natural and aesthetic quality of the landscape.

Green roofs contribute to a factor of 0.4 for a building less than 10 cm. Green roofs over 10 cm contribute to a factor of 0.7.

#### P. 8 and 9 of this document

**LINK** [www.seattle.gov/dpd/codes/dr/DR2011-10.pdf](http://www.seattle.gov/dpd/codes/dr/DR2011-10.pdf)

**LINK** [www.seattle.gov/dpd/permits/greenfactor/Overview/](http://www.seattle.gov/dpd/permits/greenfactor/Overview/)

### Washington DC

Washington's ambitious "20-20-20" plan aims to create 20 million square feet (sf) green roofs, representing 20% of roof area at all city buildings over 10,000 sf, over the next 20 years. Calculations show that this record rainwater equal to 15% planned ducting capabilities.

There has been \$ 2 million of their LTCP (Long-Term Control Plan) to green infrastructure including green roofs.

**LINK** [www.cnt.org/repository/WashingtonDC.pdf](http://www.cnt.org/repository/WashingtonDC.pdf)

#### Further Information

[www.livingroofsworld.com](http://www.livingroofsworld.com)



# PHOTO CREDIT

## FRONT PAGES

FRONT PAGE / Ursula Bach

FOREWORD / Ursula Bach

## BENEFITS OF GREEN ROOFS

8-HOUSE / Ty Stange

THE NEW NATIONAL ARCHIVES/ Dorthe Rømø

PEPLING DOSSERING / Gitte Lotinga

SWITZERLAND, BASAL / Michael Zogg

## GREEN ROOFS POLICY AND PLANNING IN COPENHAGEN

TIVOLI CONGRESS CENTRE / P. Malmos

## PROJECTS CASES

8-HOUSE / Ty Stange

8-HOUSE / Ursula Bach

BIRKEGADE / JDS Architects

NØRREBROGADE 184 VISULALISERING / SbS

NORDRE TOLDBOD / Byggros a/s

THE CITY DUNE / SLA

THE NEW NATIONAL ARCHIVES / Dorthe Rømø

TCC - HOTEL / Dorthe Rømø

CARL JACOBSEN VEJ 35 / Arkitema

SEDUM / Gitte Lotinga

TAGENSBOSKOLE / Kjaer & Richter

TAGENSBOSKOLE LUFTFOTO / Hoffmann A/S

BISPEBJERG KULTURHUS / Bispebjerg lokaludvalg

BISPEBJERG KULTURHUS / Bispebjerg lokaludvalg

GYLDENRISPARKEN / WVV, Witraz, Vandkunsten  
og Wissenberg

GYLDENRISPARKEN VISULALISERING / WVV,  
Witraz, Vandkunsten, Wissenberg

KORSGADEHALLEN / CPN

ENVIROMENTAL CENTRE / Christensen & CO arkitekter

## LOCAL PLANS CASES

VISUALISERING / COBE

KALVEBOD BRYGGE / Ursula Bach

ILLUSTRATION / Holscher arkitekter og SLA

CARLSBERG / Entatis

ÅRHUSGADE KVARTERET / Polyform arkitekter

SKELBÆKGADE VISUALISERING / Danielsen  
Architecture

GRØNTORVET VISUALISERING /

Juul + Frost arkitekter

KRYDSTOGTTERMINALEN VISUALISERING /  
Christensen & CO Arkitekter

SANKT KJELDS KVARTER / Ursula Bach

## POLICY APPROACHES IN OTHER CITIES

USA, PORTLAND / Environmental Services

CHINA / Monik Budniak

ENGLAND / Dusty Gedge

USA, PHILADELPHIA / Fredda Lippes

## PHOTO CREDITS

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**COPENHAGEN  
TOGETHER**

**CITY OF COPENHAGEN**  
The Technical and  
Environmental Administration

**GREEN ROOFS COPENHAGEN** 1. UDGAVE SEPTEMBER 2012  
**UDGIVET AF** KØBENHAVNS KOMMUNE  
**REDAKTION** DORTHE RØMØ  
**DESIGN** TMF DESIGN  
**PAPIR** 100% RECYCLING PAPER, COCOON SILK

