

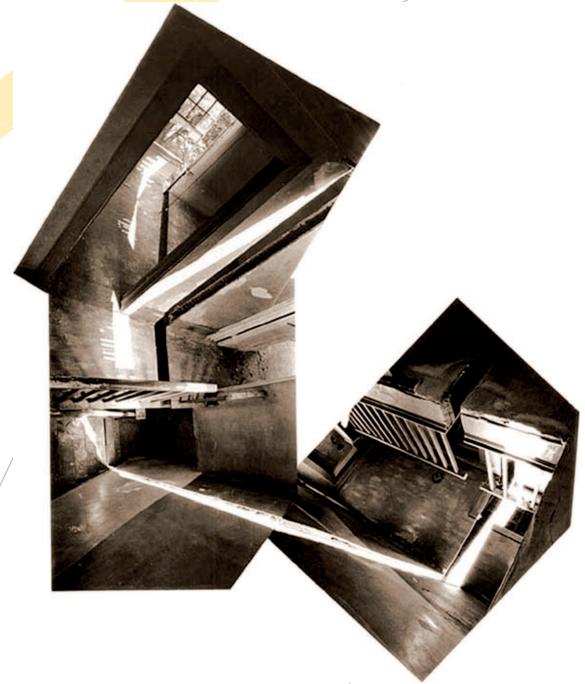
"LIPA MILJØPROSJEKT" LINESØYA

Elisabetta Caharija, Rania Daher, Michael Gruner

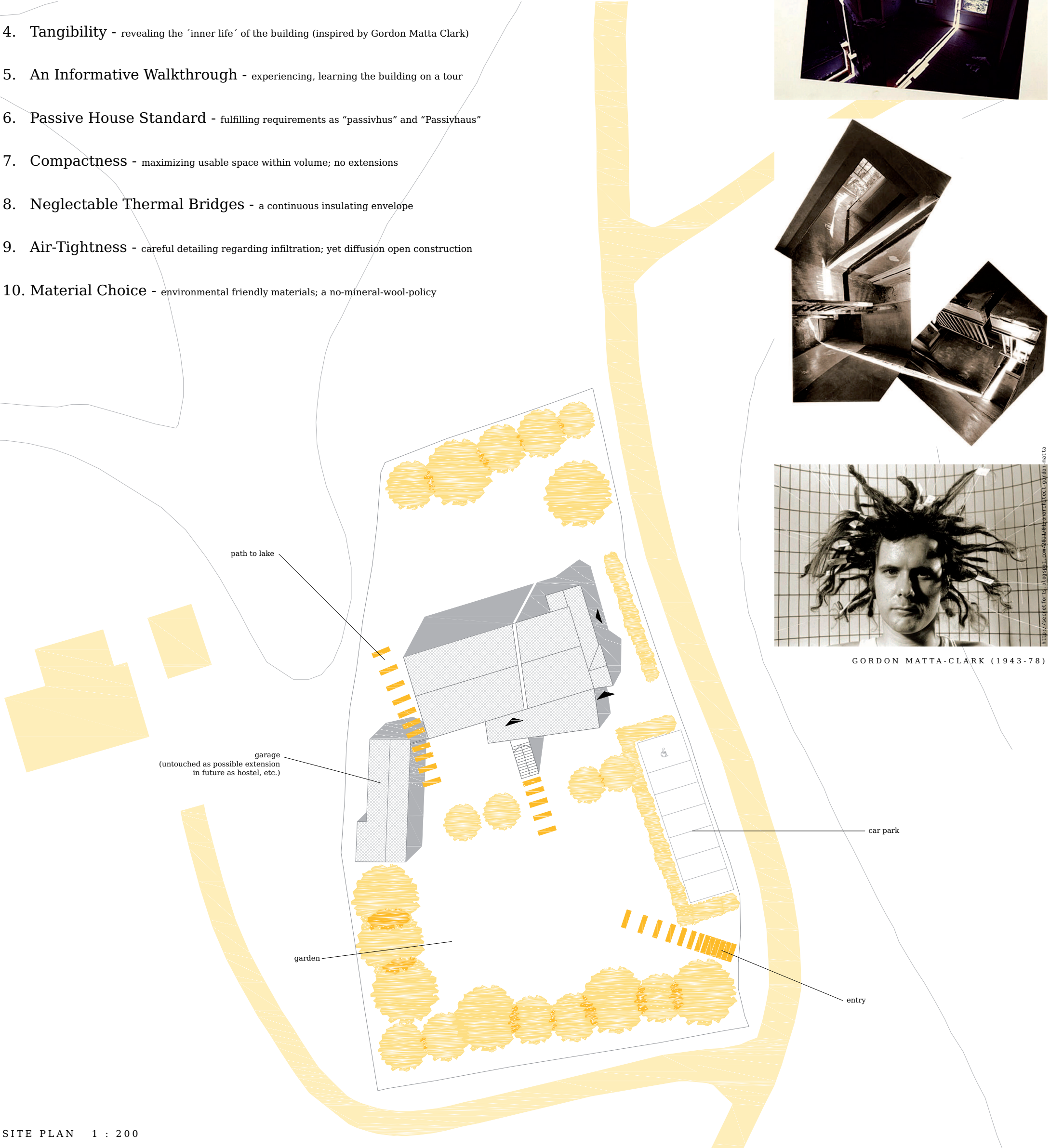
Spring 2011

10 PRINCIPLES

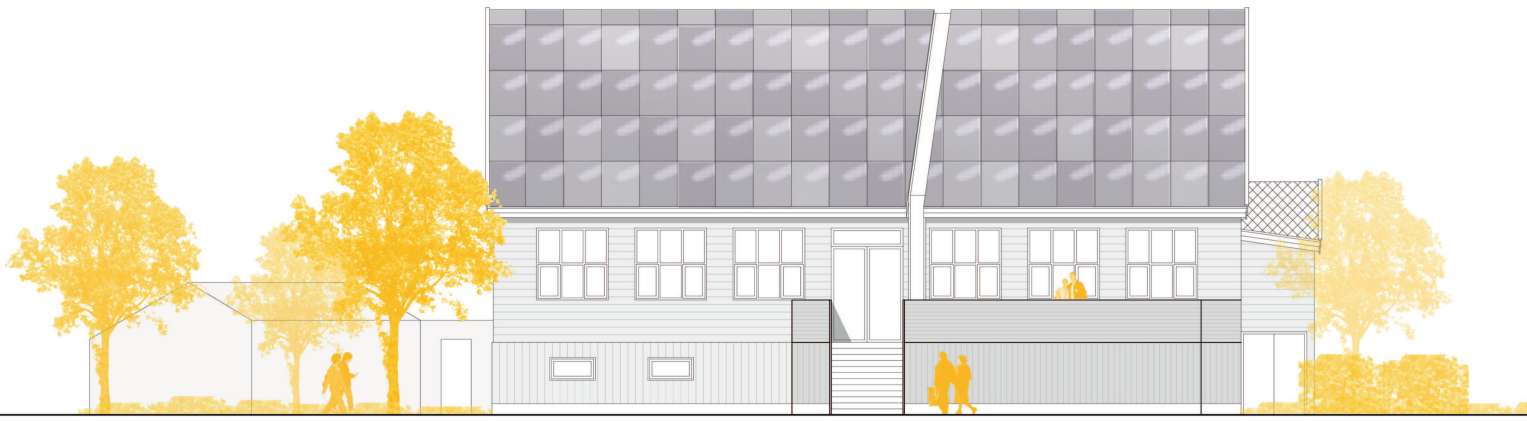
1. Refurbishment - a case study for retro-fitting
2. Respecting The Existing - sensitive fitting in local and historical context
3. Salvageability - re-use of no longer used building parts (e.g. roof girders)
4. Tangibility - revealing the 'inner life' of the building (inspired by Gordon Matta Clark)
5. An Informative Walkthrough - experiencing, learning the building on a tour
6. Passive House Standard - fulfilling requirements as "passivhus" and "Passivhaus"
7. Compactness - maximizing usable space within volume; no extensions
8. Neglectable Thermal Bridges - a continuous insulating envelope
9. Air-Tightness - careful detailing regarding infiltration; yet diffusion open construction
10. Material Choice - environmental friendly materials; a no-mineral-wool-policy



GORDON MATTA-CLARK (1943-78)



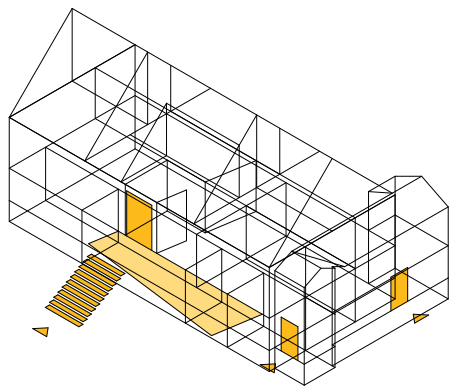
SITE PLAN 1 : 200



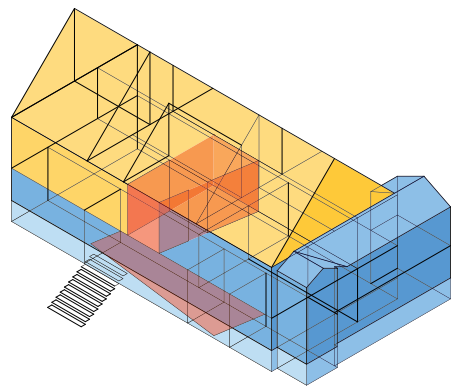
ELEVATION SOUTH FACADE 1:100



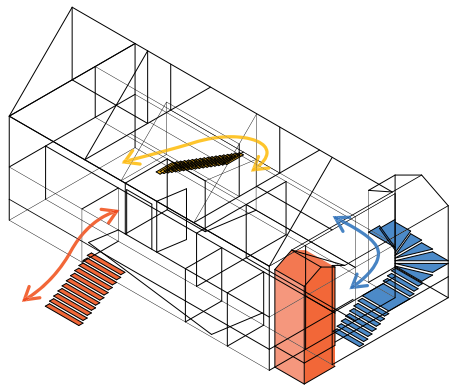
ELEVATION WEST FACADE 1:100



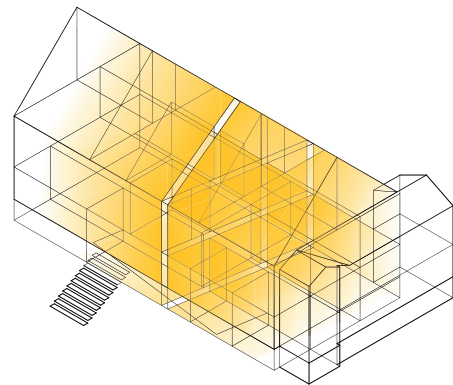
ACCESS



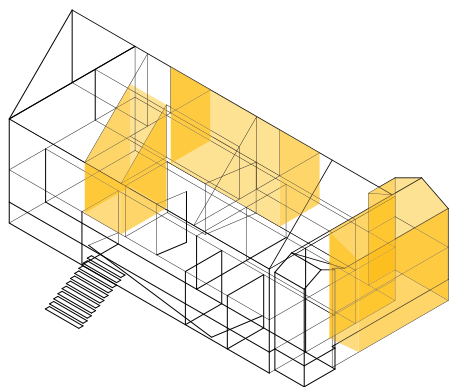
PUBLIC - PRIVATE



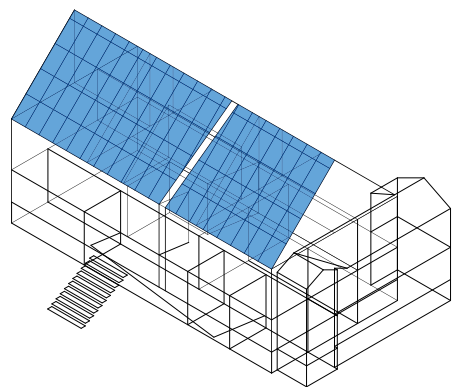
CIRCULATION



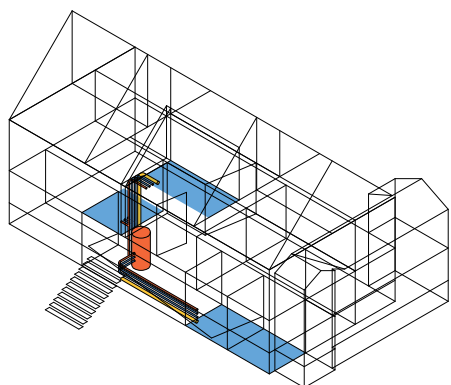
CREVICE



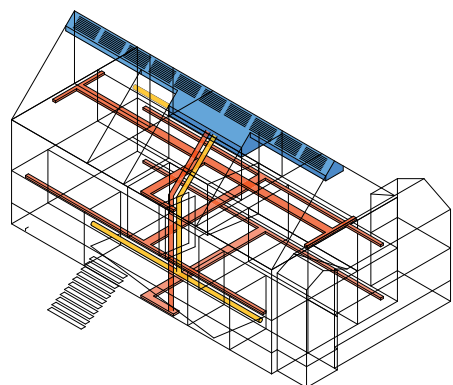
DOUBLE-HEIGHT SPACE



PHOTOVOLTAICS

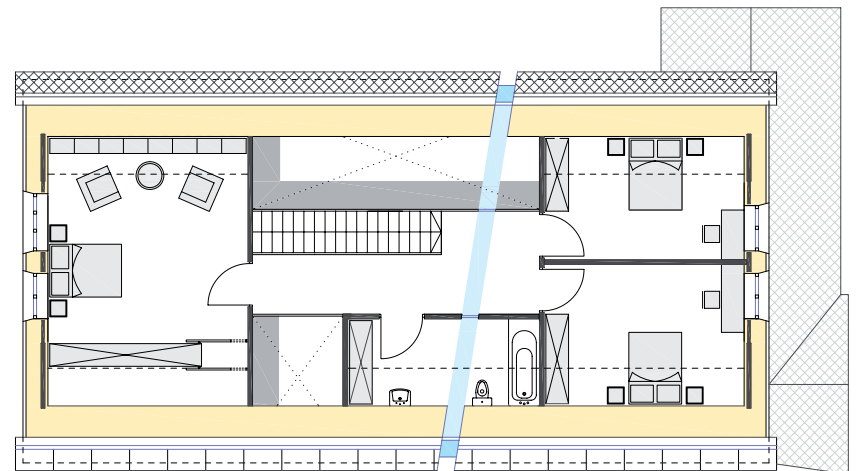


DOMESTIC HOT WATER

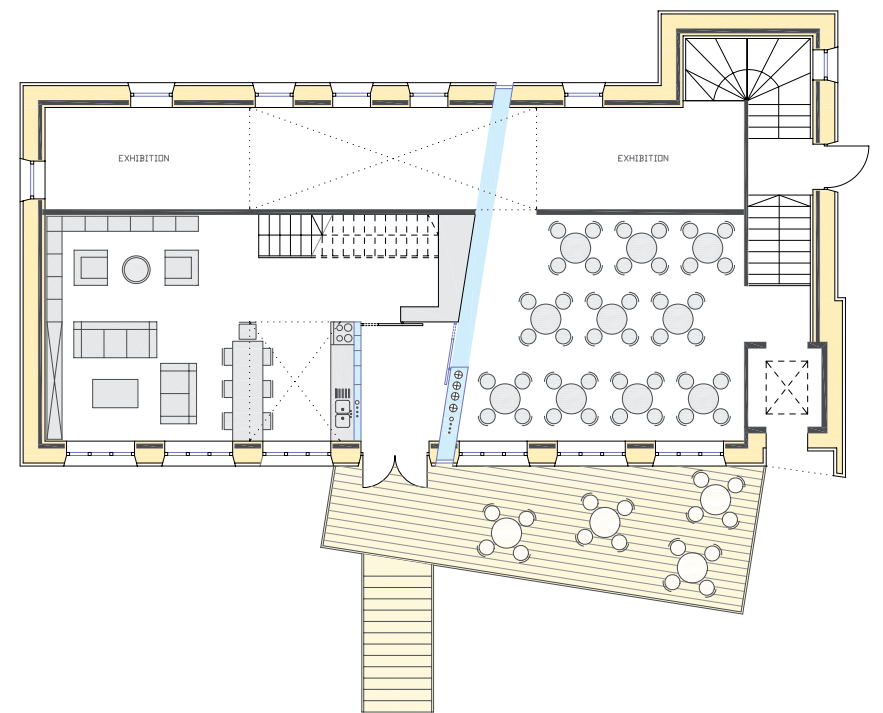


VENTILATION / HEATING

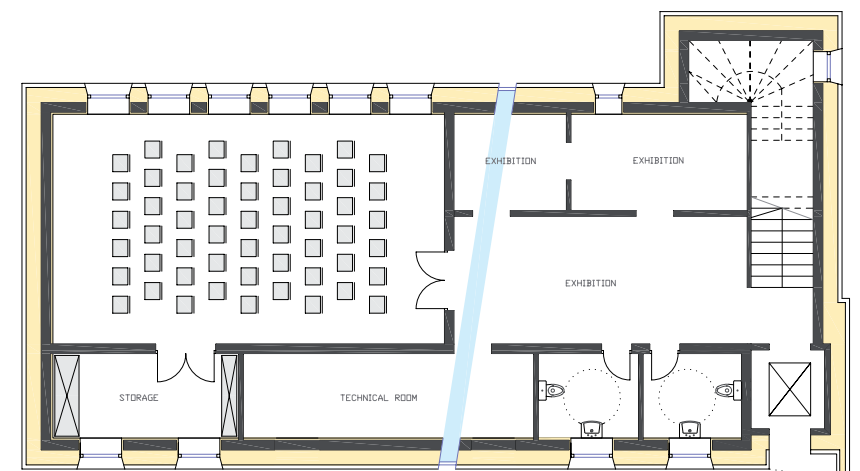
CONCEPTUAL DIAGRAMS



FLOOR PLAN SECOND FLOOR 1:100



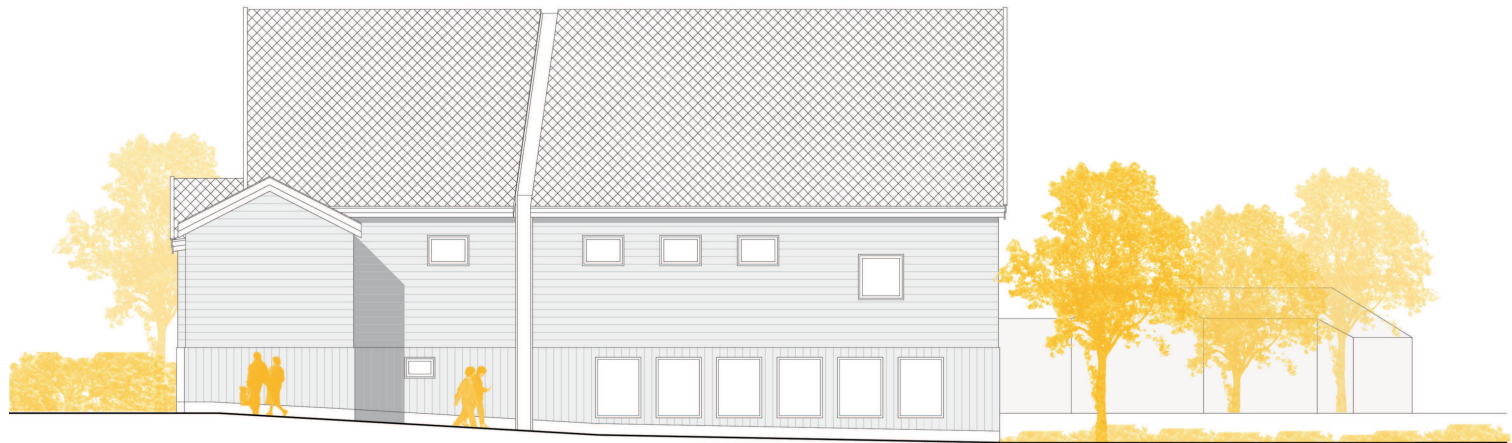
FLOOR PLAN FIRST FLOOR 1:100



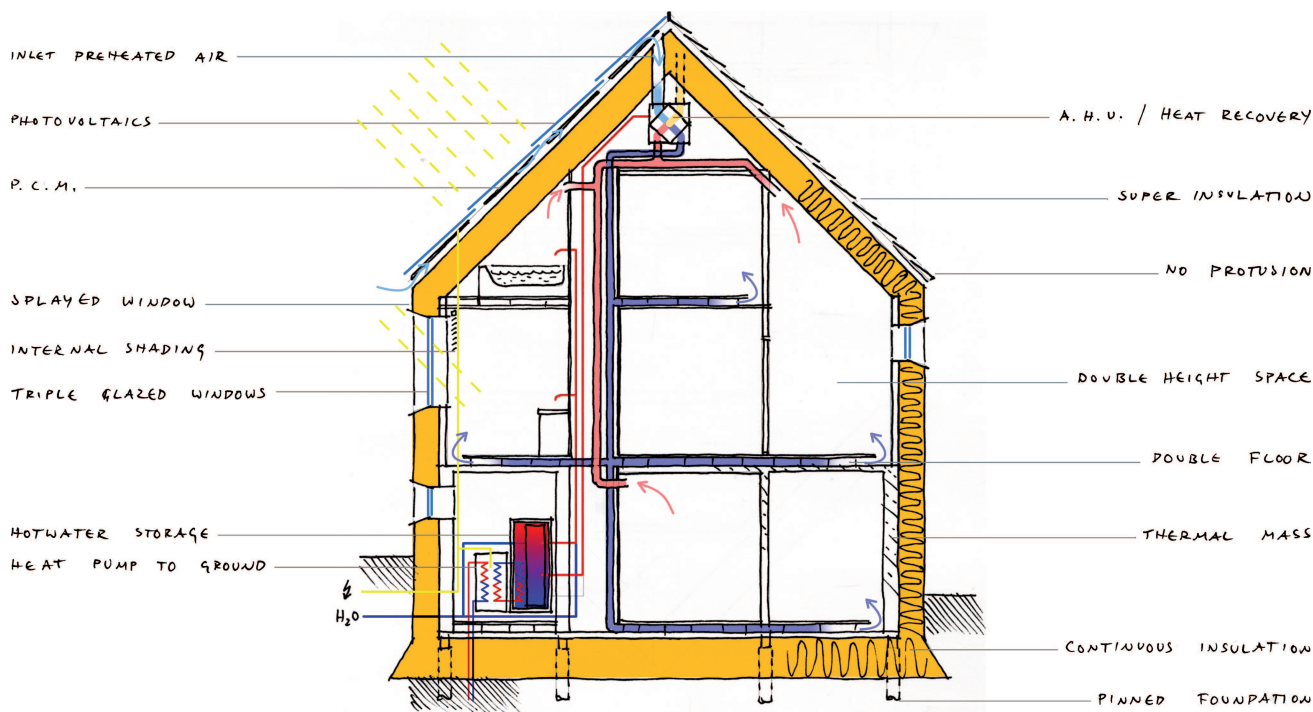
FLOOR PLAN GROUND FLOOR 1:100



ELEVATION SOUTH FACADE 1:100



ELEVATION WEST FACADE 1:100



PASSIVE AND ACTIVE STRATEGIES

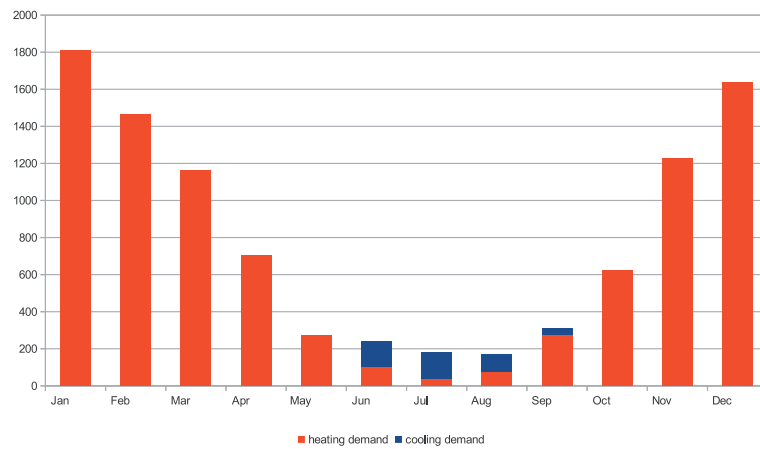
energy budget

prNS3700	power (in W/m²)	operation time (in h/a)	energy demand (in kWh/a)	
heating (supplementary)		2.5	1260.0	
ventilation heating	1.72	8736	15.0	7500.0
fans & pumps	0.90	8736	7.9	3931.2
domestic hot water	3.40	5824	19.8	9900.8
equipment	2.00	5824	11.6	5824.0
lighting	1.30	5824	7.6	3785.6
cooling	-	8736	0	0.0
total energy demand			64.4	32201.6

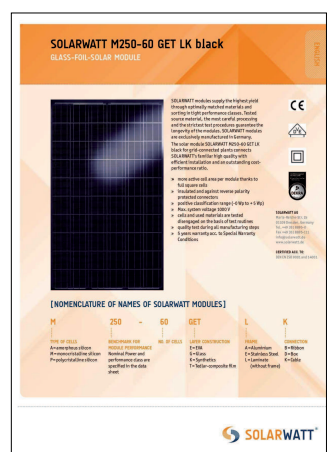
net energy demand

	electricity (in kWh/a)	heating (in kWh/a)	other (in kWh/a)	
heating		1260.0		
ventilation heating		7500.0		
fans & pumps	3931.2			
domestic hot water		9900.8		
equipment	5824.0			
lighting	3785.6			
cooling	0.0			
total energy demand	13540.8	18660.8	0.0	32201.6

HEATING DEMAND ACCORDING TO "ECOTECT"



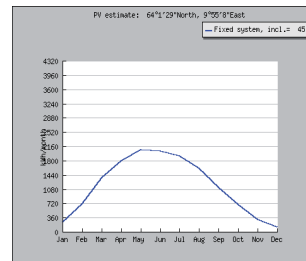
ENERGY DEMAND



PVGIS estimates of solar electricity generation

Location: 64°1'29" North, 9°55'8" East, Elevation: 65 m a.s.l., Nominal power of the PV system: 18.0 kW (crystalline silicon)
 Estimated losses due to temperature: 7.5% (using local ambient temperature)
 Estimated loss due to angular reflectance effects: 2.9%
 Other losses (cables, inverter etc.): 14.0%
 Combined PV system losses: 22.8%

Month	Fixed system: inclination=45 deg., orientation=17 deg.			
	Ed	Em	Hd	Hm
Jan	7.60	236	0.49	15.1
Feb	25.30	708	1.66	46.3
Mar	43.80	1360	2.97	92.0
Apr	59.90	1800	4.25	128
May	66.80	2070	4.92	152
Jun	67.80	2030	5.12	154
Jul	61.80	1910	4.68	145
Aug	51.90	1610	3.88	121
Sep	37.70	1180	2.69	80.7
Oct	22.40	695	1.53	47.5
Nov	10.50	318	0.69	20.8
Dec	3.92	121	0.25	7.87
Year	38.30	1170	2.77	84.1
Total for year		14000		1010

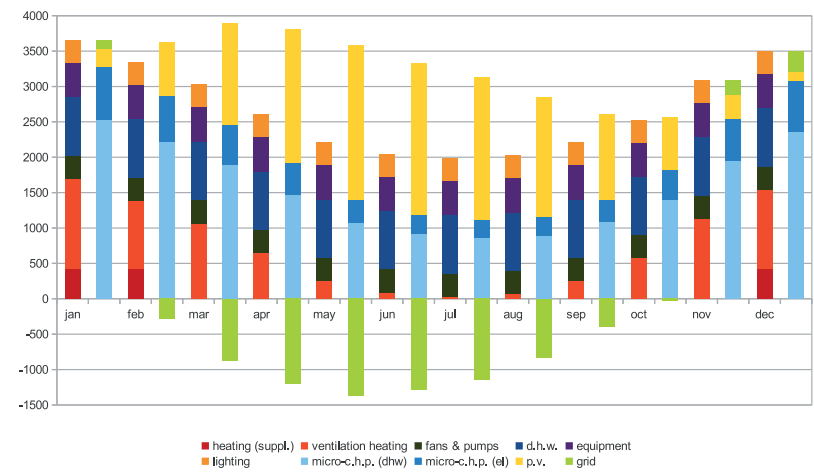


Ed: Average daily electricity production from the given system (kWh)
 Em: Average monthly electricity production from the given system (kWh/m2)
 Hd: Average daily sum of global irradiation per square meter received by the modules of the given system (kWh/m2)
 Hm: Average sum of global irradiation per square meter received by the modules of the given system (kWh/m2)



delivered energy photovoltaics + bio-fuel micro-CHP (power ~3 kW) + electricity grid connection

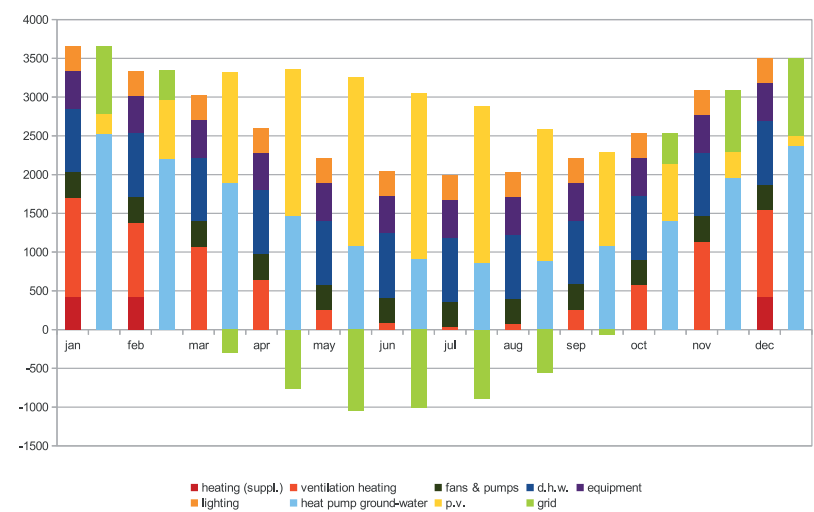
	energy supply (in kWh/a)	fraction (in %)	efficiency	delivered energy		fraction (in %)	CO2 factor (in g/kWh)	CO2 emissions	
				(in kWh/a)	(in kWh/m²a)			(in kg)	(in kg/m²)
electricity									
monocrystalline PV	13986.0	103.3%	100.0	139.9	0.3	13.4%	130.0	18.2	0.0
biofuel micro-CHP (30%)	7997.5	59.1%	0.8	9520.8	19.0	910.5%	14.0	133.3	0.3
grid	-8442.7	-62.3%	1.0	-8615.0	-17.2	-823.9%	617.0	-5315.4	-10.6
total electricity	13540.8	100.0%		1045.7	2.1	100.0%	-4938.3	-5164.0	-20.3
heating									
biofuel micro-CHP (70%)	18660.8	100.0%	0.8	22215.2	44.4	100.0%	14.0	311.0	0.6
total heating	18660.8	100.0%		22215.2	44.4	100.0%	14.0	311.0	0.6
total	32201.6			23260.9	46.5		-4853.0	-9.7	



ENERGY SUPPLY OPTION 1

delivered energy photovoltaics + ground-water heat pump (power ~2.2 kW) + electricity grid connection

	energy supply (in kWh/a)	fraction (in %)	efficiency	delivered energy		fraction (in %)	CO2 factor (in g/kWh)	CO2 emissions	
				(in kWh/a)	(in kWh/m²a)			(in kg)	(in kg/m²)
electricity									
monocrystalline PV	13986.0	103.3%	100.0	139.9	0.3	-44.5%	130.0	18.2	0.0
grid	-445.2	-3.3%	1.0	-454.3	-0.9	144.5%	617.0	-280.3	-0.6
total electricity	13540.8	100.0%		-314.4	-0.6	100.0%	833.6	-262.1	-0.5
heating									
heat pump ground-water	18660.8	100.0%	2.3	8113.4	16.2	100.0%	617.0	5006.0	10.0
total heating	18660.8	100.0%		8113.4	16.2	100.0%	617.0	5006.0	10.0
total	32201.6			7799.0	15.6		4743.8	9.5	



ENERGY SUPPLY OPTION 2 -> CHOSEN

30 2.45 3.70 2.45 30

ROOF, SOUTH FACING, WITH PHOTOVOLTAICS (820 mm)

MONOCRYSTALLINE PHOTOVOLTAICS, 167.4 x 98.4 x 5 mm
 GLASS-FOIL-SOLAR MODULE "SOLARWATT P250-60 GET LK black"
 ROOF-INTEGRATED MOUNTING FOR PHOTOVOLTAICS, (400 mm)
 "MOUNTING SYSTEM GmbH "KAPPA"
 HORIZONTAL BATTEN 48 x 36 mm, e = 165.4 mm
 VERTICAL BATTEN 48 x 48 mm, e = 600 mm
 PHASE-CHANGING-MATERIAL BOARDS, (1500 x 600 x 25 mm) 8
 UNDER P.V. 5, ON HORIZONTAL BATTENS 48 x 36 mm
 UNDER RAFTERS, IMPREGNATED 48 x 73 mm, e = 600 mm
 ROOFING FELT 3 mm
 "UNDERTAK", SHEATING TONGUE AND GROOVE 19 mm
 VENTILATION CAVITY BETWEEN VERTICAL BATTENS 48 x 36 mm, e = 600 mm
 WOOD FIBRE "UNDERTAK" PANEL "HOMATHERM UD-D1protect" (0.046) 35 mm
 RIGID WOOD FIBRE INSULATION "HOMATHERM HDP-D1protect" (0.042) 200 mm
 SHEATING TONGUE AND GROOVE 19 mm
 SOFT WOOD FIBRE INSULATION "HOMATHERM HOLZFLEX PROTECT" (0.040) 200 mm
 BETWEEN RAFTERS 48 x 198 mm, e = 600 mm
 OSB SHEATING, eD-VALUE > 3, 15 mm
 TONGUE AND GROOVE JOINTS SEALED WITH TAPE
 SOFT WOOD FIBRE INSULATION "HOMATHERM HOLZFLEX PROTECT" (0.040) 50 mm
 BETWEEN BATTENS 48 x 48 mm, e = 600 mm
 WOODEN CLADDING, TONGUE AND GROOVE 15 mm

ROOF, NORTH FACING, WITH SLATE (810 mm)

ROOFING, EXISTING ROOF SLATE, "FIRHANT" LAYING
 HORIZONTAL BATTEN 48 x 36 mm, e = (270) mm
 VERTICAL BATTEN 48 x 48 mm, e = 600 mm
 (UNDER RAFTER), IMPREGNATED 48 x 73 mm, e = 600 mm
 ROOFING FELT 3 mm
 "UNDERTAK", SHEATING TONGUE AND GROOVE 19 mm
 VENTILATION CAVITY BETWEEN VERTICAL BATTENS 48 x 36 mm, e = 600 mm
 WOOD FIBRE "UNDERTAK" PANEL "HOMATHERM UD-D1protect" (0.046) 35 mm
 RIGID WOOD FIBRE INSULATION "HOMATHERM HDP-D1protect" (0.042) 200 mm
 SHEATING TONGUE AND GROOVE 19 mm
 SOFT WOOD FIBRE INSULATION "HOMATHERM HOLZFLEX PROTECT" (0.040) 200 mm
 BETWEEN RAFTERS 48 x 198 mm, e = 600 mm
 OSB SHEATING, eD-VALUE > 3, 15 mm
 TONGUE AND GROOVE JOINTS SEALED WITH TAPE
 SOFT WOOD FIBRE INSULATION "HOMATHERM HOLZFLEX PROTECT" (0.040) 50 mm
 BETWEEN BATTENS 48 x 48 mm, e = 600 mm
 WOODEN CLADDING, TONGUE AND GROOVE 15 mm

TO AIR HANDLING UNIT

TO AIR HANDLING UNIT

FLOORING GROUND FLOOR - FIRST FLOOR (250) mm

INDUSTRIAL PARQUET 23 mm
 HYBRIDE ELASTIC GLUE (ON MODIFIED SILANE BASE)
 LOAD DISTRIBUTING OSB BOARD SHEATING 22 mm
 "TILFARER" e = 600 mm, 48x123 mm
 ON WEDGES, e = 1200 mm
 ACOUSTIC INSULATION "HOMATHERM" 30 mm
 SEPARATION FILM, PAPER
 LAMINATED VENEER LUMBER SLAB "KERTO Q" 63 mm

EXTERIOR WALL FIRST FLOOR (650 mm)

HORIZONTAL CLADDING, SIDING BOARDS, OVERLAP > 15 mm 2 x 148 x 19 mm
 VENTILATION CAVITY BETWEEN VERTICAL BATTENS 48 x 36 mm, e = 600 mm
 WOOD FIBRE "UNDERTAK" PANEL "HOMATHERM UD-D1protect" (0.046) 35 mm
 RIGID WOOD FIBRE INSULATION "HOMATHERM HDP-D1protect" (0.042) 160 mm
 CONVECTION BREAK PAPER
 SOFT WOOD FIBRE INSULATION "HOMATHERM HOLZFLEX PROTECT" (0.040) 200 mm
 BETWEEN STUDS 48 x 198 mm, e = 600 mm
 EXISTING "HOMATHERM" TONGUE AND GROOVE PLANKS ca. 40 mm, 100 mm
 CAVITIES FILLED WITH "HOMATHERM HOLZFLEX PROTECT"
 OSB BOARD, eD-VALUE > 3, 15 mm
 TONGUE AND GROOVE JOINTS SEALED WITH TAPE
 SOFT WOOD FIBRE INSULATION "HOMATHERM HOLZFLEX PROTECT" (0.040) 50 mm
 BETWEEN BATTENS 48 x 48 mm, e = 600 mm
 WOODEN CLADDING, TONGUE AND GROOVE 15 mm

FLOORING GROUND FLOOR - FIRST FLOOR 220 mm

INDUSTRIAL PARQUET 23 mm
 HYBRIDE ELASTIC GLUE (ON MODIFIED SILANE BASE)
 RE-USED FLOOR BOARDS 22 mm
 "TILFARER" e = 600 mm, 48x148 mm
 ON WEDGES, e = 1800 mm
 ACOUSTIC INSULATION "HOMATHERM" 50 mm
 SEPARATION FILM, PAPER
 EXISTING REINFORCED CONCRETE SLAB 120/360 mm

EXTERIOR WALL, GROUND FLOOR ABOVE GROUND (820 mm)

VERTICAL CLADDING, SIDING BOARDS, OVERLAP > 15 mm 2 x 148 x 19 mm
 HORIZONTAL BATTENS 48 x 36 mm, e = 600 mm
 VENTILATION CAVITY BETWEEN VERTICAL BATTENS 48 x 36 mm, e = 600 mm
 WOOD FIBRE "UNDERTAK" PANEL "HOMATHERM UD-D1protect" (0.046) 35 mm
 RIGID WOOD FIBRE INSULATION "HOMATHERM HDP-D1protect" (0.042) 160 mm
 CONVECTION BREAK PAPER
 SOFT WOOD FIBRE INSULATION "HOMATHERM HOLZFLEX PROTECT" (0.040) 200 mm
 BETWEEN STUDS 48 x 198 mm, e = 600 mm
 EXISTING REINFORCED CONCRETE WALL, 250 mm
 SOFT WOOD FIBRE INSULATION "HOMATHERM HOLZFLEX PROTECT" (0.040) 50 mm
 BETWEEN BATTENS 48 x 48 mm, e = 600 mm
 WOODEN CLADDING, TONGUE AND GROOVE 15 mm

SLAB TO GROUND (CONVENTIONAL SOLUTION) (690) mm

INDUSTRIAL PARQUET 23 mm
 HYBRIDE ELASTIC GLUE (ON MODIFIED SILANE BASE)
 LOAD DISTRIBUTING OSB BOARD SHEATING 22 mm
 ACOUSTIC INSULATION "HOMATHERM" (0.040), 50 mm
 BETWEEN "TILFARER" e = 600 mm, 73 x 48 mm
 ELASTOMERIC WATERPROOFING SLURRY 3 mm
 FLOOR SLAB, REINFORCED CONCRETE 100 mm
 SEPARATION FILM, RE-FIL 2 x 0.2 mm
 PERIMETER INSULATION "FOANGLAS FLOOR PANEL" (0.04) 140 mm
 PERIMETER INSULATION "FOANGLAS FLOOR BOARD" 140 mm
 CAPILLAR BREAKING GLASS FOAM GRAVEL (0.09) 200 mm
 DRAINAGE FIBROUS FABRIC

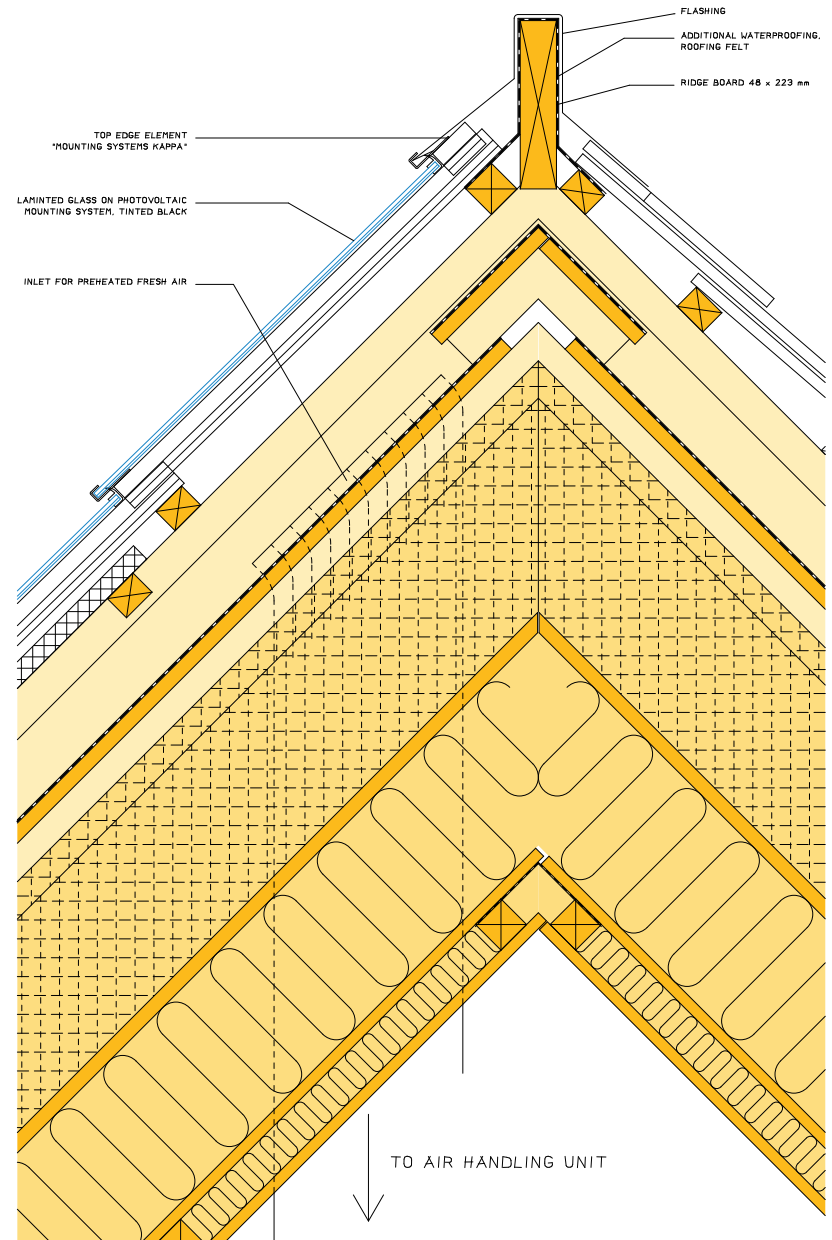
SLAB TO GROUND (ALTERNATIVE) 1140 mm

INDUSTRIAL PARQUET 23 mm
 HYBRIDE ELASTIC GLUE (ON MODIFIED SILANE BASE)
 RE-USED FLOOR BOARDS 22 mm
 "TILFARER" e = 600 mm, 48x148 mm
 ON WEDGES, e = 1800 mm
 ACOUSTIC INSULATION "HOMATHERM" 50 mm
 SEPARATION FILM, PAPER
 FLOOR SLAB, REINFORCED CONCRETE 120 mm
 SEPARATION FILM, RE-FIL 2 x 0.2 mm
 GLASS FOAM GRAVEL, (0.09) 600 mm
 COMPRESSION RATIO 1 : 13
 DRAINAGE FIBROUS FABRIC

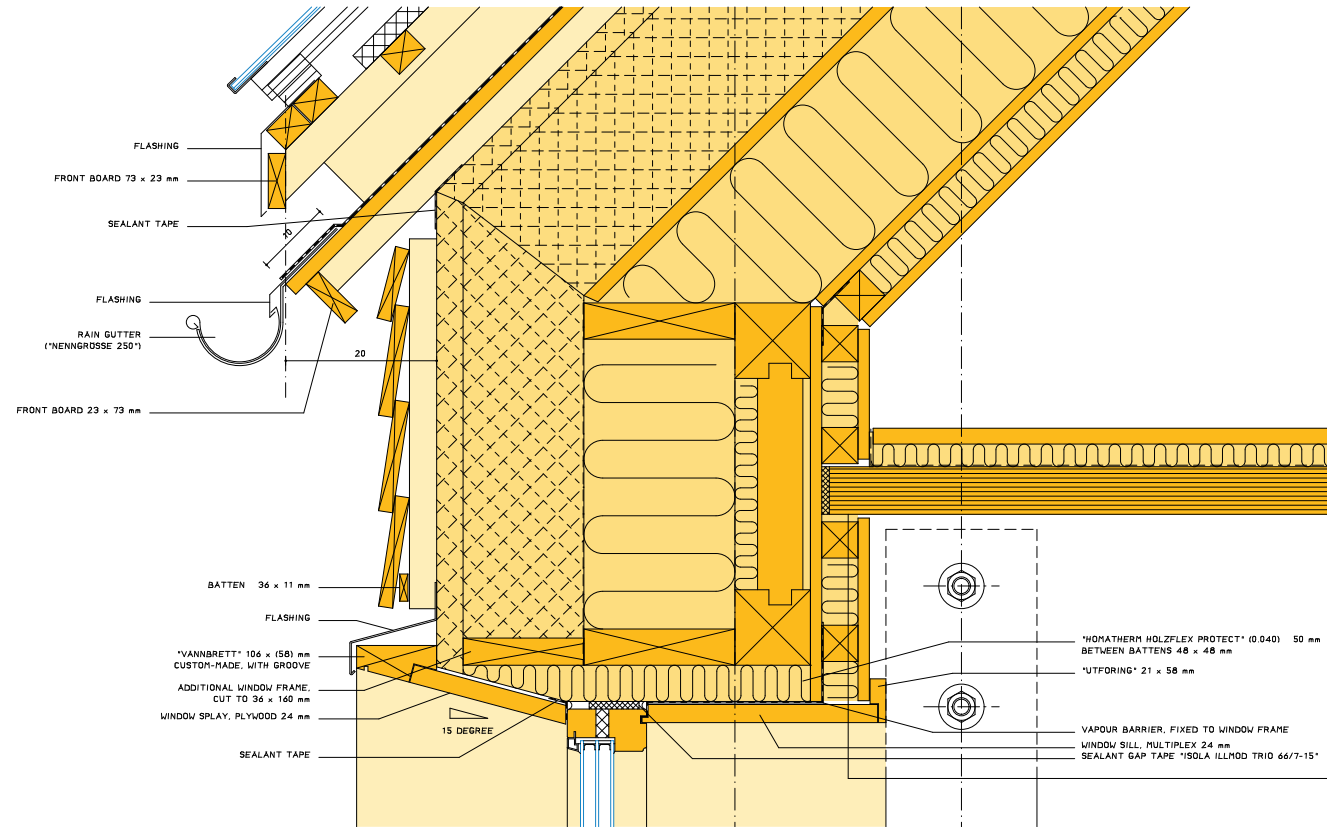
EXTERIOR WALL, GROUND FLOOR BELOW GROUND (650 mm)

BUILDING DRAINAGE, FIBROUS FABRIC
 BUILDING DRAINAGE, DIMPLE SHEATING
 PERIMETER INSULATION "FOANGLAS WALL BOARD" (0.04) 140 mm
 PERIMETER INSULATION "FOANGLAS PANEL" (0.04) 2 x 100
 ELASTOMERIC WATERPROOFING SLURRY 3 mm
 EXISTING REINFORCED CONCRETE WALL, 250 mm
 SOFT WOOD FIBRE INSULATION "HOMATHERM HOLZFLEX PROTECT" (0.040) 50 mm
 BETWEEN BATTENS 48 x 48 mm, e = 600 mm
 WOODEN CLADDING, TONGUE AND GROOVE 15 mm

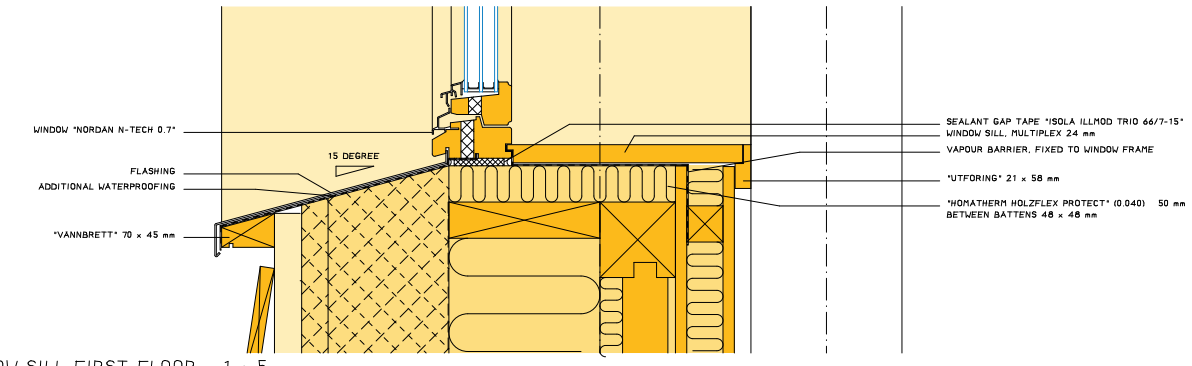
CROSS SECTION 1 : 20



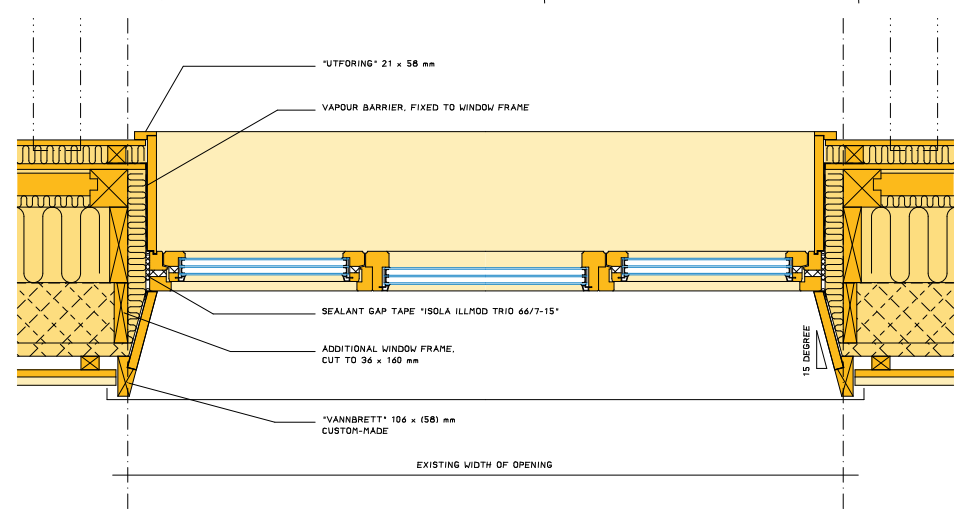
DETAIL RIDGE OF ROOF 1 : 5



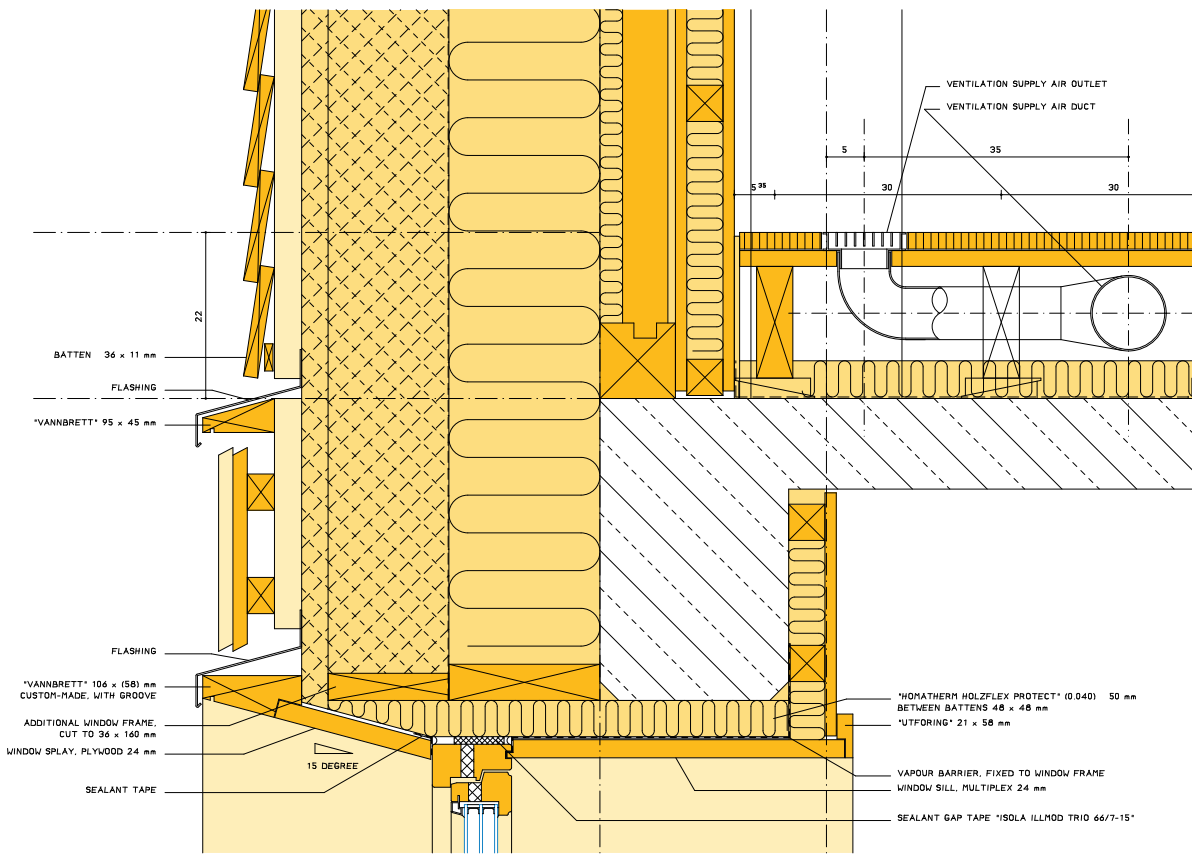
DETAIL EAVES - SOUTH ROOF WITH PHOTOVOLTAICS + WINDOW LINTEL FIRST FLOOR 1 : 5



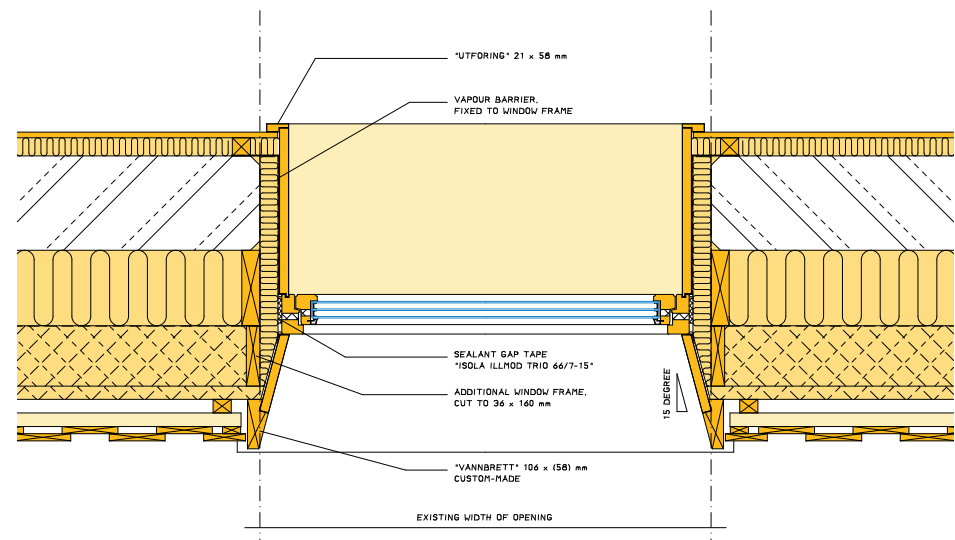
DETAIL WINDOW SILL FIRST FLOOR 1 : 5



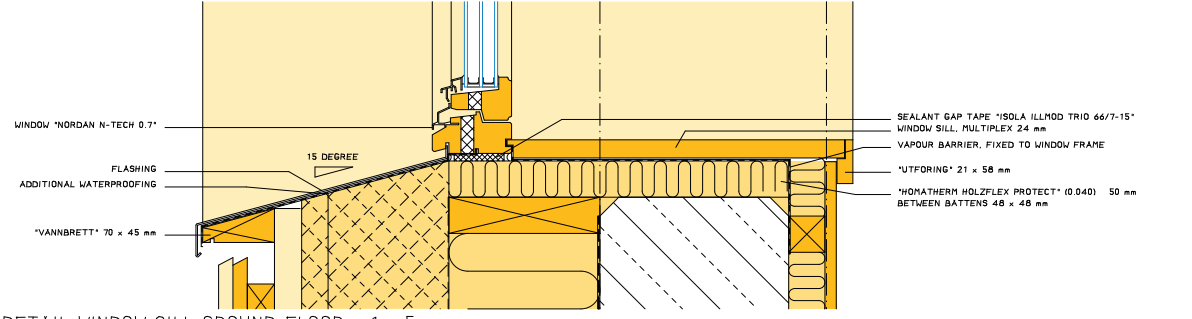
DETAIL WINDOW JAMB FIRST FLOOR 1 : 10



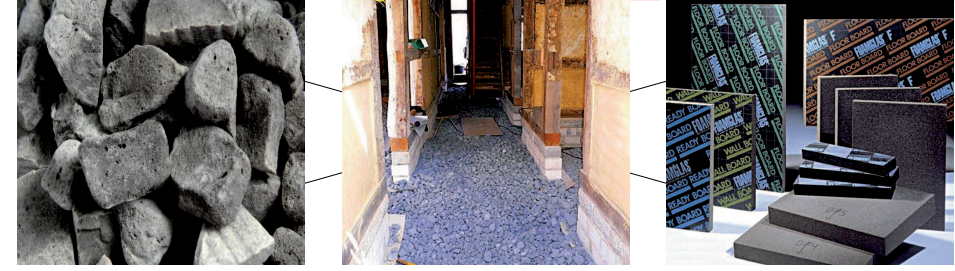
DETAIL WALL GROUND FLOOR - FIRST FLOOR + WINDOW LINTEL GROUND FLOOR 1 : 5



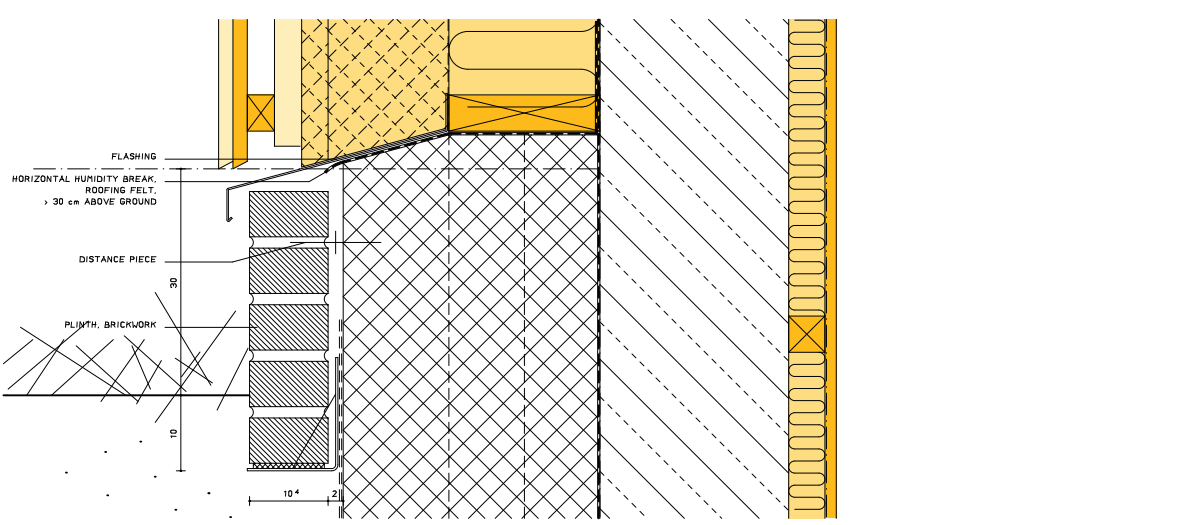
DETAIL WINDOW JAMB GROUND FLOOR 1 : 10



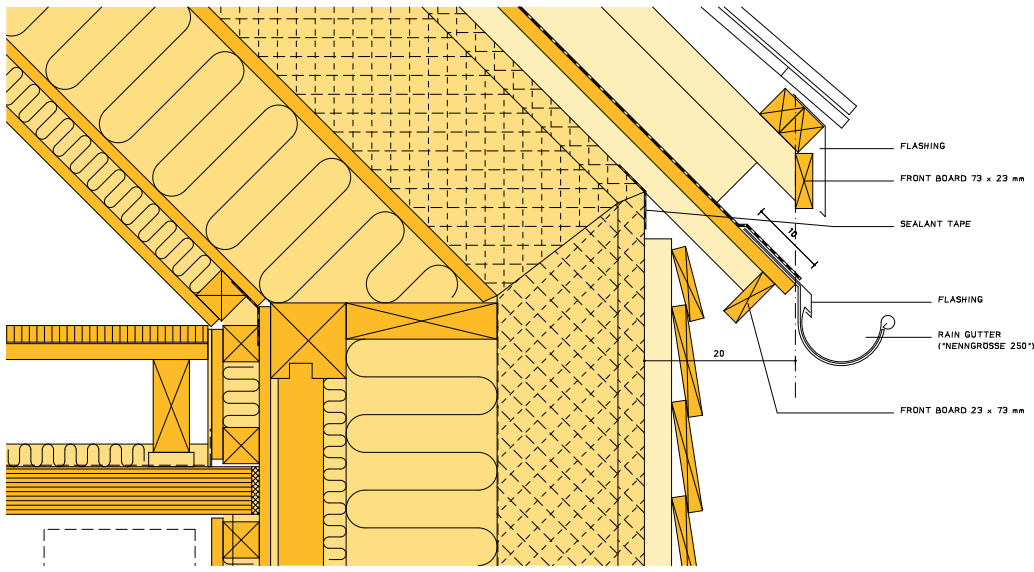
DETAIL WINDOW SILL GROUND FLOOR 1 : 5



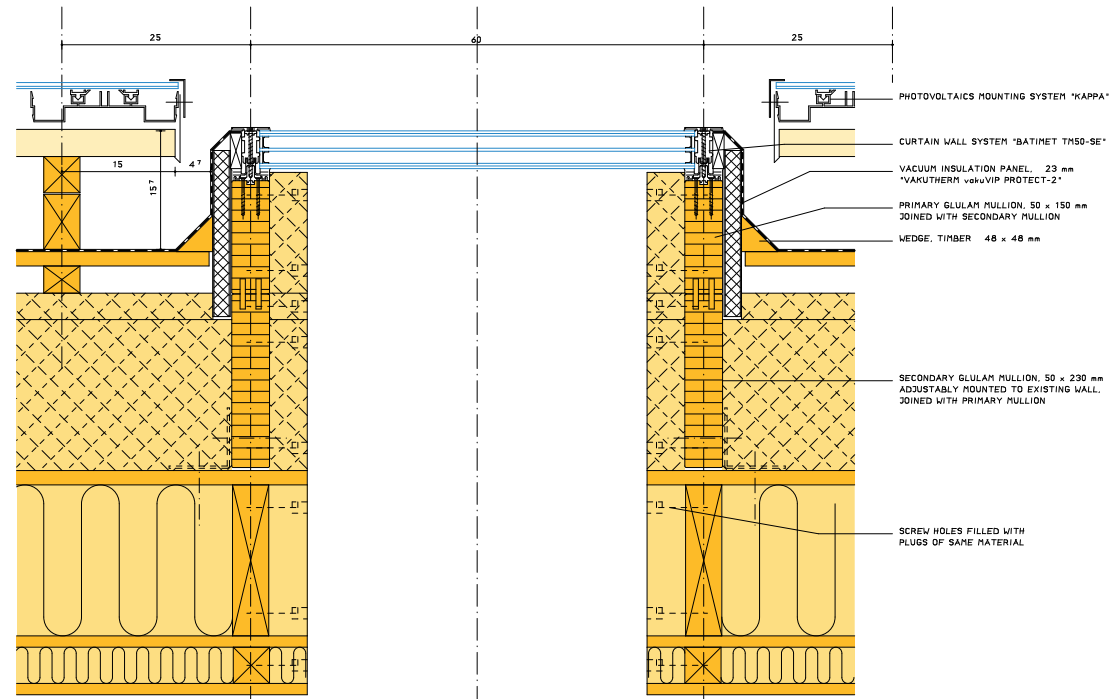
FOAM GLASS / FOAM GLASS GRAVEL



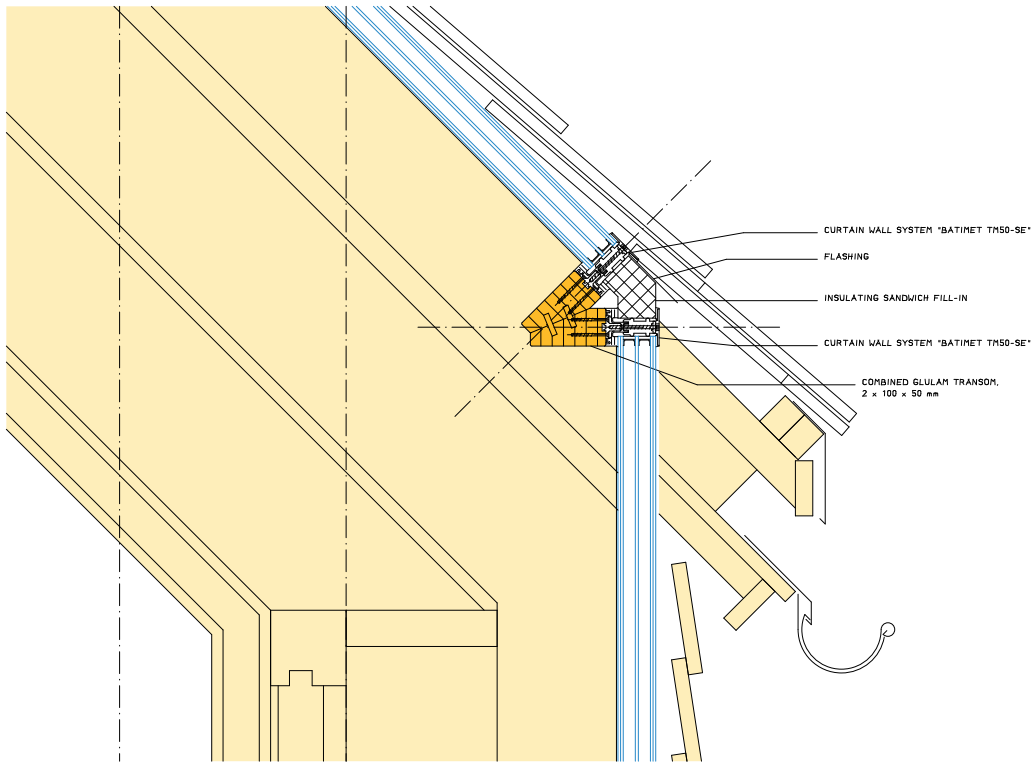
DETAIL PLINTH GROUND FLOOR 1 : 5



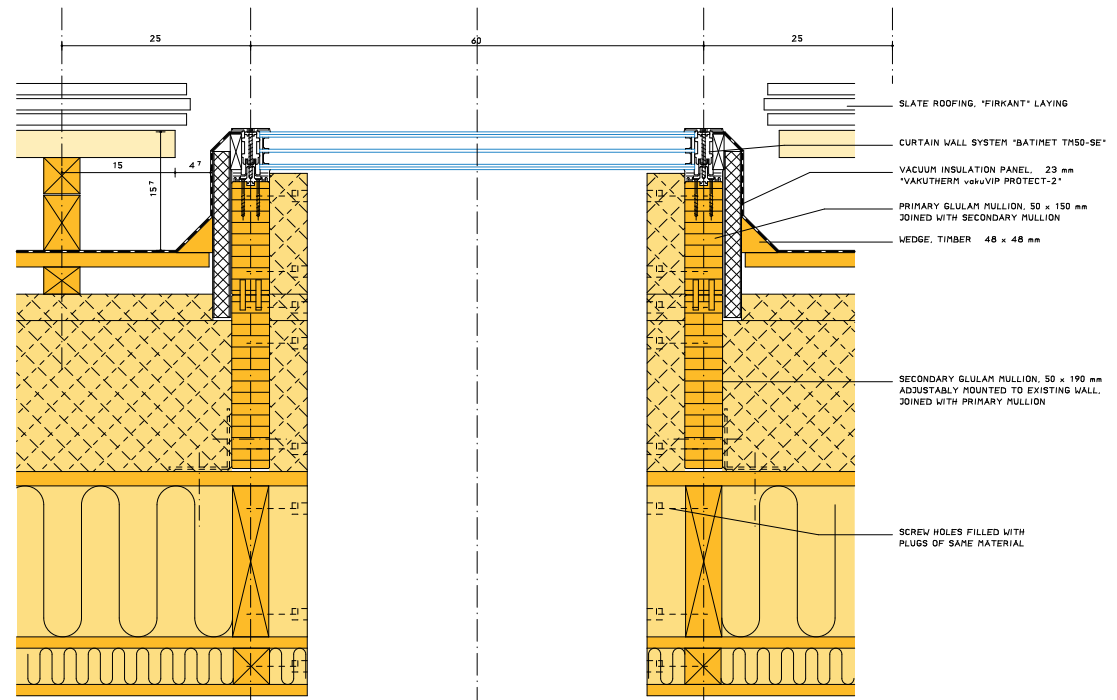
DETAIL EAVES - NORTH ROOF WITH SLATE ROOFING 1 : 5



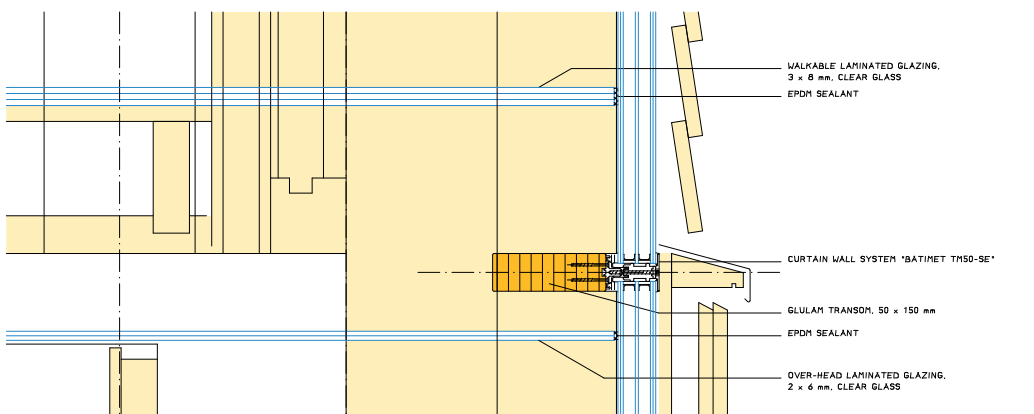
DETAIL "MATTA C." - SOUTH ROOF WITH PHOTOVOLTAICS 1 : 5



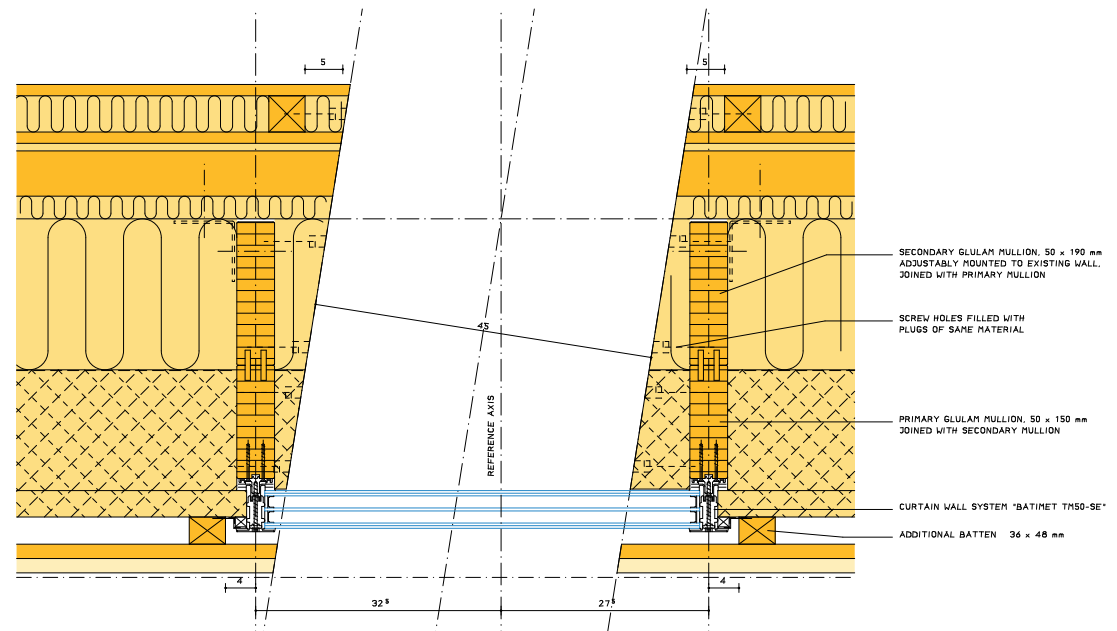
DETAIL "MATTA C." - EAVES 1 : 5



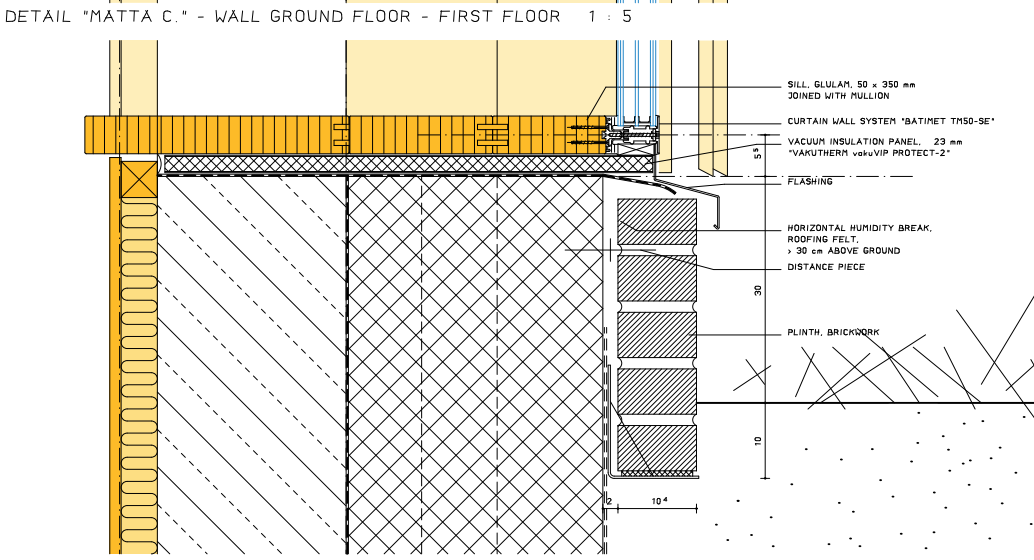
DETAIL "MATTA C." - NORTH ROOF WITH SLATE ROOFING 1 : 5



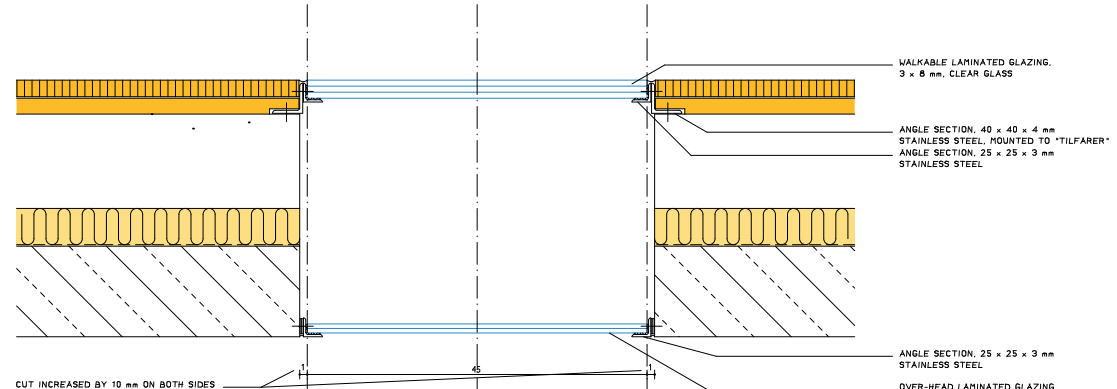
DETAIL "MATTA C." - WALL GROUND FLOOR - FIRST FLOOR 1 : 5



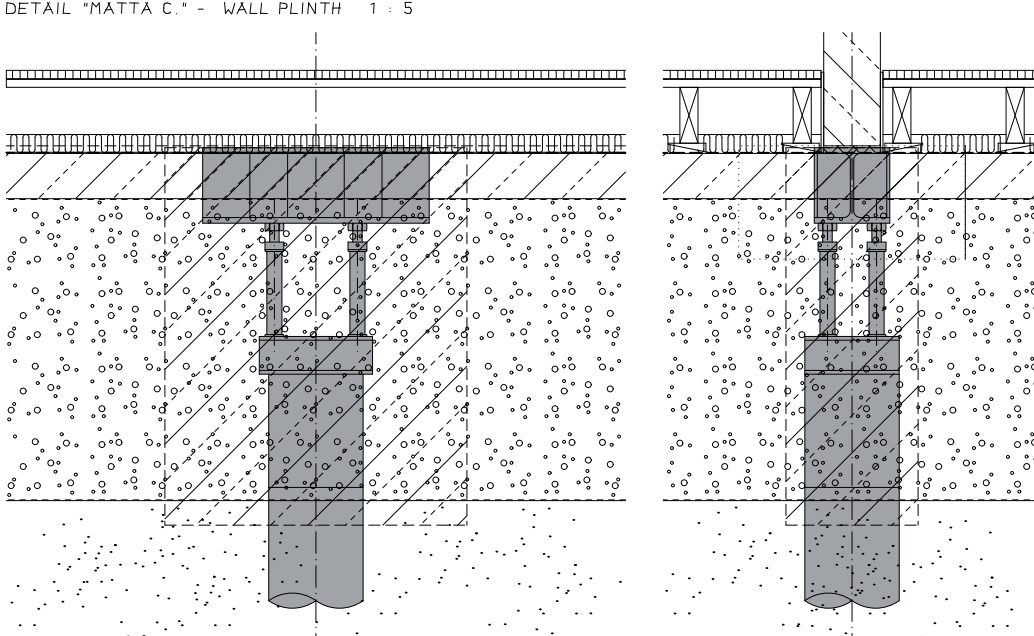
DETAIL "MATTA C." - WALL FIRST FLOOR 1 : 5



DETAIL "MATTA C." - WALL PLINTH 1 : 5



DETAIL "MATTA C." - SLAB GROUND FLOOR - FIRST FLOOR 1 : 5



ELEVATIONS "ERKAPFAHL" 1 : 10



UNDERPINNING SYSTEM "ERKAPFAHL"