

# Refurbishing Roof System and Roof Terraces on a Major Residential Building Complex

NRCA, Washington

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# Terraced houses



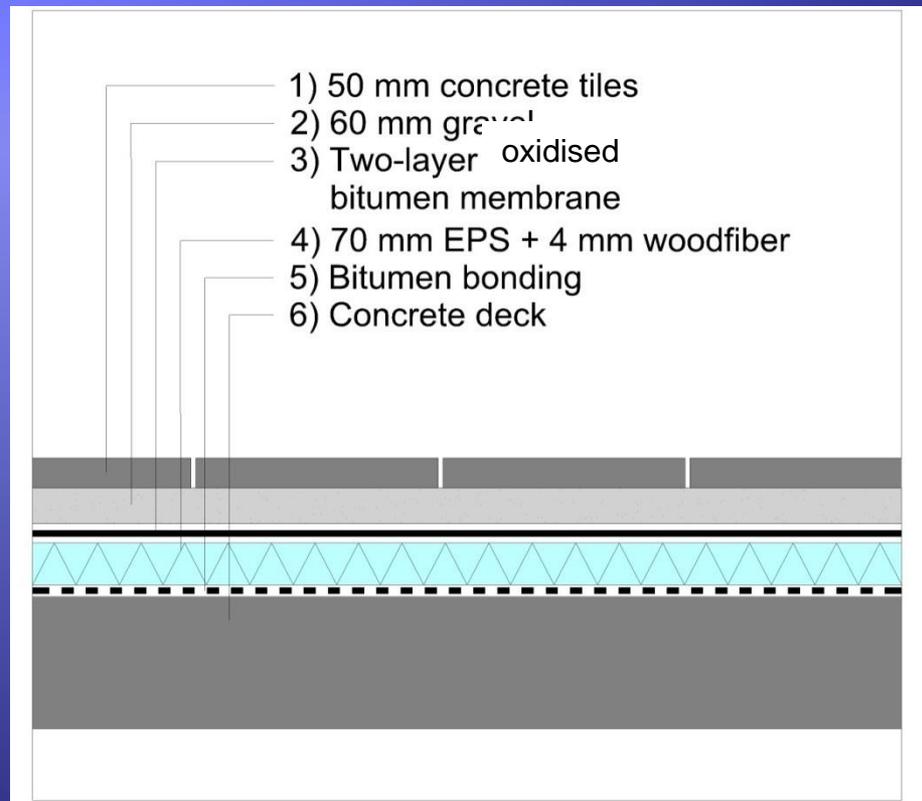
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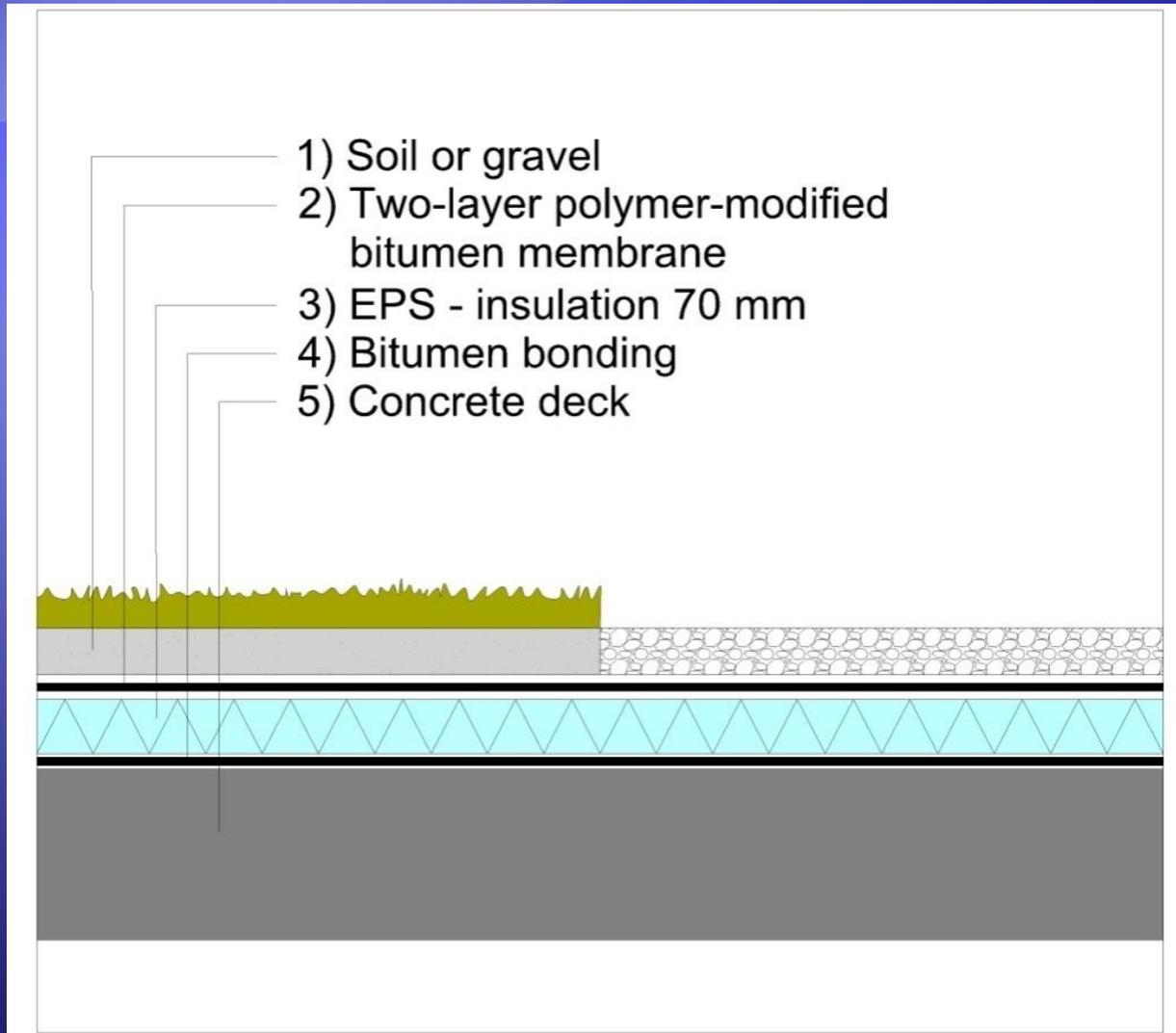
# Observations from 1973 - 2011

- ◆ Build in 1970 - 1973
- ◆ First leaks in 1973
- ◆ Leaks in 1981: 500 out of 1725 apartments
- ◆ Renovated first time 1990-1991
- ◆ First leaks in 1991
- ◆ Renovated second time 2001-2004
- ◆ Costs 100 mill. \$ each time

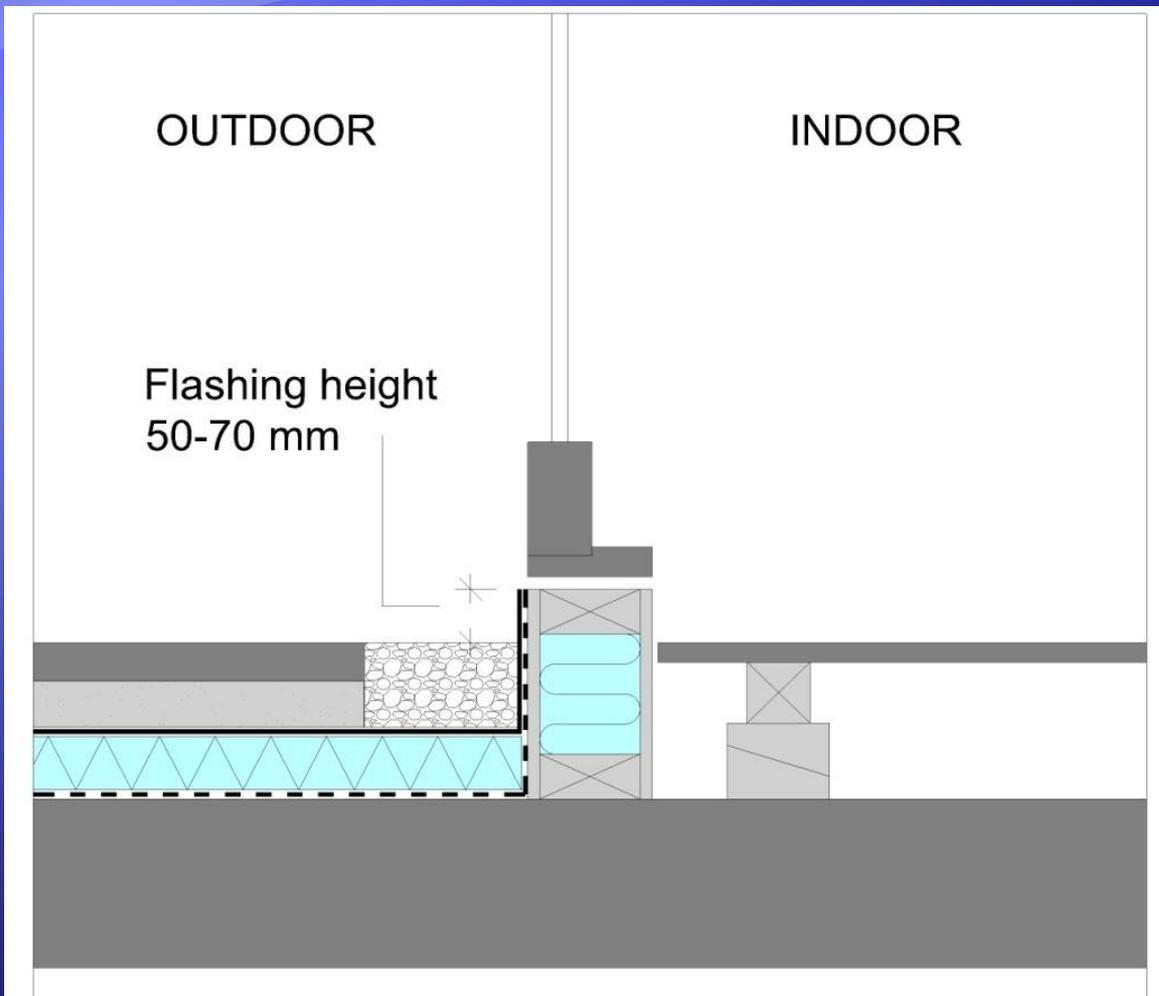
# Roof terraces - original design



# Green and ballasted roofs



# ORIGINAL DESIGN



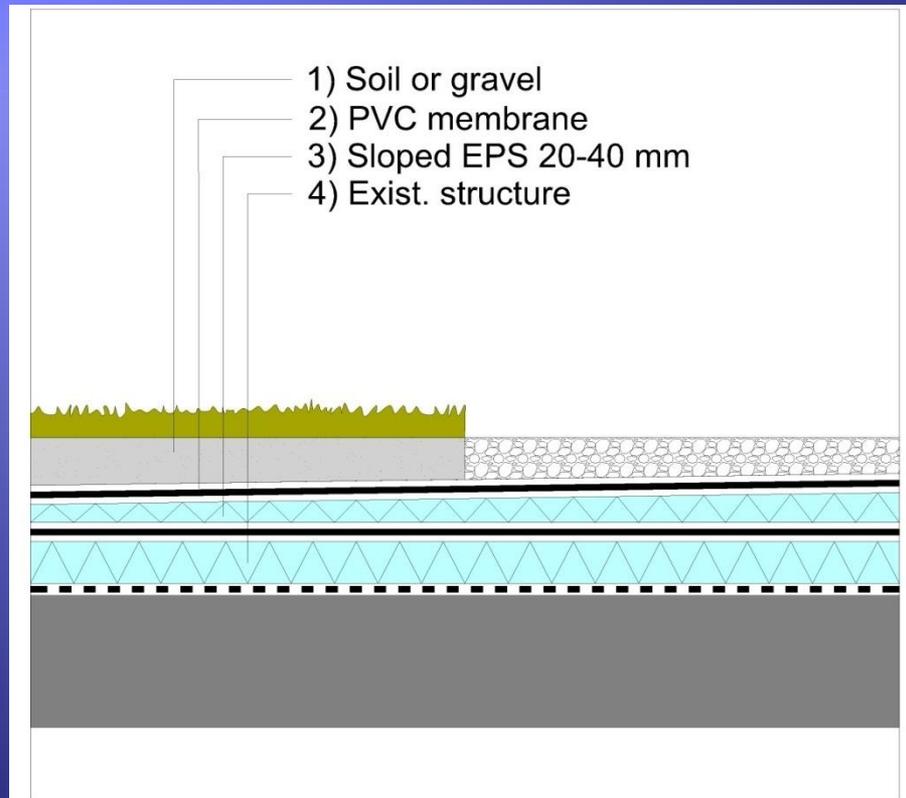
# Roofing material

- ◆ 2 layer oxidized bitumen
- ◆ 70 mm EPS with 3 mm wood fibre board
- ◆ No slope

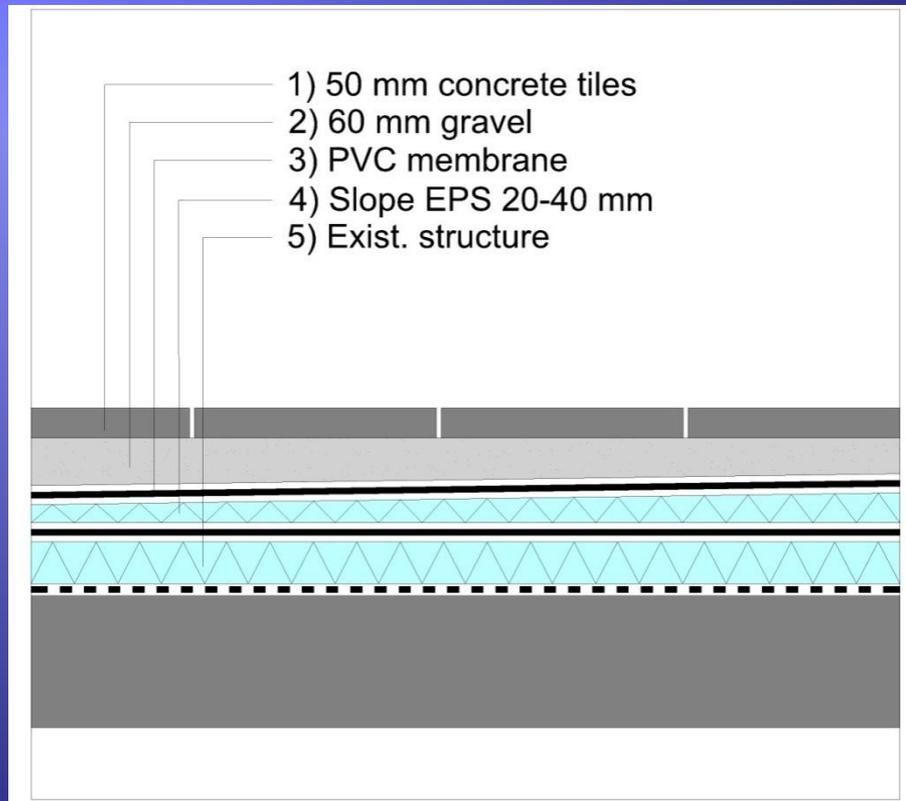
# First renovation in 1990-91

- ◆ Tapered insulation and PVC membrane
- ◆ Slope 1:100 or 1 %
- ◆ Height of up stands unchanged
- ◆ Flashing height lower due to extra insulation

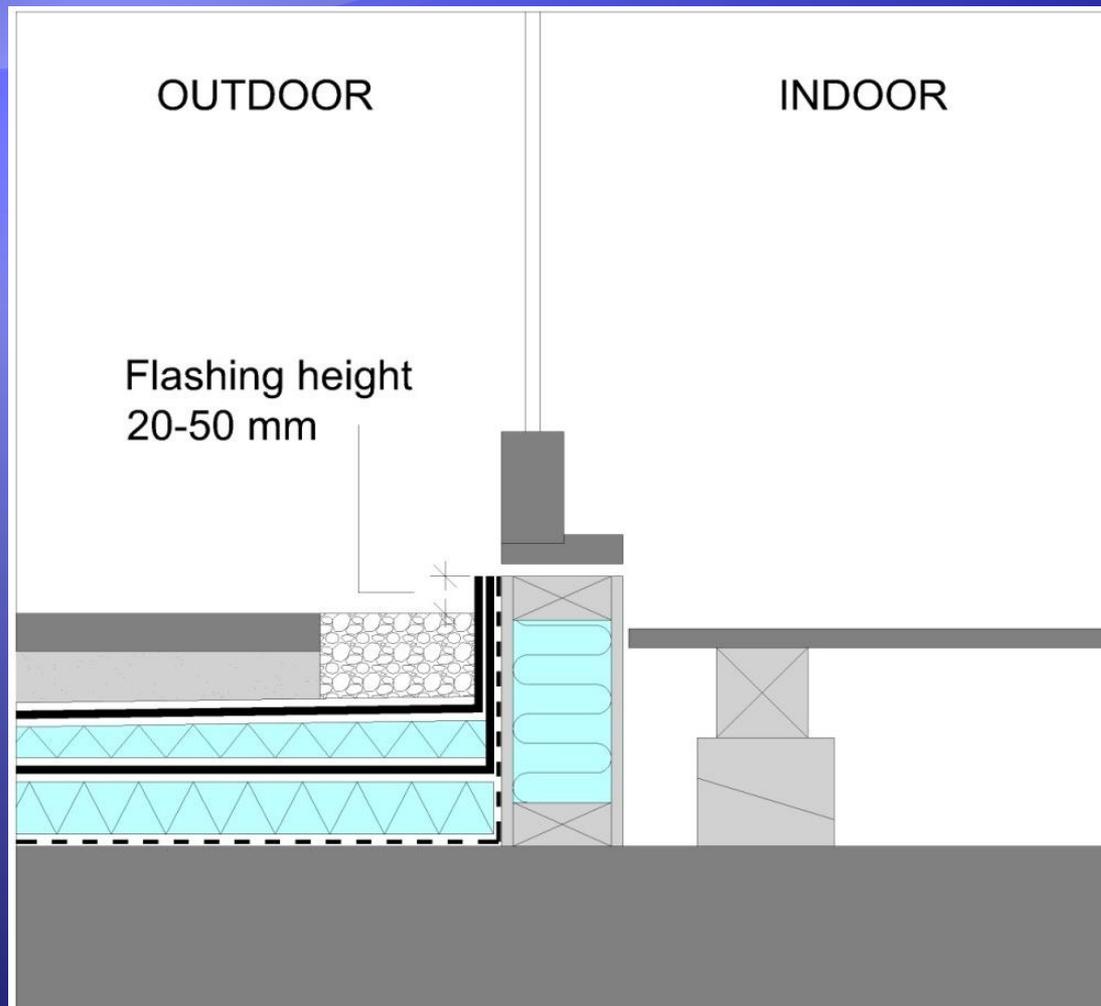
# Vegetated and ballasted roofs



# Roof terraces



# Lower height of flashings



# LOW FLASHING HEIGHT



# Loss of plasticizer from 35 % to 5 %



# Loss of plasticizers

- ◆ Bacteria and mould in soil and ballast
- ◆ Bad quality of plasticizers
- ◆ No significant loss to EPS insulation due to separation layer of glass fiber felt
- ◆ Membrane gets stiff and shrinks
- ◆ Extremely bad PVC quality

# Shrinkage of the EPS insulation up to 0.5 %



# Wet EPS insulation



# Acceptance of 1 kg water/m<sup>2</sup>



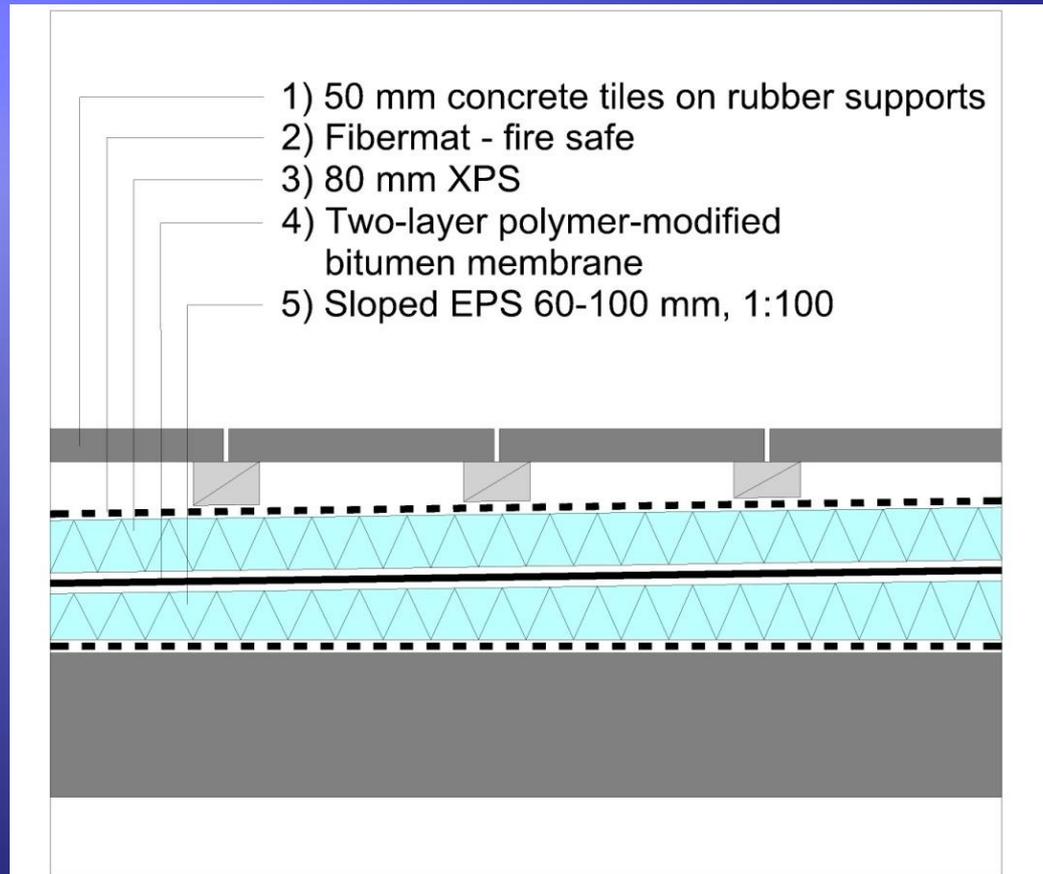
# Insulation from 1th renovation

- ◆ Criteria : max 1,0 kg/ m<sup>2</sup> of water
- ◆ Corresponding to 1 litre of water per square meter in a 100 mm thick insulation
- ◆ New criteria from 2010 is 0.5 vol. % due to thicker insulation
- ◆ EPS with a density of 20 kg/m<sup>3</sup> can contain up to 98 vol. % water
- ◆ Original insulation was dry on the roofs

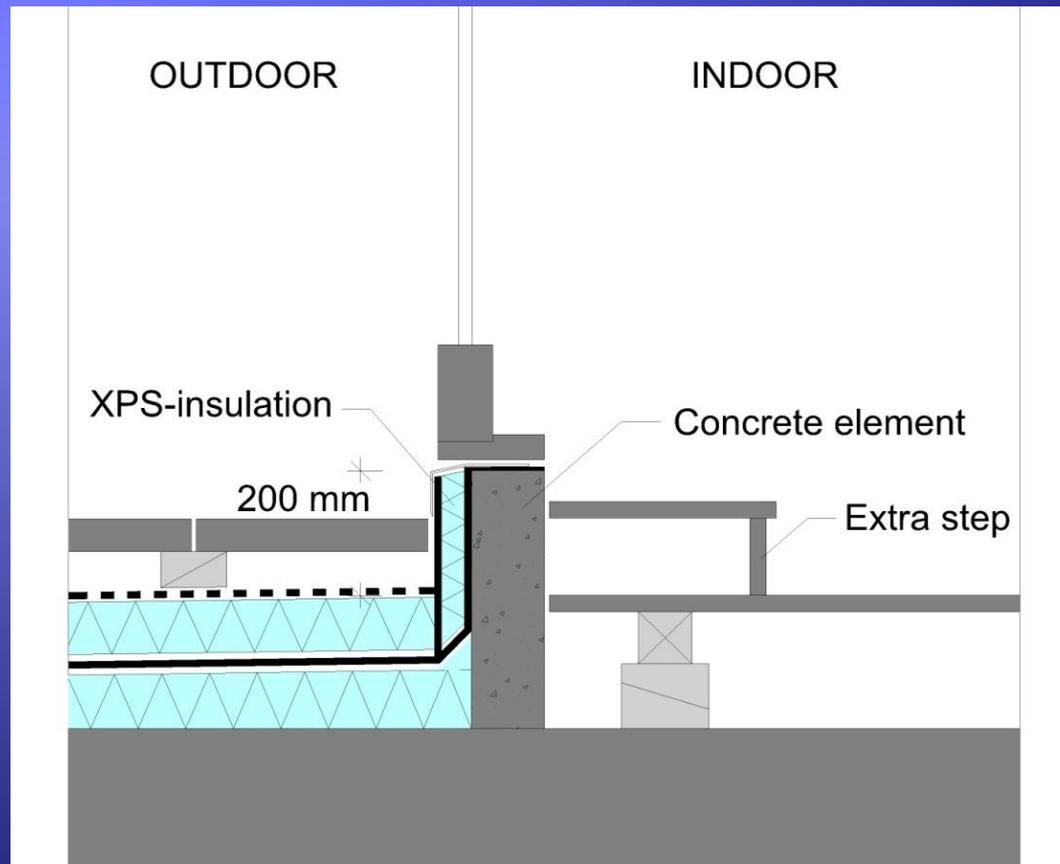
## 2<sup>nd</sup> renovation 2001-04

- ◆ New increased insulation thickness
- ◆ Slope 1:40 or 1.5 degrees on roof systems
- ◆ Slope 1:100 in duo-roofs on terraces
- ◆ Two layer SBS polymer-modified bitumen membrane
- ◆ Better drainage
- ◆ Higher up stands

# Roof terraces – duo roof concrete tiles on rubber footings



# Higher up stands by changing the façades to be 200 mm smaller



# New concrete up stands and new façades



# 2 layer SBS polymer-modified bitumen membrane



# Membrane on roof terraces

- ◆ Two-layer SBS polymer-modified bitumen
- ◆ 4.2 mm polyester reinforced with 180 g/m<sup>2</sup> polyester carrier
- ◆ 1<sup>st</sup> layer loose laid with torched overlapping
- ◆ 2<sup>nd</sup> layer fully torched to 1th layer
- ◆ Insulation EPS ( 150 kN/m<sup>2</sup>)
- ◆ XPS for the insulation on top of membrane

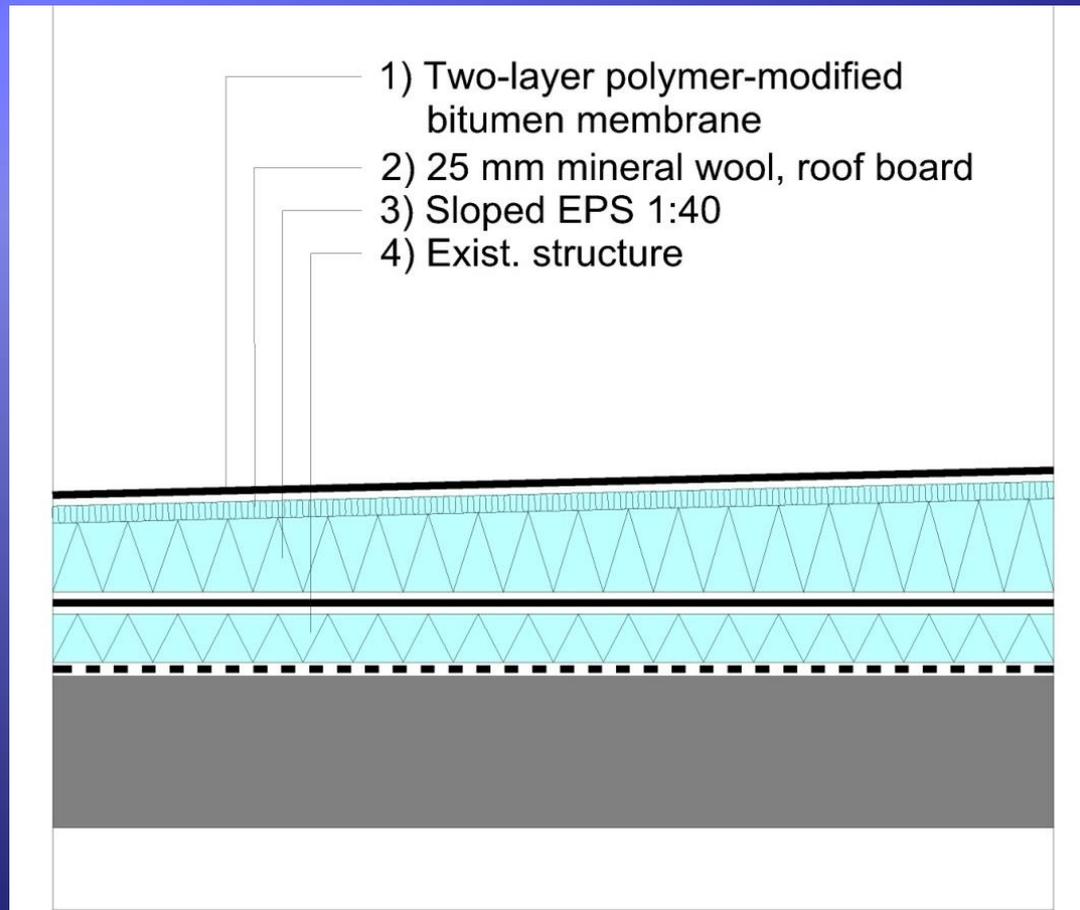
# Torching



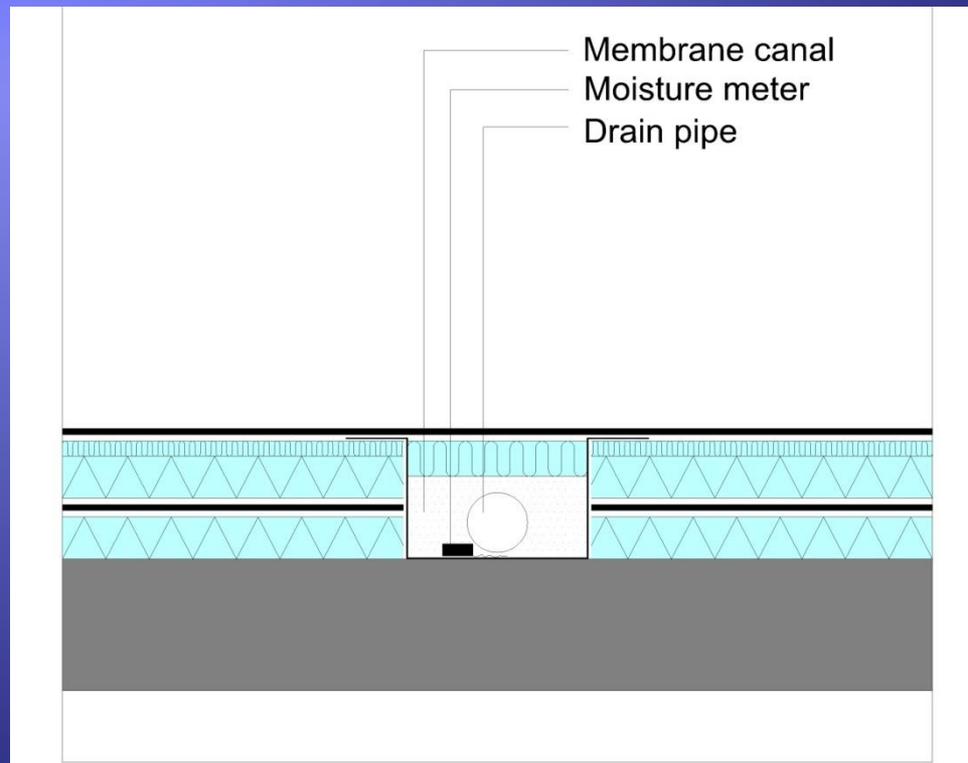
# Vegetation in the edge of the roof was removed



# Roofs with mechanically fixed membrane



# Symphonic drain with pipes built into the insulation



# Mechanical fixing and built in pipes is a dangerous combination



# Construction period

- ◆ The tenants stayed in the apartments
- ◆ The building was covered with a movable tent in the renovation period
- ◆ Moisture damages was limited



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# Roof terrace



# The tenants use the terraces for all purposes



# The architect was not happy





Roof terraces can be used in different ways



# Green roofs

- ◆ 3<sup>rd</sup> renovation
- ◆ Going on now

# The small green roofs were not renovated in 2nd renovation



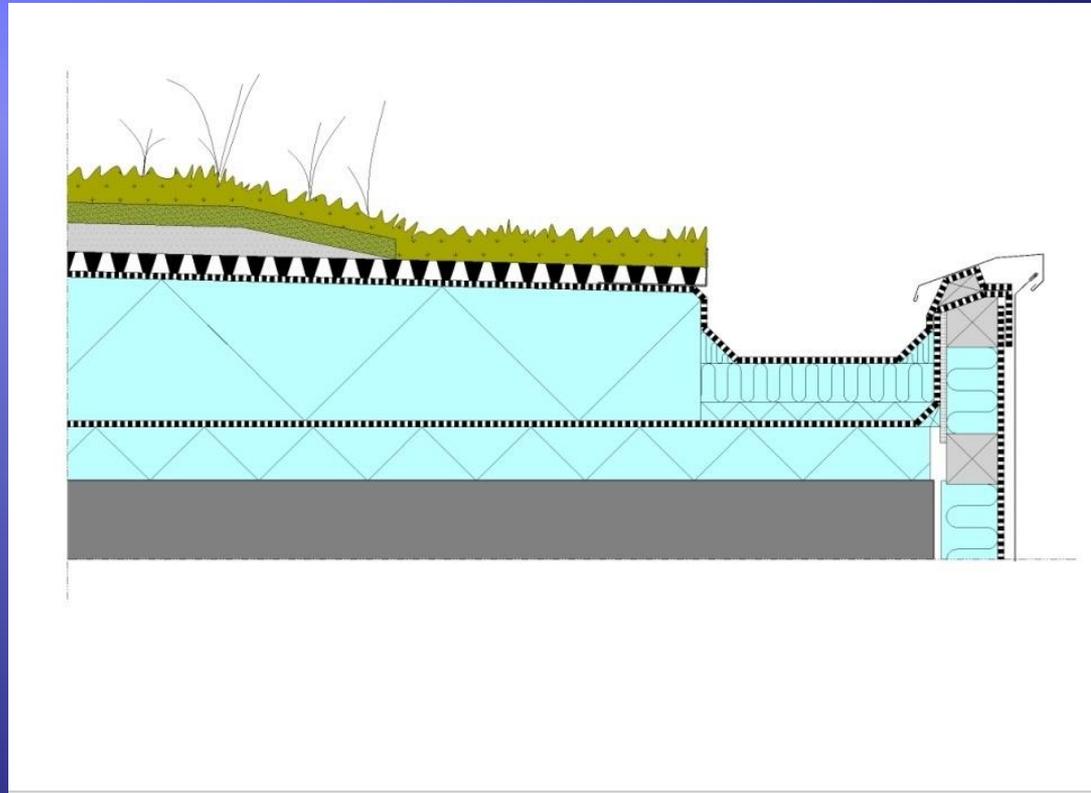
# Small green roofs

- ◆ 1.2 mm PVC membrane
- ◆ 1.5 mm PVC membrane as sacrificial layer
- ◆ The loss of plasticizer occurred mainly in the sacrificial layer
- ◆ Service life was extended with 10 years
- ◆ Problems at flashing where there was no sacrificial layer
- ◆ The thickness of the vegetation has increased

# Renovation

- ◆ PVC membrane and insulation from first renovation is removed
- ◆ New tapered insulation of EPS
- ◆ 2 layer SBS polymer modified bitumen membrane
- ◆ Vegetation system

# Edge detail



# Prefab vegetations





# Finished green roof



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# Terraced apartments



**It looks a bit rusty**  
**but it is water tight**



# Conclusions

- ◆ Always look at the critical details first - in this case the up stands
- ◆ Choose the right material for the actual environment and get documentation
- ◆ Include an inspection plan in the contract
- ◆ No drainage built into the insulation
- ◆ Drainage system with redundancy - overflow possibility lower than the flashing height

**The contractor will not have his  
head chopped off but will have  
no fee for maintenance if there  
are more than 5 call backs per  
year**

# Green roof



# Contact details

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