SGN PLACE

SEVENOAKS GASHOLDER STATION

CRAMPTONS ROAD, SEVENOAKS, KENT, TN14 5ES

PLANNING APPLICATION - MARCH 2021

SGN Place

SKELLY & COUCH

ENERGY STRATEGY

1499 - SEVENOAKS GASHOLDERS SITE

REV. 7.0 / MARCH 2021

Contents

1. OVERVIEW....2
   1.1. Introduction....2
   1.2. The Site....2
2. Regional and Local Policies....3
   2.1. The Low Carbon and Sustainability Agenda . 3
   2.2. Sevenoaks Local Plan....3
   2.3. Building Regulations Compliance....3
3. ENVIRONMENTAL DESIGN STRATEGY....5
   3.1. The Energy Hierarchy....6
   3.2. Be Lean....7
   3.3. Be Clean....8
   3.4. Be Green....9
4. Low and Zero Carbon Technologies....10
   4.1. Introduction....10
   4.2. Summary of Feasibility Study....10
   4.3. Planning Requirements....10
   4.4. Incentives for LZC Energy Production....10
   4.5. Photovoltaic Panels....10
   4.6. Solar Thermal Panels....11
   4.7. Ground Source Heat Pumps....11
   4.8. Air Source Heat Pumps....12
5. ENERGY ASSESSMENT....13
   5.1. Energy and Sustainability Strategy....13
   5.2. Energy Model Overview....13
   5.3. Fabric and Systems....14
   5.4. Carbon Factors....14
   5.5. Unregulated Energy....14
   5.6. Results....14
   5.7. SAP Results Summary....15
6. Overheating Risk Analysis....16
   6.1. Introduction....16
   6.2. Relevant Assessment Criteria....16
   6.3. Assessment Method....16
   6.4. Overheating Model....16
   6.5. Results....19
7. Daylight Assessment....20
   7.1. Introduction....20
   7.2. Assessment Method....20
   7.3. Daylight Model....20
   7.4. Results....21
8. Water Consumption....22
   8.1. Reducing Consumption....22
   8.2. Monitoring....22
   8.3. Rainwater recycling....22
9. Metering Strategy....23
   9.1. Electricity Metering....23
   9.2. Water Metering....23
   9.3. Renewables....23

APPENDIX I: Natural Ventilation Free Areas....24

APPENDIX II : Daylight Factors....28

Audit History

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1. OVERVIEW

1.1. Introduction

This Energy Strategy report has been prepared by Skelly and Couch Ltd. in support of the planning application for the development of the Sevenoaks Gas Holder Site located in Sevenoaks, Kent, on behalf of Kin Developments Ltd. and SGN Place Ltd. The proposal is for the construction of a residential development consisting of 136no. dwellings, with new vehicular accesses from Otford Road and Cramptons Road, associated parking, landscaping, drainage, boundary treatments and earthworks (the 'Proposed Development').

This report outlines the energy strategies proposed for all aspects of the development at Sevenoaks and following the energy assessment guidance will demonstrate how regulated carbon emissions reductions will be met in line with all relevant local planning policies.

1.2. The Site

The site, previously owned by SGN Networks and used for gas storage, will be turned into a residential development consisting of 3 separate types of flats, the Rotunda paying homage to the gas tower that previously stood there, along with terraces of townhouses along Crampton's Road to the East of site. A summary of dwelling types and quantities is tabulated below.

Type	Quantity
Townhouse, 2 bedrooms	1
Townhouse, 3 bedrooms	9
Rotunda, 1 bedroom	19
Rotunda, 2 bedrooms	30
Rotunda, 3 bedrooms	18
Block, Studio	1
Block, 1 bedroom	26
Block, 2 bedrooms	27
Block, 3 bedrooms	5
Total	**136**

Site Boundary

Proposed Development

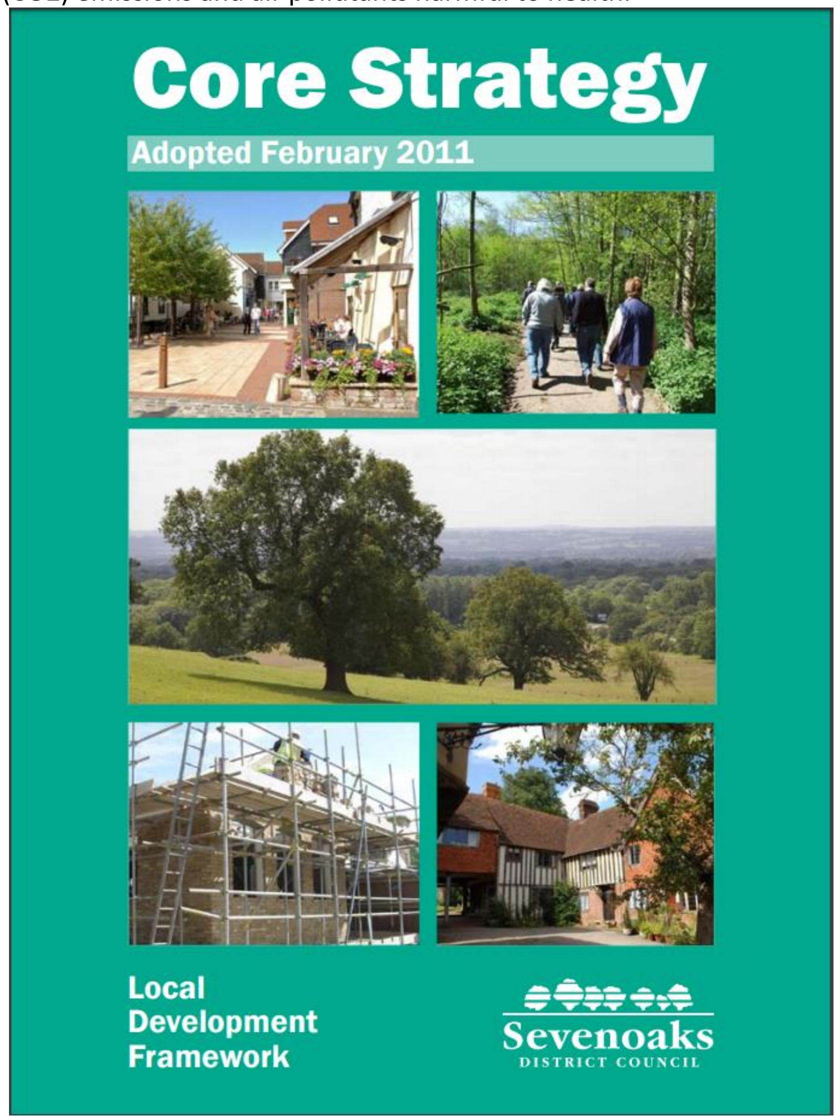
2. REGIONAL AND LOCAL POLICIES

2.1. The Low Carbon and Sustainability Agenda

The need to create a more sustainable built environment for future generations has led, in the last few years, to the introduction of a series of minimum design standards for sustainable design and construction of new and refurbished buildings. This section summarises the requirements for sustainable design from building control, and the local planning authority for the proposed development.

2.2.Sevenoaks Local Plan

Sevenoaks Council encourages new developments to be energy and resource efficient. The Sevenoaks Core Strategy, adopted in February 2011, requires new developments to minimise use of energy and other non-renewable resources, as well as to facilitate an increase in the use of low and zero carbon technologies to help reduce carbon dioxide (CO_2) emissions and air pollutants harmful to health.



In addition to meeting Part L1A compliance, the development needs to meet the requirement of 10% reduction of energy consumption through the use of onsite renewables as stipulated by NRM11 of the South East Plan.

> Policy NRM11 of the South East Plan:
> Local authorities should:
>
> i) promote and secure greater use of decentralised and renewable or low-carbon technology energy in new development, including through setting ambitious but viable proportions of the new energy supply for new development to be required to come from such sources. In advance of local targets being set in development plan documents, new developments of more than 10 dwellings or 1000m^2 of non-residential floorspace should secure at least 10% of their energy from decentralised and renewable or low-carbon sources unless, having regard to the type of development involved and its design, this is not feasible.
>
> ii) use design briefs and/or supplementary planning documents to promote development design for energy efficiency, low carbon and renewable energy.
>
> iii) work towards incorporation of renewable energy sources including, in particular, passive solar design, solar water heating, photovoltaics, ground source heat pumps and in larger scale development, wind and biomass generated energy.
>
> iv) actively promote energy efficiency and use of renewable and low carbon energy sources where opportunities arise by virtue of the scale of new development including regional growth areas, growth points and eco towns.
>
> Local authorities and other public bodies, as property owners and managers, should seek to achieve high levels of energy efficiency when refurbishing their existing stock.

2.3.Building Regulations Compliance

Building Regulations apply to all developments, and are in place to ensure buildings meet health, safety, welfare, convenience, and sustainability standards; they focus on the technical aspects of designing and constructing a building.

The proposed development will be fully compliant with all revisions of the Building Regulations relevant to MEPH design.

The Building Regulations Part L - Conservation of Fuel and Power are continually being updated in an attempt to improve the energy efficiency of new and refurbished building work that needs to be inspected by Building Control or an approved inspector.

2.3.1. Current Regulations

Part L1A 2013: Conservation of Fuel and Power in New Dwellings

Compliance at the design stage is demonstrated by calculating and comparing the CO_2 emissions rate for the proposed dwelling (or individual houses and apartments in this case), known as the Dwelling Emissions rate (DER), and an equivalent notional building of the same geometry but with a set of benchmark performance characteristics as specified in the 2010 NCM modelling guide, known as the Target Emissions Rate (TER).

The government approved Standard Assessment Procedure (SAP) methodology has been employed to demonstrate compliance with these regulations.

2.3.2. Future Regulations

Future Homes Standard

The UK has set in law a target to bring all its greenhouse gas emissions to net zero by 2050. As part of the journey to 2050 the Government committed to introducing the Future Homes Standard in 2025 and an uplift to energy efficiency standards and requirements in 2020 as a stepping stone to the Future Homes Standard. They expect that an average home will have 75- 80% less carbon emissions than one built to current energy efficiency requirements.

The consultation included proposals for revising the Approved Documents for Part L and F to make them easier to navigate and to support efforts to simplify Approved Documents more generally. It set out proposals for changes to transitional arrangements to encourage quicker implementation of the new energy efficiency requirements and also proposed to remove the ability of local planning authorities to set higher energy efficiency standards than those in the Building Regulations.

Changes to Part L and Part F of the Building Regulations

A consultation was held which ran from 1 October 2019 to 7 February 2020. It is the first stage of a two-part consultation about proposed changes to the Building Regulations. Some of the more salient proposals are summarised below:

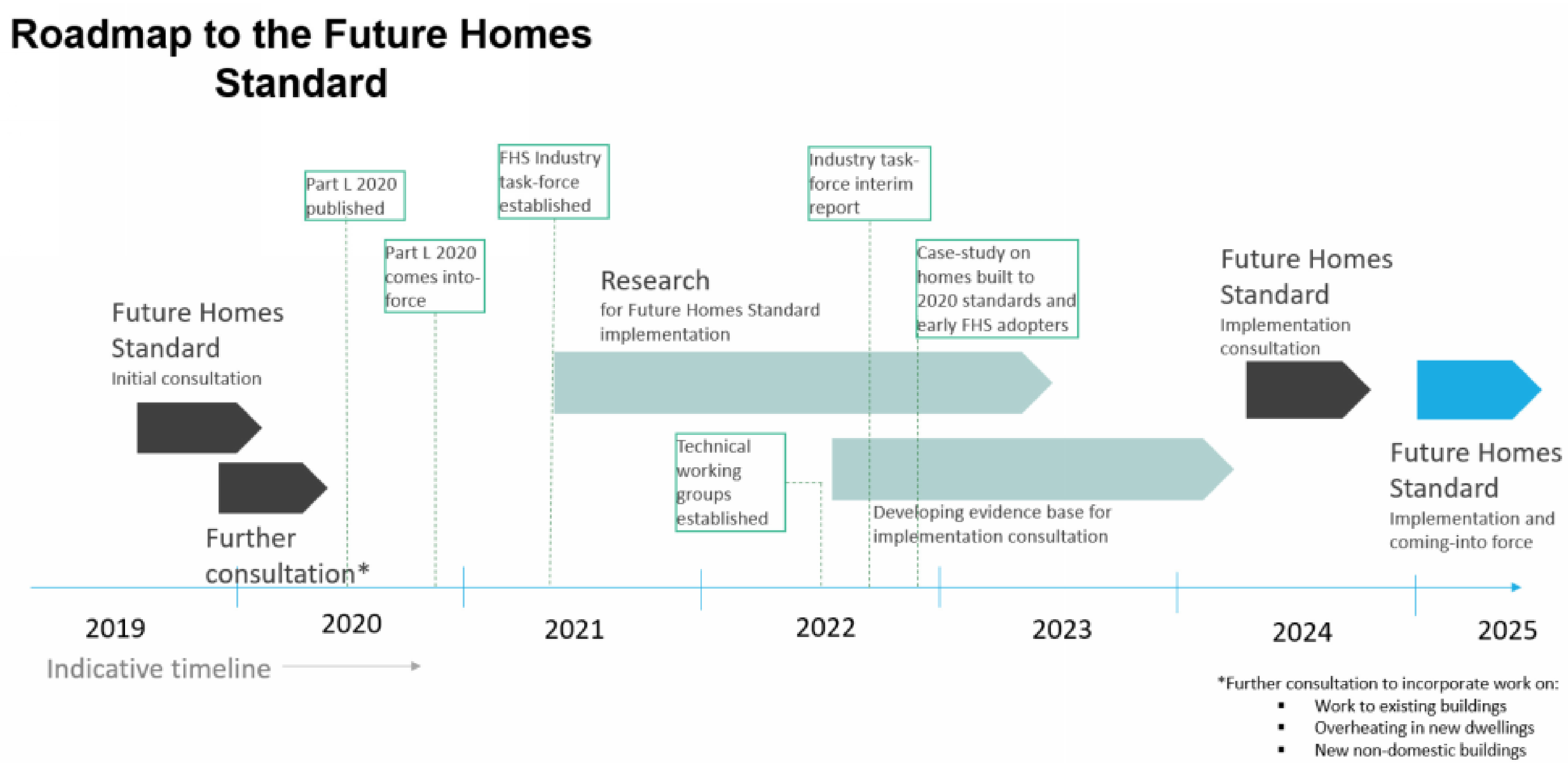
A new metric is being introduced into the SAP calculation known as the Primary Energy Rate. New designs will need to pass a target PER in addition to the pre-existing carbon emission rate.

Grid electricity now has a lower carbon emission factor than gas. It therefore no longer needs a fuel factor to support its use. It has been proposed to remove the fuel factor for grid electricity.

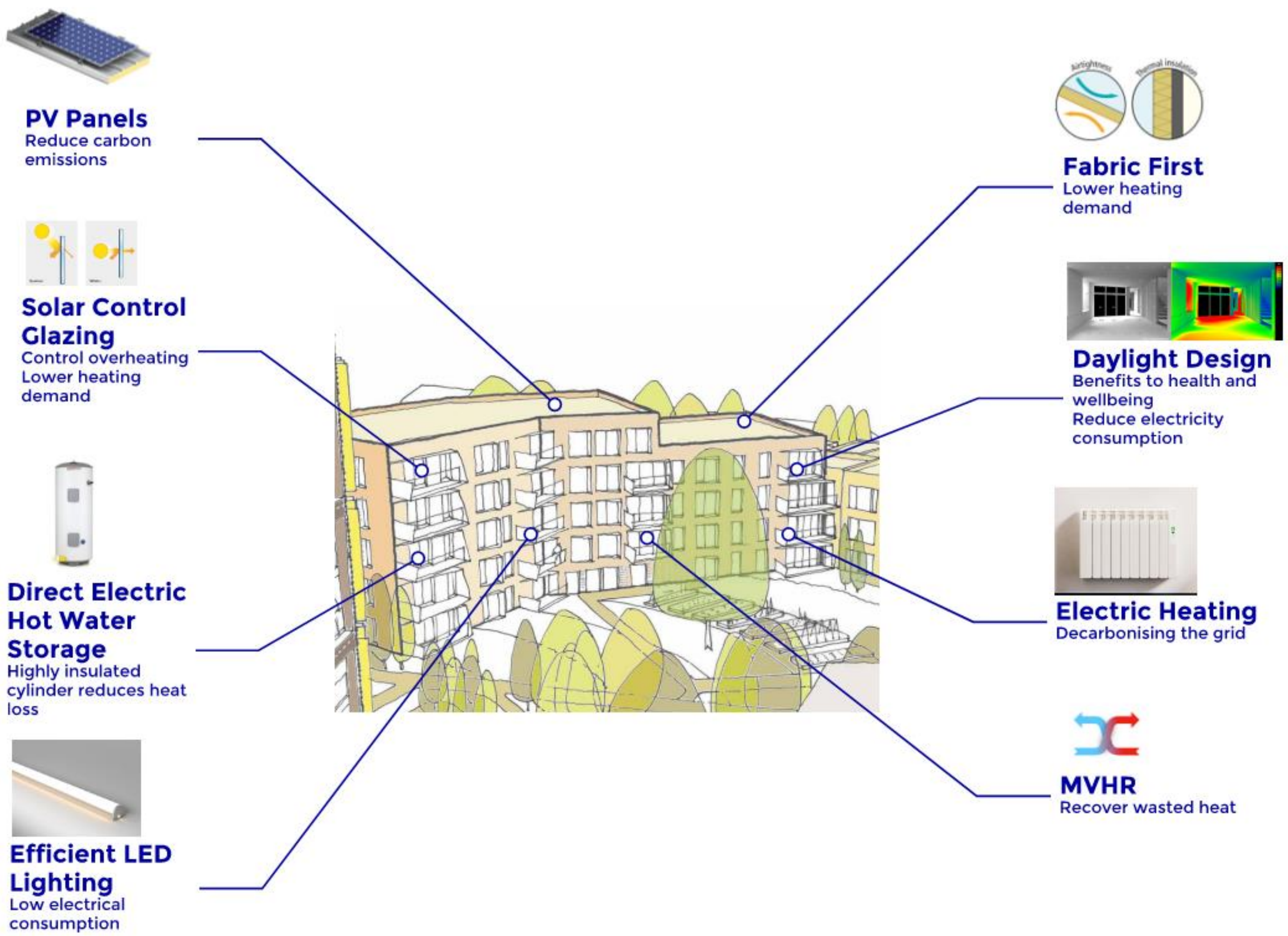
It has been proposed to improve the minimum standards for fabric in the guidance. The proposed uplifts to the minimum standards can be found in the draft Approved Document L and below. These are based on a statistical analysis of data used to produce the EPCs of all new homes built to 2013 Part L standards. The proposed minimum standards would remove the worst performing 25% of each thermal element being currently built.

Electricity now has a lower CO2 emission factor than natural gas. While electricity continues to have a higher primary energy than gas, it could be an appealing low capital cost option for developers to install direct electric heating solutions to meet primary energy and CO2 targets. Direct electric heating installed in new homes could incur over £350 higher bills per year for occupants when compared to gas heating, unless we change the Part L standards to make sure that new homes do not result in high energy bills.

To address this issue, and to reduce the risk that energy bills are unaffordable for consumers, it has been proposed to introduce a new requirement for new dwellings in addition to primary energy and CO2, based on the theoretical energy cost of the dwelling. This is referred to in the draft Approved Document L as the Householder Affordability Rating.



3. ENVIRONMENTAL DESIGN STRATEGY



3.1. The Energy Hierarchy

The Energy Hierarchy offers an effective framework to guide sustainable building design and decision-making. In line with best practice the design has been developed to follow this hierarchy.

By prioritising demand-side activities to reduce consumption and wastage and improve efficiency, the hierarchy links closely to the principles of sustainable development and offers an integrated, easy to use, approach to energy system design and the management of energy demand and supply.

The various levels to the hierarchy are detailed below.

Stage 1 – Be Lean

Achieve the highest feasible standards and specifications for energy efficiency.

Prioritise energy efficiency over supplying energy efficiently and renewable energy, having regard to the technical and financial feasibility of achieving this.

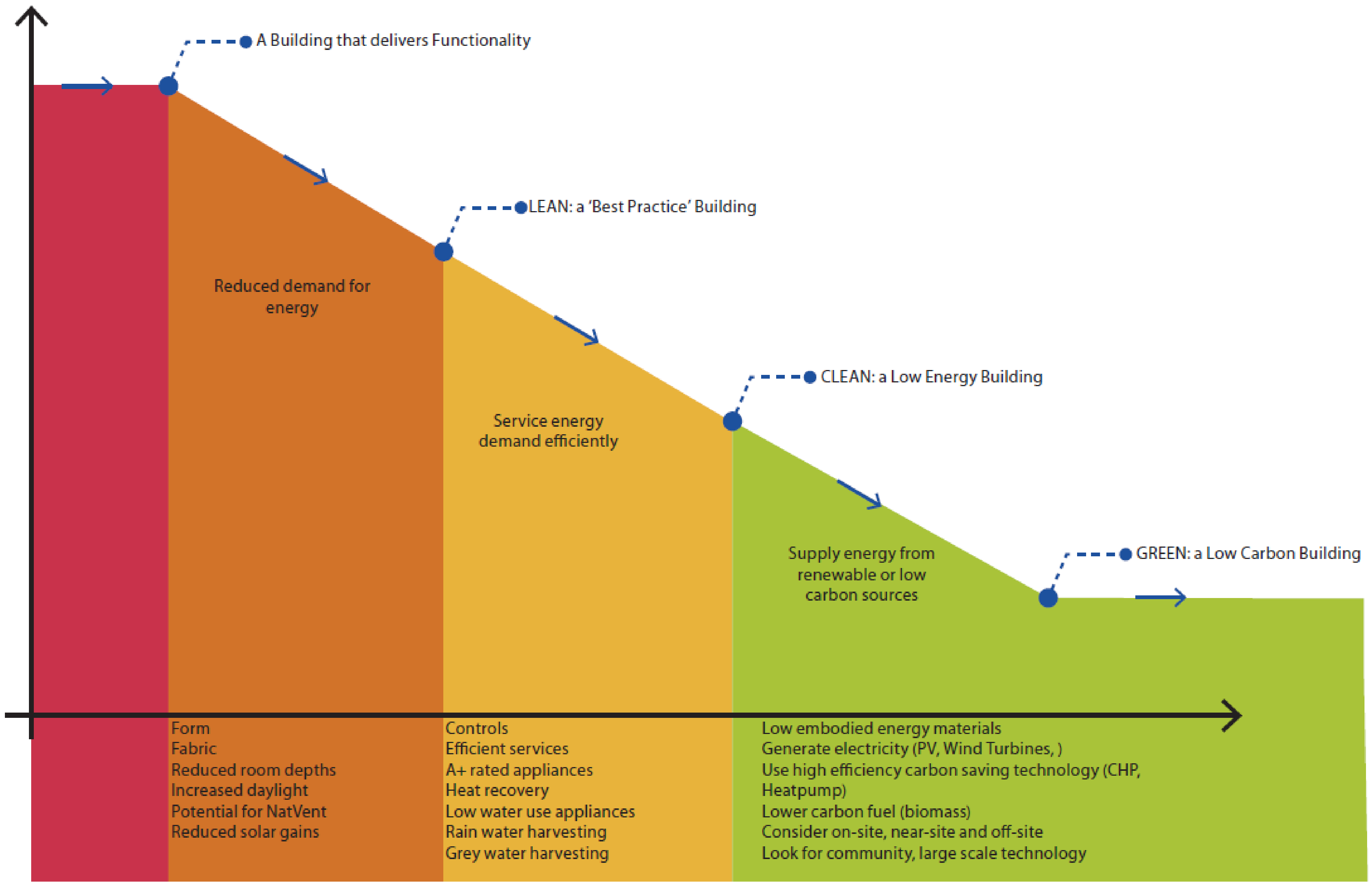
Include a display energy device showing electricity and heating fuel consumption data.

Stage 2 – be Clean

Where there are no proposals for a DE network or the opportunity to connect to a network does not exist, on-site CHP will be expected where the heating demand and characteristics makes it feasible.

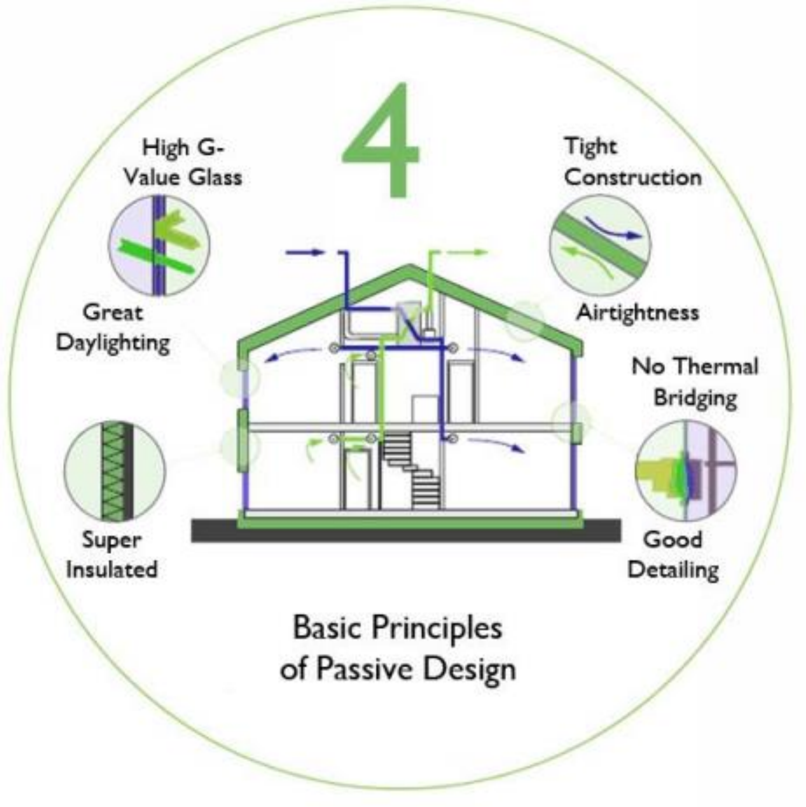
Stage 3 – be Green

Further reduce a development's carbon emissions through the use of on-site renewable energy technologies. The amount of renewable energy appropriate for a development will be dependent on site and location circumstances, the nature of the development proposal, and carbon reductions already achieved through the energy hierarchy.



The Energy Hierarchy applied to building design

3.2.Be Lean



The first step of the energy hierarchy is to reduce energy use through both passive and active lean design measures. The basic principles of passive design are as follows:

- Super insulated fabric
- Airtight construction
- No thermal bridging/ Good detailing
- Balanced window glazing properties: G-value and visible light transmittance (VLT) glazing to optimise solar gains and internal daylight levels

3.2.1. Building Fabric

A large proportion of energy used within residential buildings comes directly from heating. A high-quality thermal envelope and airtight building will ensure that fabric heat loss and cold bridges are minimised.

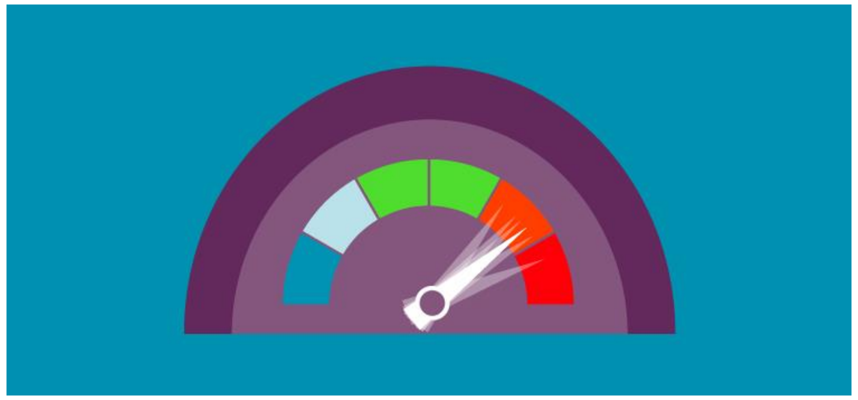
Building Element	Limiting U-value (W/m2.K)	Notional Building (W/m2.K)	Design U-value (W/m2.K)
Roof	0.20	0.13	0.15
Walls	0.30	0.18	0.15
Floor	0.25	0.13	0.15
Glazing	2.0	1.4	1.3
Doors	2.0	1.0	1.4

A highly airtight development will ensure minimal space heating demands, as detailed in the table below.

Limiting air permeability ($m^3/hr/m^2$ @ 50Pa)	Notional Building ($m^3/hr/m^2$ @ 50Pa)	Target air permeability ($m^3/hr/m^2$ @ 50Pa)
10.0	5.0	2.0

3.2.2. Limit Overheating

To design out the need for active cooling within the dwellings it is important to minimise the risk of overheating as far as practicable.



The design has addressed these issues as follows:

- Upper limits to the area of window glazing provided to prevent excessive solar gains, whilst balancing this with the requirement for providing good daylight levels
- Good daylight levels throughout reduce the need for artificial lighting and thereby limit heat gains from artificial lighting
- Providing generous amounts of opening windows to provide boosted ventilation rates during hot periods.
- Acoustically-attenuated ventilation openings provide a base level of purge ventilation where necessary. These are further supplemented by opening windows during very hot spells
- Shading elements (balconies, recesses and overhangs) have been provided and tuned across the development to mitigate solar gains in critical areas and reduce overheating risk
- Solar control glazing has been specified to limit solar gain

An overheating assessment has been carried out to quantify this risk in Section 6.

3.2.3. Daylight

The maximisation of daylight is one of the most important environmental factors for buildings. Artificial lighting contributes up to 25% of the energy costs of a typical building, despite operation largely within daylight hours. Evidence suggests that the provision of good levels of natural light can contribute to enhanced health and well-being.

Provision to good levels of daylight have been prioritised as follows:

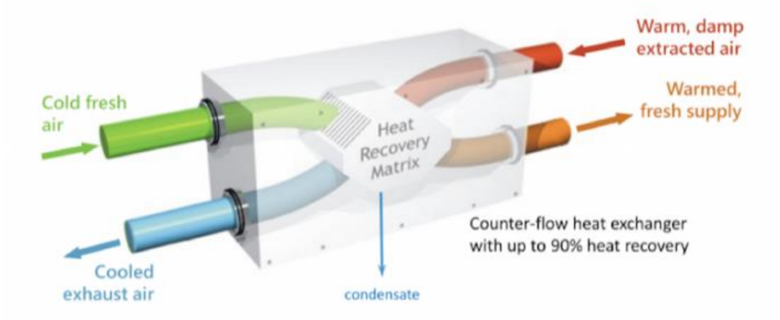
- Generous levels of window glazing have been provided in the houses and flats whilst considering the risk of overheating
- Windows have generally been spaced evenly to ensure good uniformity of daylight, minimising dark spots
- Specifying glazing with a minimum visible light transmittance of 0.70 will ensure most of the daylight received is transmitted into the space

A daylight assessment has been carried out in Section 7. In this assessment a selection of houses and flats have been modelled and evaluated against best practice criteria.

3.2.4. Efficient Ventilation

Ventilation heat losses over the heating season can be one of the highest contributors to overall energy consumption in buildings.

The strategy adopted is to control the supply of fresh air by mechanical means during the heating season. Heat is recovered from the air extracted from bathrooms and kitchens and transferred to the incoming fresh air. This approach minimises the energy required to heat the air by providing enough fresh air to maintain healthy indoor environments and no more. It further complements the super-insulated fabric and air tightness targets which all act to ensure minimal space heating demands.



Mechanical Ventilation with Heat Recovery (MVHR)

Local MVHR units in each dwelling will provide continuous mechanical ventilation and a background ventilation rate in line with Part F minimum whole dwelling ventilation rates. The units extract air from all kitchens, bathrooms, and WCs, and supply filtered fresh air from outside to the living areas. Maintaining a minimum ventilation rate improves air quality within the dwelling without opening windows or relying on trickle vents. The heat exchanger within the MVHR units recover up to 95% of the heat from the extracted stale air that would normally be wasted, reducing overall heat loads.

3.2.5. Minimising Water Usage

The design shall incorporate water saving strategies, such as low flush toilets, low flow showers and non-concussive spray taps in order to keep the maximum water usage to 110 litres per person per day.

Minimising water usage has the knock-on benefit of reducing the amount of hot water to be heated.

Water consumption will be monitored, and each apartment individually metered. Other features shall include mains leak detection and sanitary shut-off.

3.3. Be Clean

One possibility for delivering energy efficiently is through District Heat Networks. District Heat Networks can provide higher efficiencies and better pollution control than localised heat sources/boilers. However, having reviewed heat mapping reports of the local area, connection to an existing district heating network is not currently feasible.

Combined heat and power (CHP) has traditionally been an efficient process that captures and utilises the heat that is a by-product of the electricity generation process.

Due to the decarbonisation of grid electricity in recent years, and the continuation of this trend into the foreseeable future, using CHP is not as favourable as it once was, compared to generating heat using direct electric heating. Moreover, the space heating load profiles of the development are not well suited to using CHP in the most efficient means of operation, and therefore is not considered feasible for the scheme.

The design in order to deliver energy as efficiently as possible shall utilise state-of-the-art services and controls as follows:

- High-performance specification of MVHR units with minimal electrical energy consumption and maximum heat recovery efficiency
- Grade A efficiency electrical appliances throughout
- Sub-metering on all major energy consuming loads
- Variable speed control on pumps and fans
- Optimised and compensated heating controls
- High frequency LED lights and high efficiency lamps for light fittings
- Highly insulated hot water cylinders minimise unwanted heat loss

The townhouses and flats will be heated by direct electric panel radiators. The radiators will be controlled via a programmer and room thermostats.

The carbon intensity of the electrical grid has dramatically reduced over the past decade (better than gas per unit of energy) and it is expected to decarbonise further into the operational life of the buildings. The result of this is that the carbon cost associated with space and water heating will continue to diminish as grid decarbonisation increases.

Hot water generation and storage will be provided by local direct electric hot water cylinders. Cylinders and hot water pipework will be insulated to minimise unwanted heat losses. Cylinders will have a maximum heat loss factor of 1.88 kWh/day and will be provided with cylinder stats for efficient temperature control.

3.4. Be Green

Photovoltaic panels are to be provided on the roofs of the apartment buildings. Electrical energy generated will provide power to the apartments in lieu of grid electricity, and during times of low demand power will be exported back to the grid.

Flat roofs enable the panels to be tilted due South which will maximise radiation captured from the sun. Siting the PV arrays on the taller apartment buildings minimises overshadowing from neighbouring buildings and maximises their efficiency.

4. LOW AND ZERO CARBON TECHNOLOGIES

4.1. Introduction

The following section provides a feasibility analysis of Low or Zero Carbon (LZC) technologies for use at Sevenoaks Gasholders. There are various options when it comes to LZC technology, but a combination of project constraints rules the majority of these out.

These constraints are capital expenditure, return on investment, carbon savings potential, clean energy output potential, spatial requirements, operation and maintenance requirements, and planning requirements.

The following technologies were discounted immediately for this site:

- **Hydroelectric:** there are no suitable water courses or hydroelectric plants near the site.
- **Hydrogen:** generation and storage are still in the experimental stage at this scale and no systems are currently commercially available.
- **Biomass:** planning energy and carbon targets rule out the use of gas boilers or alternatives (including CHP or biomass CHP).
- **CHP:** as Biomass
- **Biomass CHP:** as Biomass
- **Wind Turbines:** wind turbine technology is not suitable for high density areas and those within close proximity to residential properties

The feasibility study therefore reviewed the use of the following:

- Photovoltaics
- Solar Thermal Panels
- Open/Closed Loop Ground Source Heat Pumps
- Air Source Heat Pumps

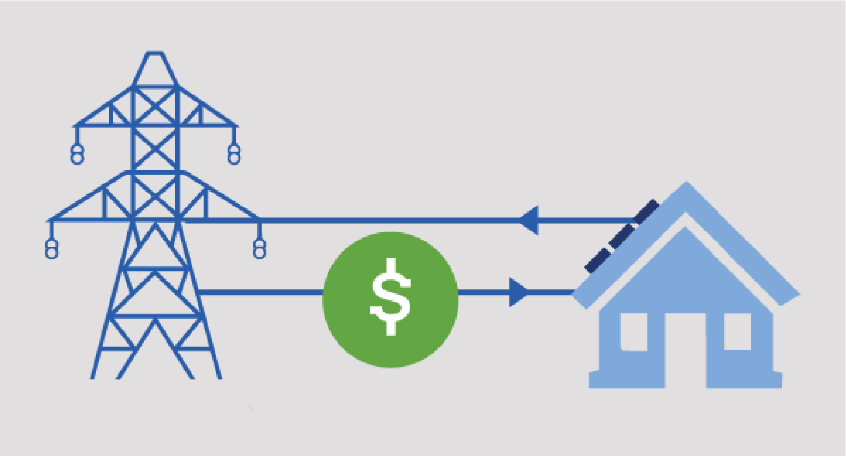
4.2. Summary of Feasibility Study

The study revealed that photovoltaic panels would be well suited for the development at Sevenoaks, the relatively low capital costs compared to other LZCTs make it favourable. Furthermore, the low maintenance requirements and therefore low operating costs make it well suited to a residential scheme with individual ownership of housing.

4.3. Planning Requirements

There is a requirement from Sevenoaks Council, as stipulated by NRM11 of the South East Plan, for a 10% reduction in a development's energy consumption through the use of onsite renewable energy generation. This 10% reduction will be met through the use of photovoltaic panels.

4.4. Incentives for LZC Energy Production



4.4.1. Renewable Heat Incentive (RHI)

The Renewable Heat Incentive scheme provides financial incentives for heat production by renewable or low-carbon sources. Eligible installations receive quarterly payments for 7 years based on the amount of heat generated. The payments are adjusted annually in line with the relevant price index.

Heat metering is required on all renewable heat installations.

Domestic RHI – From 01 April 2020		
Technology	**Tariff (p/kWh)**	**Duration (Years)**
Biomass	6.97	7
Solar Thermal	21.36	7
ASHP	10.85	7
GSHP	21.16	7

4.5. Photovoltaic Panels

Photovoltaic (PV) technologies generate electrical energy from sunlight that can be used to not only reduce user reliance on the national grid.

4.5.1. Advantages

The advantages of PV panels include:

- Produces clean renewable electrical energy
- High visibility, therefore excellent educational and PR value
- Once built the energy is virtually free
- Mechanically simple, therefore low maintenance and operating costs

- High public acceptance
- May offset the cost of roof or cladding
- Modular in nature so easy to size appropriately and extend
- Easy to integrate with battery storage
- Good safety record
- Can be integrated into new or existing buildings

4.5.2. Disadvantages

The disadvantages include:

- Solar energy is not a reliable energy source, output is reduced in overcast conditions and produces no energy at night
- Risk of future overshadowing
- PV cells produce DC electricity which must be converted to AC
- Efficiency drops as temperature rises
- Low-voltage output can be difficult to transmit
- Long Paybacks as inefficient and still relatively expensive
- Carbon savings effectively halved with updated carbon factors
- Feed-in tariffs ended in April 2019

To assess the feasibility of PV technology a high-level analysis was undertaken to estimate energy contribution and potential carbon savings.

4.5.3. Summary

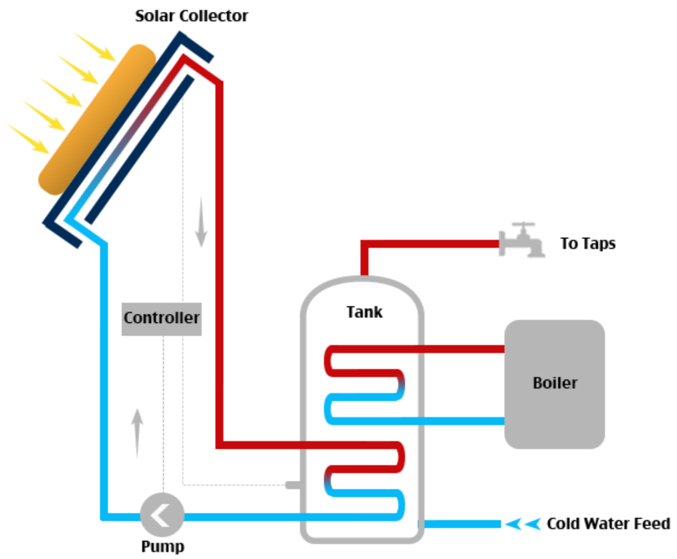
The apartment blocks offer an ideal site to locate PV panels, as they stand taller than the adjacent townhouses and flats, and the roof spaces are therefore relatively unshaded. This means high efficiencies can be achieved. Furthermore, as the landlord's switchgear is in the apartment blocks at ground floor level, a short and direct connection of the PV arrays to the electrical distribution network can be achieved.

The table below summarises the study at the Sevenoaks Gasholder Site. Representative emissions factors (SAP 10.1) have been used to do the calculations. Further discussion on the calculations conducted to work out PV load requirements is found in Section 5.

PV Summary	Sevenoaks Gasholders
PV array area (best case)	457 m^2
Area of Roof Required	507 m^2
Size of Installation	87.3 kWp
Annual electricity generation	82,500 kWh
Annual carbon savings	11,200 kgCO2
Capital Cost	£180,500
Service Life	25 years
Net Income over Life	£ 151,500

4.6. Solar Thermal Panels

Solar thermal panels use heat from the sun to warm up water, thus helping provide hot water for the building. A conventional system uses a mains powered circulation pump that couples the solar panels to a hot water storage tank.



4.6.1. Advantages

The advantages of solar thermal collectors include:

- Produces clean renewable heat energy
- Low maintenance and operating costs
- May offset the cost of roof or cladding
- Good safety record
- Can be integrated into new or existing buildings

4.6.2. Disadvantages

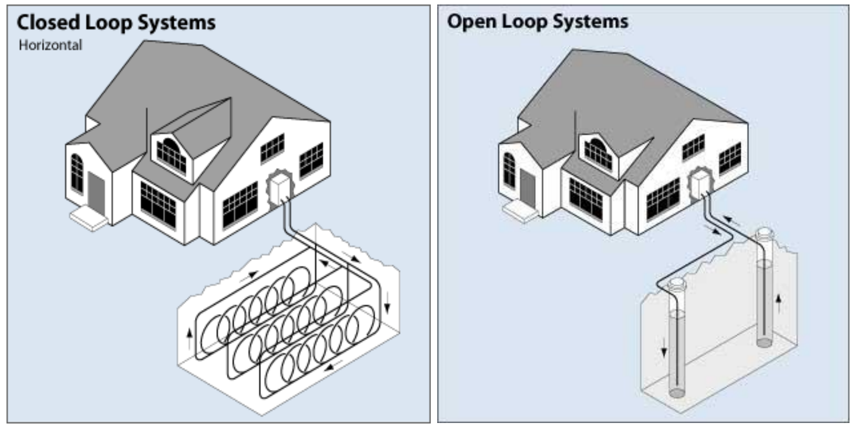
- Solar energy is not a reliable energy source, output is reduced in overcast conditions and produces no energy at night
- Risk of future overshadowing
- Low-grade heat is produced requiring large heat emitters and hot water generation can be difficult
- Storage is required
- Requires a large area compared to other technologies

4.6.3. Summary

To meet the hot water demand solar thermal panels would be required on individual townhouses and flats as there is no central hot water production. This would have a significant architectural implication. At present the apartment blocks are taller than the townhouses, and so the views out from the apartments would be affected by a solar thermal scheme if deployed for the townhouses.

On the apartment blocks the occupant density per square metre of roof area is high such that there is not sufficient roof space to meet the high domestic hot water load using solar thermal panels.

4.7. Ground Source Heat Pumps



Ground source heating involves extracting heat from the ground to heat the building, by circulating water through buried pipes. The length of the pipe depends on the building's energy requirements.

The low-grade heat extracted from the ground is passed through a heat pump, which provides high grade heat (in the form of hot water) to the building. The system can also be used in reverse to provide cooling in summer. By coupling the heat pump with the ground, a much higher Coefficient of Performance (COP) is achieved than the air coupled heat pumps.

The ground's temperature at around 2m deep remains at a steady 11°C. In the winter, this relatively high temperature can be taken advantage of as a heat source.

4.7.1. Advantages

The advantages of ground source heat pumps include:

- Updated carbon factors coupled with higher efficiencies mean that they are now lower carbon emitters than gas boilers
- No local emissions
- No gas supply/infrastructure required
- Reversible units can provide heating in the winter and cooling in the summer

4.7.2. Disadvantages

The disadvantages include:

- Low-grade heat is produced which means that heat emitters must be larger and hot water generation can be difficult
- High capital expenditure and rising electrical costs affect paybacks
- Storage vessels are required
- Complex machinery with high maintenance costs
- Require extensive ground works
- Water in closed loop circuits requires glycol, which is a hazardous substance
- They can be noisy

4.7.3. Summary

Although their efficiency and potential for significant carbon reductions are attractive, the capital expenditure and on-going maintenance would add unnecessary costs and complications to the construction process.

There are no accessible water courses or suitable aquifers to tap in to for an open loop or pond/lake system, therefore extensive ground works would be required, at a high capital cost.

The chosen energy strategy relies on a high performing building fabric and demand-controlled ventilation. The low resulting heating demand means direct electric radiators can provide the space heating requirements. In effect, no wet heating systems are required. Introducing a GSHP system would require the addition of heating pipework, valves, and controls, which would be seen as an additional capital and material cost that is not necessary.

Based on the above GSHPs are deemed not feasible.

4.8. Air Source Heat Pumps

In air source heat pumps heat is extracted from the external air which is used to heat water or air for useful heat within the building.

An air source heat pump can extract heat from the air even when the outside temperature is as low as minus 15° C. Heat pumps have some impact on the environment as they need electricity to run, but the heat they extract from the air is constantly being renewed naturally.

Unlike gas boilers, heat pumps deliver heat at lower temperatures over much longer periods. This means that during the winter they may need to be left on longer to work efficiently.

4.8.1. Advantages

- Lower capital expenditure and maintenance costs compared to GSHPs
- Reversible units can provide simultaneous heating and cooling which increases efficiencies
- No gas supply/infrastructure required
- No local emissions
- Relatively long life
- Updated carbon factors coupled with higher efficiencies mean that they are now lower carbon emitters than gas boilers

4.8.2. Disadvantages

- Low-grade heat is produced which means that heat emitters must be larger and hot water generation can be difficult
- Maintenance costs are higher compared to boilers
- They can be noisy if not attenuated

4.8.3. Summary

ASHPs are an attractive consideration for this development, however the main challenge is finding a suitable location for the units.

Providing individual ASHPs per townhouse/flats is not cost effective, and introduces significant architectural, cost and maintenance implications.

As discussed with GSHPs, the chosen energy strategy relies on a high performing building fabric and demand-controlled ventilation. The low resulting heating demand means direct electric radiators can provide the space heating requirements. In effect, no wet heating systems are required. Introducing ASHP systems would require the addition of heating pipework, valves, and controls, which would be seen as an additional cost that is not necessary.

For the reasons given above ASHPs are not deemed the best LZCT available for this development.

5. ENERGY ASSESSMENT

An energy assessment has been carried out to demonstrate how the targets for the reduction in regulated CO2 emissions will be met using the energy strategy and hierarchy outlined in Section 3

For the purpose of this energy assessment the updated draft SAP10.1 carbon factors have been used, and regulated energy demand has been calculated using Stroma FSAP10 Beta. The updated carbon factors are discussed in Section 5.4.

The unregulated energy demands of the development were calculated using the BREDEM 2012 methodology.

5.1. Energy and Sustainability Strategy

The energy and sustainability strategy is based on an investment in the building fabric which will reduce the space heating as far as possible.

Low space heating loads will be met with direct electric panel radiators, which keeps the amount of plant to a minimum whilst enabling the scheme to benefit from the reducing carbon intensity of the electricity grid.

Hot water will be provided by local direct electric hot water cylinders with thermostatic control.

Whole dwelling ventilation rates are to be provided by MVHR, which ensure heat can be recovered from bathroom and kitchen extracts whilst providing controlled rates of fresh air throughout the heating season.

High performance glazing will ensure the need for sufficient winter solar gains are balanced with the need to limit summertime overheating and provide good levels of daylight to living spaces.

Artificial lighting will be provided through low energy LED fittings used throughout.

5.2.Energy Model Overview

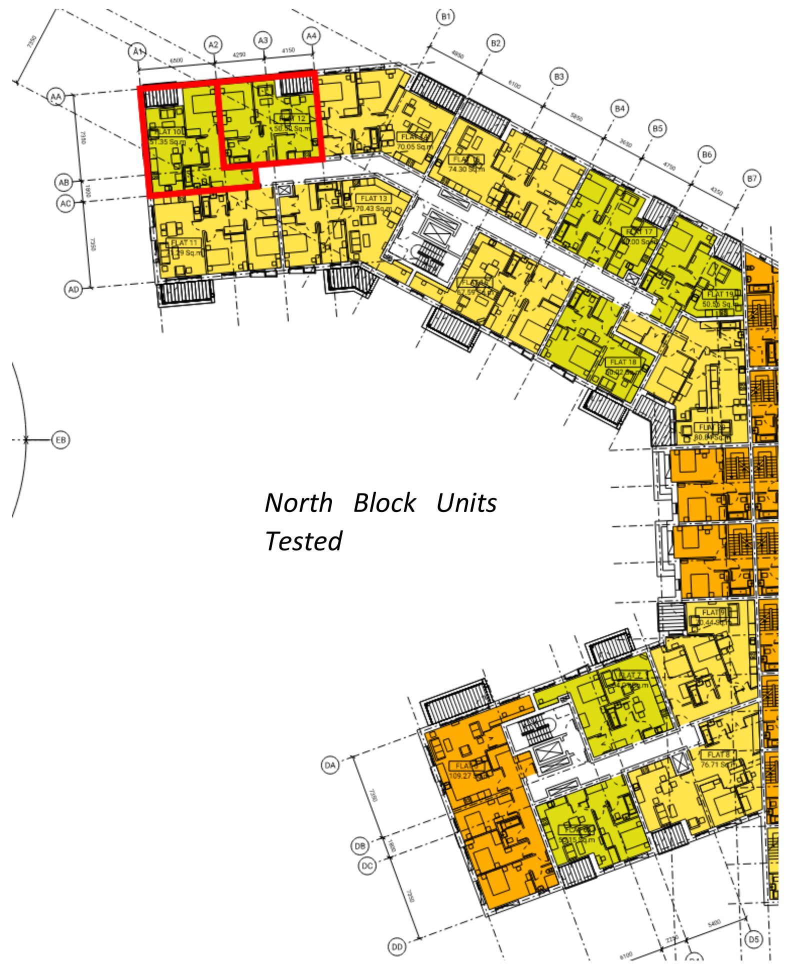
SAP software was used to output a Target Emissions Rate (TER) based on the notional building and a Dwelling Emissions Rate (DER) of the actual building without the use of renewables.

Apartment and townhouses deemed to be worst-case due to their orientation and external facades have been tested and used to calculate a 'worst-case' sitewide energy consumption and associated carbon emissions. The selected apartments have been tested at ground, mid and top floor level to account for different thermal interaction between adjacent spaces.

See Section 5.7 for the full SAP results.

5.2.1. NORTH & SOUTH BLOCK

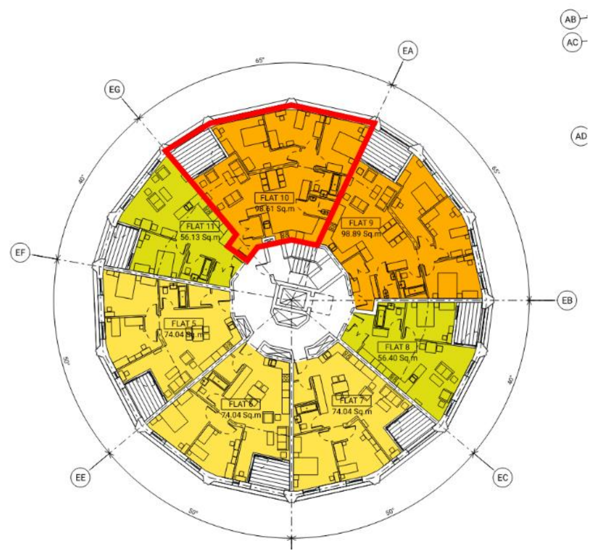
One North facing corner apartment and one with only a single exposed façade have been selected for testing and used to represent all apartment types in both the North and South block of the development. Although the corner apartment on the South block has a greater exposed area, it benefits from solar enhanced gains due to being South facing and therefore deemed to perform better than the North facing corner apartment in the North block. These apartments have been tested at ground, second and third (top) level.



North Block Units Tested

5.2.2. ROTUNDA

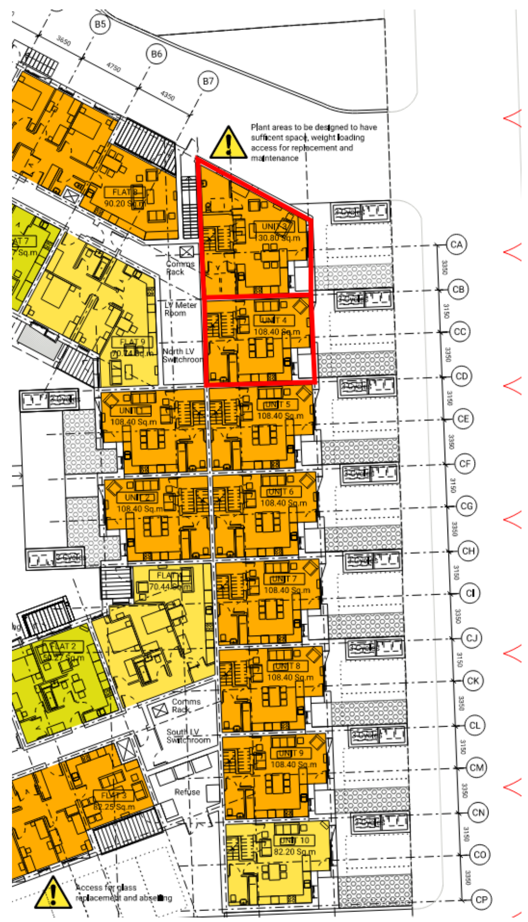
The North facing 3-bedroom apartment has been selected for testing due to its large internal and exposed area along with its orientation. This apartment has been tested at ground, mid (4^{th}) and top (9^{th}) level.



Rotunda Units Tested

5.2.3. TOWNHOUSES

One attached and one semi-detached townhouse have been tested, as shown below.



Townhouse Units Tested

5.3.Fabric and Systems

The target U values for the scheme are as per the table below, these design values are used throughout the modelling and analysis conducted.

Building Element	Limiting U-value (W/m2.K)	Notional Building (W/m2.K)	Design U-value (W/m2.K)
Roof	0.20	0.13	0.15
Walls	0.30	0.18	0.15
Floor	0.25	0.13	0.15
Glazing	2.0	1.4	1.3
Doors	2.0	1.0	1.4

The target air tightness to be achieved is 2 m^3/hour/m^2 @50Pa. The scheme will incorporate accredited construction details which will minimise thermal bridging heat losses and uncontrolled air infiltration.

A G-value of 0.45 was assumed for all glazing. MVHR efficiencies were specified as 1.5 Watts/litre/second and 80% heat recovery efficiency.

Direct electric panel radiators were assumed to be 100% efficient at point of use and will be controlled via a programmer and room thermostats.

Direct hot water cylinders of 145 litres volume were assumed for all dwellings. Heat loss factors of 1.18 kWh/day were assumed in line with manufacturer's current data. Cylinders will be located in heated spaces and cylinder thermostats will be used to regulate hot water storage temperatures.

5.4.Carbon Factors

Carbon Factors - kgCO2/kWh		
	Mains Gas	**Grid Electricity**
SAP2012	0.216	0.519
SAP10.1	0.210	0.136

It should be noted that the carbon intensity of grid electricity in the UK has substantially reduced over the past decade. As such, carbon emissions calculated using SAP 2012 carbon emissions factors would not be wholly representative of a new development and its future performance, particularly where direct electric space heating and direct electric water heating is used.

In light of this the design has been assessed using data which more reflects the current state of decarbonisation in the electricity grid. The carbon factors given in BRE's Draft SAP10.1 guidance have been used for the assessment and are given in the table below. These values will form the basis for the forthcoming update to the Part L regulations.

5.5.Unregulated Energy

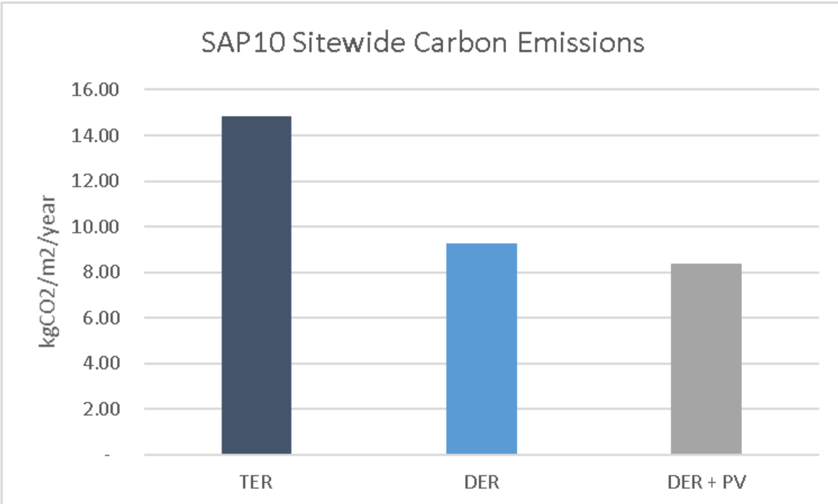
Whilst the SAP procedure calculates the regulated energy load for the development, additional calculations are required to determine the development's 'unregulated' energy load. This accounts for factors not considered in the SAP energy assessment, such as communal lighting, lifts, and cooking/appliance loads. BRE's BREDEM 2012 calculation methodology is used to calculate these loads. A summary of the unregulated loads is tabulated below.

Type	Load (kWh/year)
Communal and External Lighting	46,530
Lifts	623
Cooking	52,616

5.6. Results

5.6.1. Part L Compliance

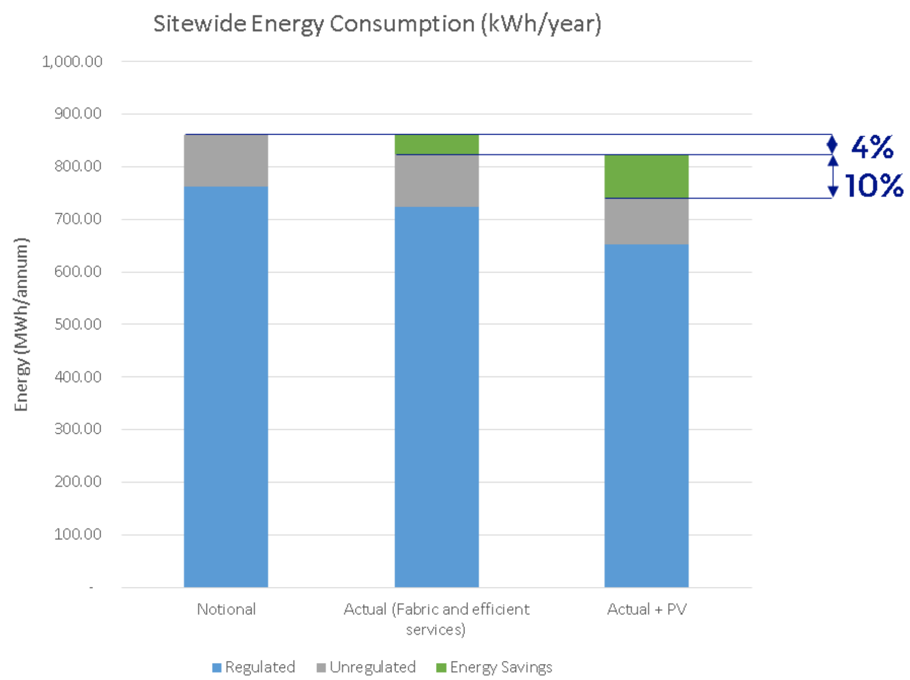
The site-wide target emission rate (TER) and dwelling emission rate (DER), as calculated with the new draft Part L methodology, is shown in the table below. The design exceeds the Building Regulations' requirements significantly with a 37% reduction in carbon emissions. A further 10% reduction in carbon emissions is achieved on the DER with the implementation of PV panels.



TER (kgCO2/m2/yr)	DER (kgCO2/m2/yr)	Improvement
14.8	9.3	37%

5.6.2. Planning Compliance

Photovoltaic panel arrays are proposed to further reduce the development's energy and carbon consumption, as well as to comply with Sevenoaks Council's requirement that 10% of the site-wide energy load be provided through on-site renewable energy generation. The site wide energy load is the combination of the building's regulated (SAP10) and unregulated (BREDEM) loads. A breakdown of these loads is shown below.



Electrical energy generated will provide power to the apartments in lieu of grid electricity, and during times of low demand power will be exported back to the grid.

Photovoltaic panels are proposed on the roofs of the apartment blocks, the effect on the site wide carbon emissions are given in the table and graph above. The scheme is based on 317 no. monocrystalline PV panels, each with an output of 275 Watts, and an average yield of 945 kWh per kWp. Carbon emissions have been calculated using SAP10 emissions factors. The size of the PV array has been calculated in order to provide 10% of the development's annual energy consumption, as required by Sevenoaks Council.

The addition of the PV panels results in a further carbon saving of 11,200 kg of CO2 per year.

5.7. SAP Results Summary

A tabulated summary of the SAP 10.1 results for the worst case flats tested is shown below.

Dwelling Type	TER (kgCO2/m²/year)	DER (kgCO2/m²/year)	Percentage Reduction
Townhouse Attached	13.25	9.97	25%
Town House Corner	14.82	11.74	21%
Rotunda GF	13.35	8.12	39%
Rotunda Mid Floor	13.39	7.65	43%
Rotunda 9th	15.08	10.45	31%
North Block GF	17.48	11.77	33%
North Block Mid	15.87	9.25	42%
North Block Top	17.90	11.23	37%
North Block Corner GF	18.96	14.46	24%
North Block Corner Mid	16.83	10.58	37%
North Block Corner Top	18.45	12.48	32%

6. OVERHEATING RISK ANALYSIS

6.1. Introduction

Recent evidence has shown that overheating risks need to be taken seriously in the residential sector. Many new or refurbished homes have designs that contribute to overheating risk by, for example, having high proportions of glazing (resulting in excessive solar heat gains), inadequate natural ventilation strategies or mechanical ventilation systems that are not delivering intended air change rates.

Overheating risks also affecting existing homes, especially in buildings that do not have adequate methods for dissipating heat gains and are less resilient to climate change.

The health and wellbeing impacts of overheating can be significant for residents, resulting in stress, anxiety, sleep deprivation and even early deaths in heat waves, especially for vulnerable occupants. The situation is predicted to get worse. The Committee on Climate Change has estimated that mortality rates arising from overheating could rise from 2000 per year in 2015 to 7000 per year by the 2050s.

Assessing overheating risk in homes is a complex issue and not adequately assessed by building regulations. Indeed, it would be wrong to assume that a home that complies with building regulations were designed to focus on energy conservation also gives sufficient assurance of avoidance of overheating. Therefore, comfort conditions are separately assessed to quantify the risk of overheating.

Many factors influence overheating in homes, including the intensity of heat gains, occupancy patterns, orientation, dwelling layout, shading strategy and ventilation method. Dynamic thermal modelling can be used to simulate the internal temperature conditions and will therefore help establish whether threshold conditions of discomfort will be reached.

6.2. Relevant Assessment Criteria

The summertime performance of the development and associated overheating risks have been tested against the CIBSE TM59 criteria in line with best practice for residential developments.

6.3.Assessment Method

Compliance with CIBSE TM59 is based on rooms passing the following two criteria:

1. The number of hours during which ΔT of indoor air temperature to outdoor is greater than or equal to one degree (K) during the period of May to September shall not exceed 3% of occupied hours.
2. For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 22:00-07:00 shall not exceed 26 °C for more than 1% of summer (May-Sep) hours.

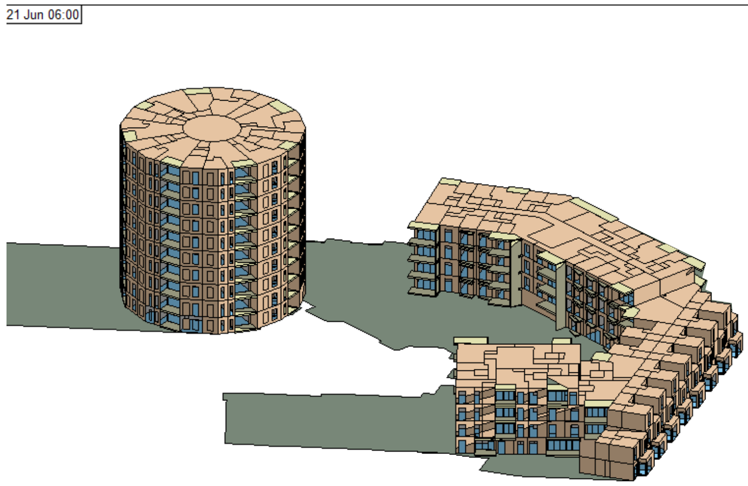
6.4.Overheating Model

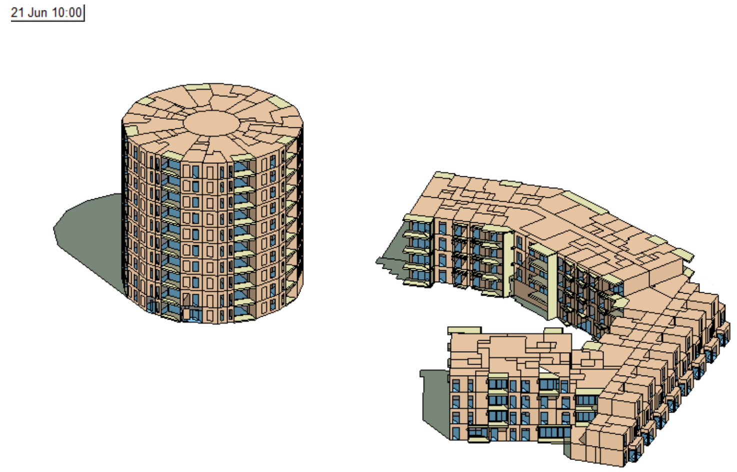
Dynamic simulation modelling has been carried out using the IES VE 2019 software.

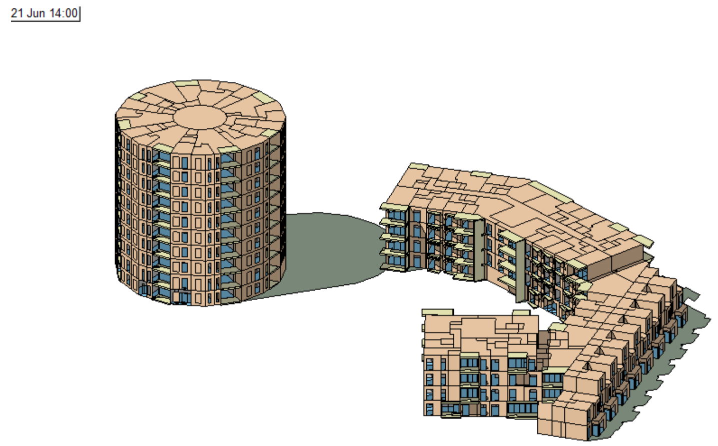
The model was split into three sub-models to ease simulation:

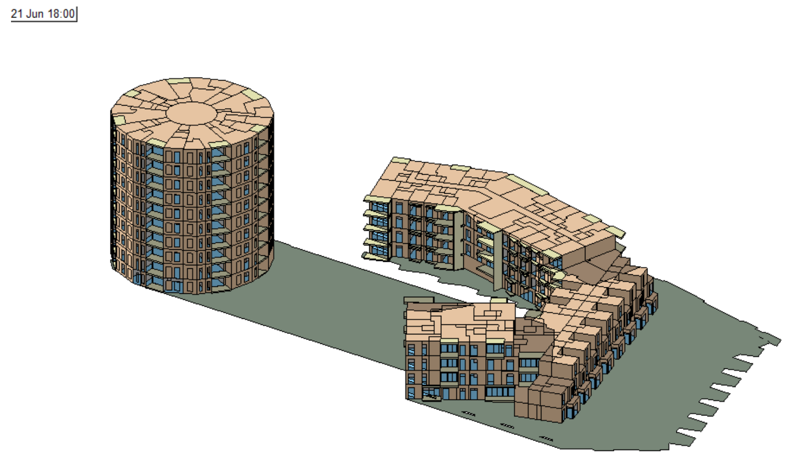
- Rotunda: Apartments on the Ground, First, Seventh and Ninth floors were analysed
- Townhouses: A selection of most susceptible townhouses were analysed
- North/South Block: All flats in these blocks were modelled due to large solar gains in many of the inner apartments.

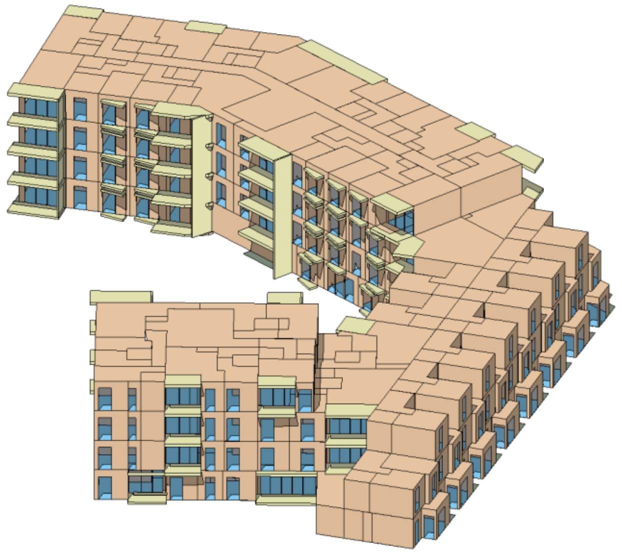
Time lapse images of the model are shown below, as well as close ups of the shading elements on the following page. See Section 3.2.2 for an overview of the overheating strategy.



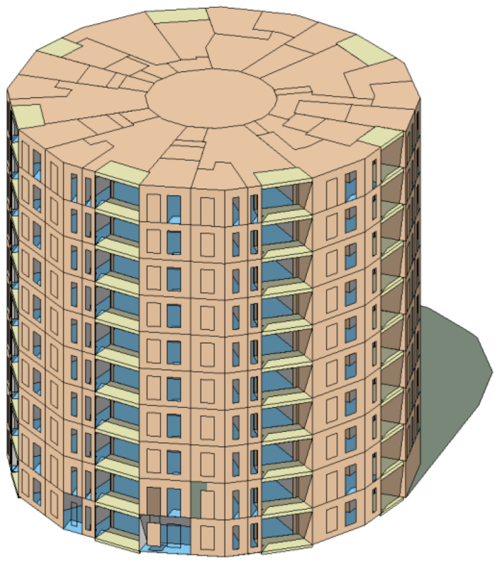








Close up of North/South block shading elements



Close up of Rotunda shading elements

6.4.1. Climate Data

Climate data from the London Gatwick weather station has been selected for assessment purposes, due to it being the closest geographically to the site compared to all others available.

A predictive weather set based on an urban environment within London, adjusted for climate change, has been used to model the selected apartments and investigate their future performance, as defined in CIBSE TM49. The dataset used is the London Gatwick DSY1 2020 50th percentile high emissions scenario.

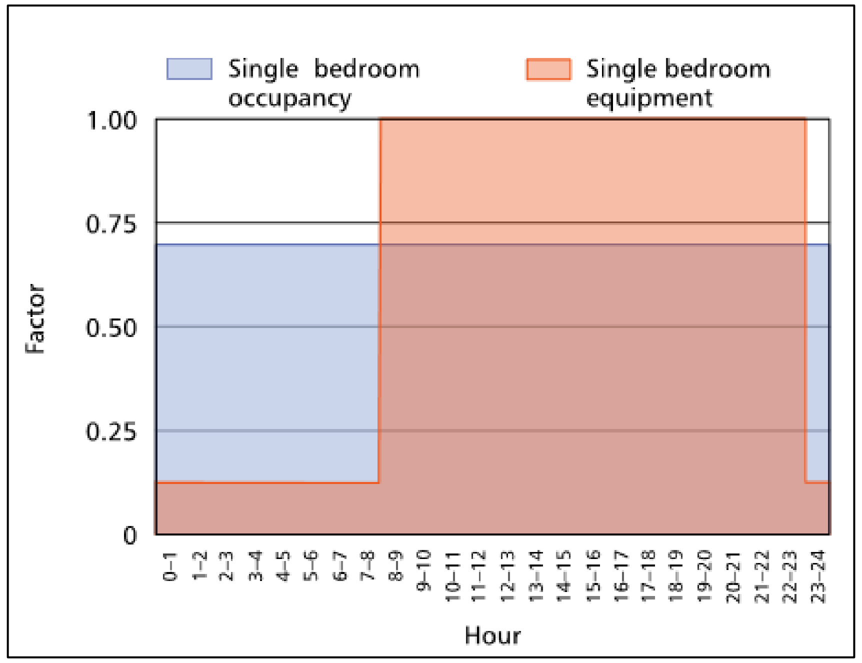
6.4.2. Internal Gains

The internal gains profiles used in the model are as defined by CIBSE TM59 and are visually illustrated in the figures below.

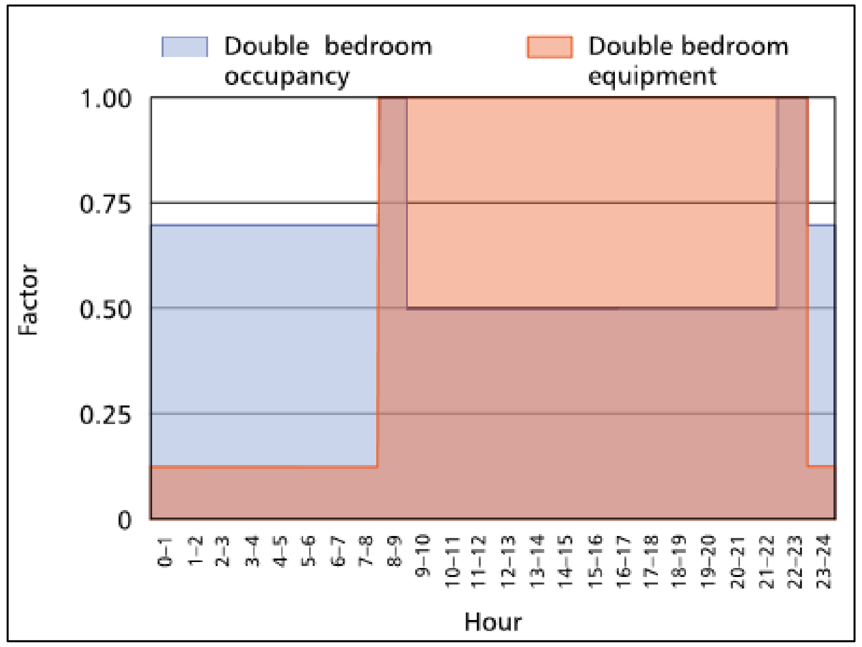
Miscellaneous rooms not covered by TM59 were modelled as follows:

- Bathrooms – no occupancy gains applied
- WCs – no occupancy gains applied
- Landings and stairs – no occupancy gains applied

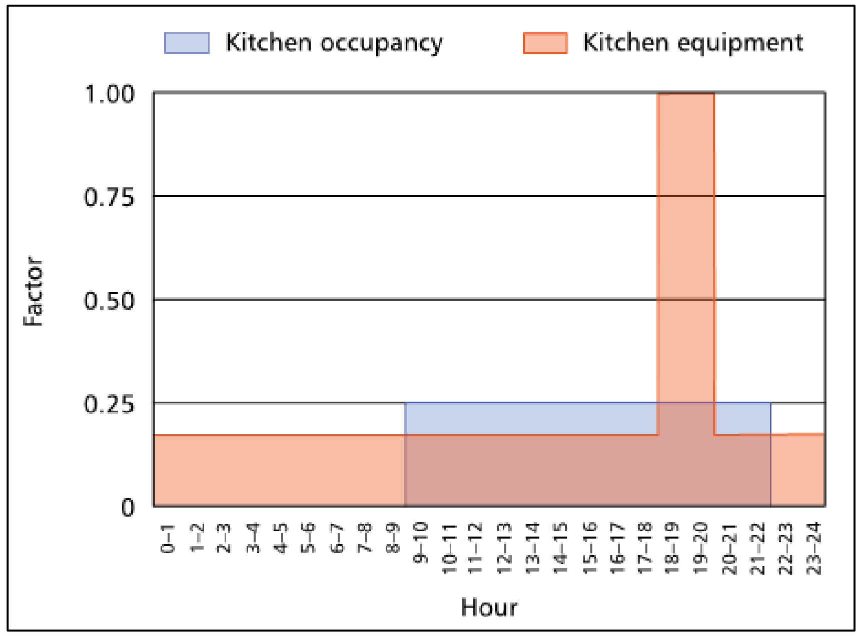
Lighting gains for all occupied rooms are applied as per TM59: 2 W/m^2 between 6pm-11pm.



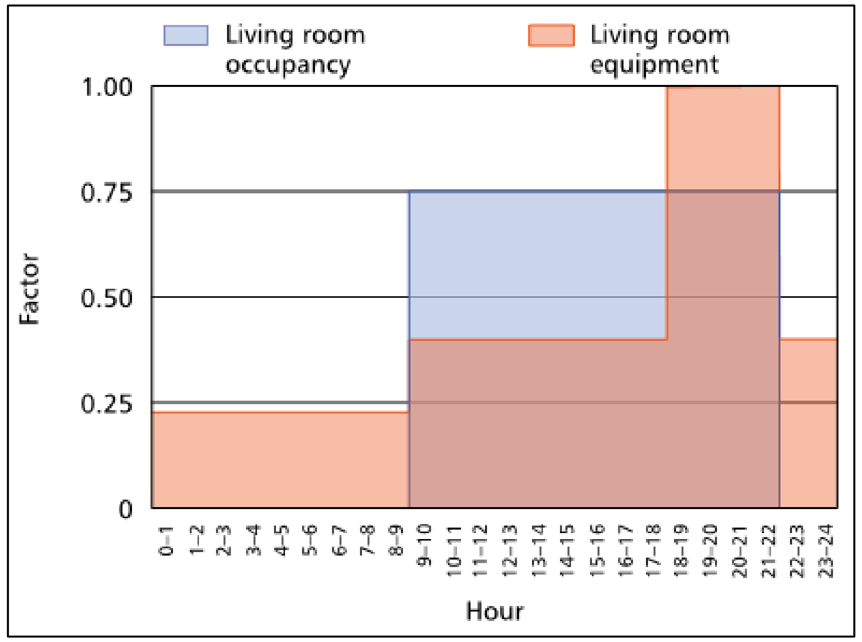
Single bedroom occupancy and equipment profiles



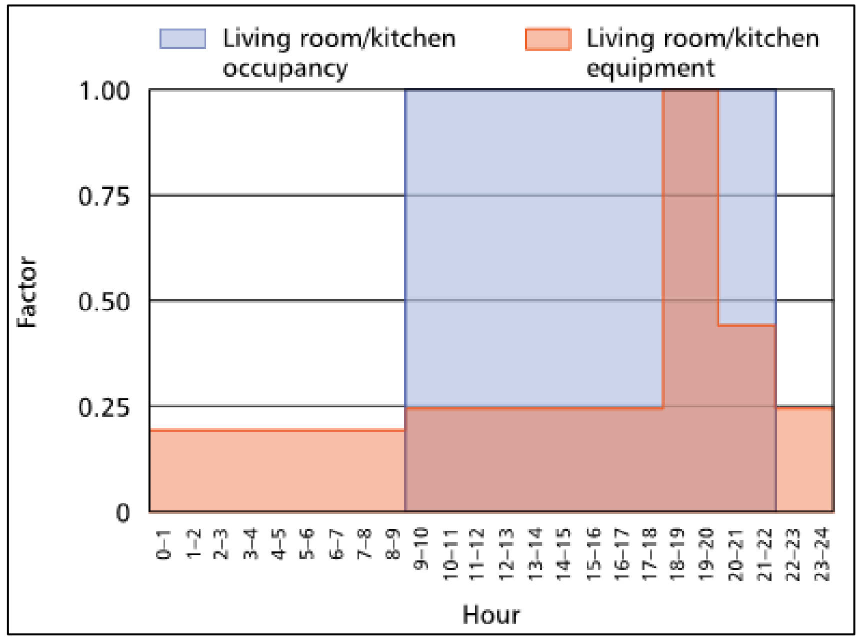
Double bedroom occupancy and equipment profiles



Shared kitchen/dining room occupancy and equipment profiles, as modelled in the townhouses



Living room occupancy and equipment profiles, as modelled in the townhouses



Shared kitchen/dining/living room occupancy and equipment profiles, as modelled in the flats and apartments

6.4.3. Natural Ventilation

Both the bedrooms and living rooms tested against TM59 have large window openings for natural ventilation and night-time purging, along with overhangs due to external balconies and shading elements reducing direct solar gains. Constant mechanically supplied fresh air is provided to each unit meaning natural ventilation openings will only be required for peak summertime conditions.

The residential units' thermal fabric is designed to provide good airtightness and reduce heat transfer both into and out of the building.

Bedroom glazing has been modelled as side hung windows, opening at maximum angle of 30°, open when the room is occupied, and the internal temperature is above 22° C. The bedroom doors have been modelled to be open during daytime, to allow for cross-ventilation in the apartments, but closed during sleeping hours as specified in TM59. The balcony windows in the living/kitchen areas have been modelled in such a way that they are open when above 22° C. As there is no perceived security risk in leaving these balcony doors open at night-time for floors not situated at ground level; natural ventilation can be utilised even when the room is unoccupied. Ground floor bedroom windows are to have restricted openings to allow them to remain open whilst unoccupied.

6.4.4. Solar Gain Control

A number of measures have been modelled to limit solar gains entering dwellings:

- Shading elements and balcony overhangs
- The application of solar control glazing

6.5. Results

6.5.1. Glazing G-Value

The modelling has assessed the sensitivity of dwellings to changes in G-value, and the impact of reduced G-values on overheating risks. This process has validated the design decision that glazing with a medium level of solar control (G=0.45), this is shown to be necessary to mitigate overheating risks across the developments.

6.5.2. Natural Ventilation Free Areas

The free areas required for each room are shown in Appendix I, these have been calculated through an iterative modelling process and provide the ventilation necessary to ensure that all spaces pass the TM59 criteria. For dual aspect spaces, this area should be spread distributed across multiple elevations to encourage cross-ventilation.

The window design will be carried out by the architect with Skelly & Couch reviewing against the natural ventilation requirements.

6.5.3. TM59 Assessment Results and Discussion

Utilising the solar control measures alongside the natural ventilation regime and free areas outlined above, all spaces modelled (as outlined in Section 6.4) pass the TM59 overheating criteria using the Gatwick DSY1 2020 50th percentile high emissions scenario weather data.

The natural ventilation opening areas were refined through the modelling and assessment process to ensure sufficient ventilation to mitigate overheating risks.

Other design measures taken to minimise overheating risks are described in Section 1.1. In combination these measures combine to ensure that a comfortable environment can be sustained through the summer period.

7. DAYLIGHT ASSESSMENT

7.1. Introduction

Daylighting is a key aspect of improving occupant satisfaction, comfort, and wellbeing; a dark interior space with little external light will be an uninviting space for residents. Careful design is required when considering the distribution and size of glazing, as simply including large glazed facades would result in a poorly performing fabric suffering from significant solar gains and overheating risks; excessive natural light can also result in unintended negative consequences such as glare. Unless explicitly required otherwise daylighting in internal spaces should be encouraged, doing so whilst conscious of the risks highlighted above.

Many of the health benefits derived from daylight can also be obtained with electric lighting (using lamps with an appropriate spectrum). However, as most of the benefits come from long term exposure to relatively high levels of light, it is not practical or sustainable to solely provide this light from electrical sources.

The role of the circadian system (which controls daily and seasonal body rhythms) is to link the functions of the body (e.g. the sleep/wake cycle, and changes in core body temperature and in hormone secretion) with the external day/night cycle. Disruption to this system (from lack of light, for example) can cause problems such as depression and poor sleep quality which could lead to more serious problems.

Mood can be modified by lighting. The dynamic nature of daylight is strongly favoured by building occupants. Adequate access to daylight can have a positive impact on mood, especially in situations where people are static for long periods of time.

A small percentage of people suffer a seasonal mood disorder known as seasonal affective disorder (SAD) with a further number suffering a mild form known as sub-syndromal SAD (S-SAD). Symptoms include depression, lack of energy, increased need for sleep and increased appetite and weight gain, occurring in the winter when there is little daylight, with symptoms lessening in the summer when there is more daylight. Such symptoms can be reduced by exposure to daylight.

The ultraviolet (UV) radiation in sunlight can be damaging to the skin. However, with people now spending many daylight hours inside buildings, there is the danger of vitamin D deficiency caused by insufficient exposure to UV radiation. A vitamin D deficiency leads to rickets in children and softening of the bones in adults.

Exposure to sunlight, even through glass, can kill many types of viruses and bacteria and so can be of great value in winter when there is a high incidence of respiratory infections.

7.2. Assessment Method

Individual rooms are to be assessed using the average daylight factor (ADF) metric, which is a measure of the amount of daylight received.

Calculated values will be assessed against best practice guidelines as defined in: BRE Report 209, BS 8206-2, and BS EN 17037:2018. Based on the results design coordination with the architect will be carried out to make improvements to the daylight performance where required.

Room type	Minimum ADF	Source
Bedrooms	1.0 %	BS 8206-2
Living rooms	1.5 %	BS 8206-2

7.3. Daylight Model

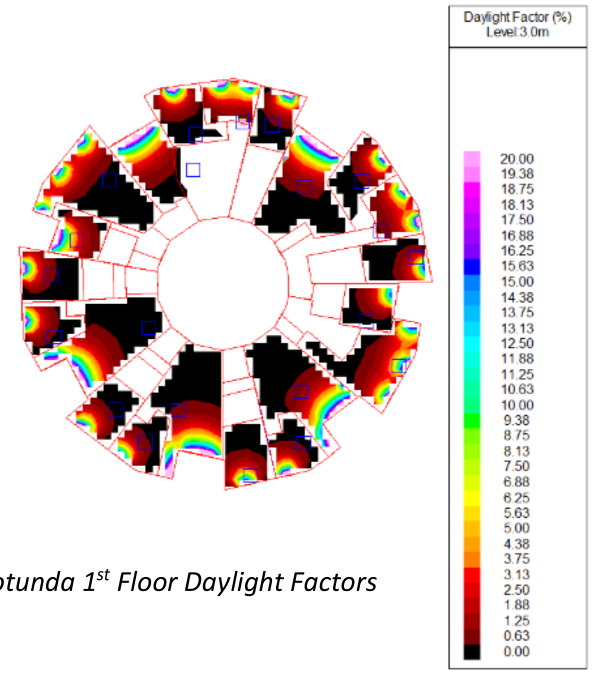
Daylight simulation has been carried out using the FlucsDL module of the IES VE 2019 software, this uses a ray tracing method.

A sample of dwellings have been chosen, including typical townhouses and block of flats, and apartment units on ground floors, which generally receive the least amount of daylight, due to overshadowing from neighbouring buildings. Shading elements such as balconies and overhangs have been included in the model

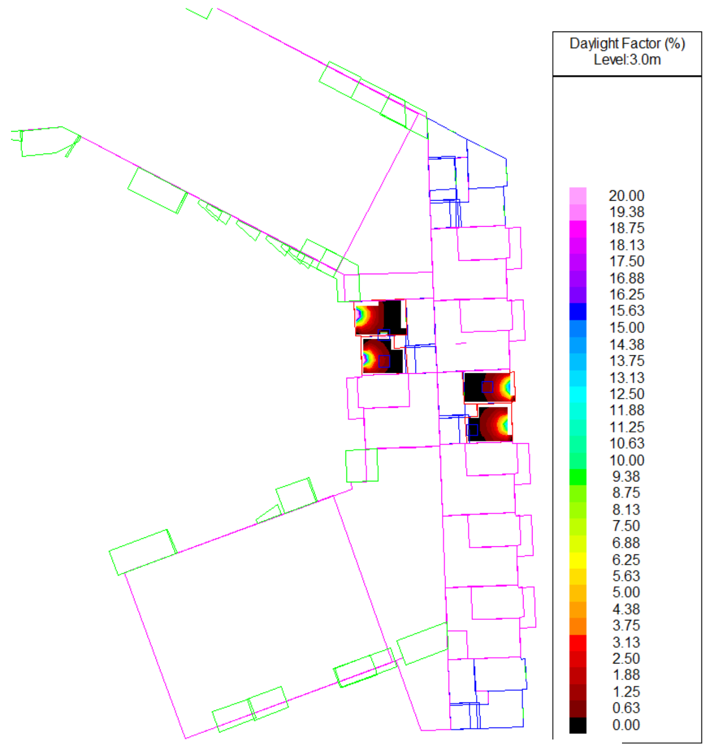
7.4. Results

Calculated average daylight factors are summarised in Appendix II. Contour plots on the following pages show the distribution of daylight received across the development. A summary of average daylight factors for spaces modelled is tabulated below; both bedroom and living room areas exceed the minimum ADFs required in BS 8206-2 and BRE guidance.

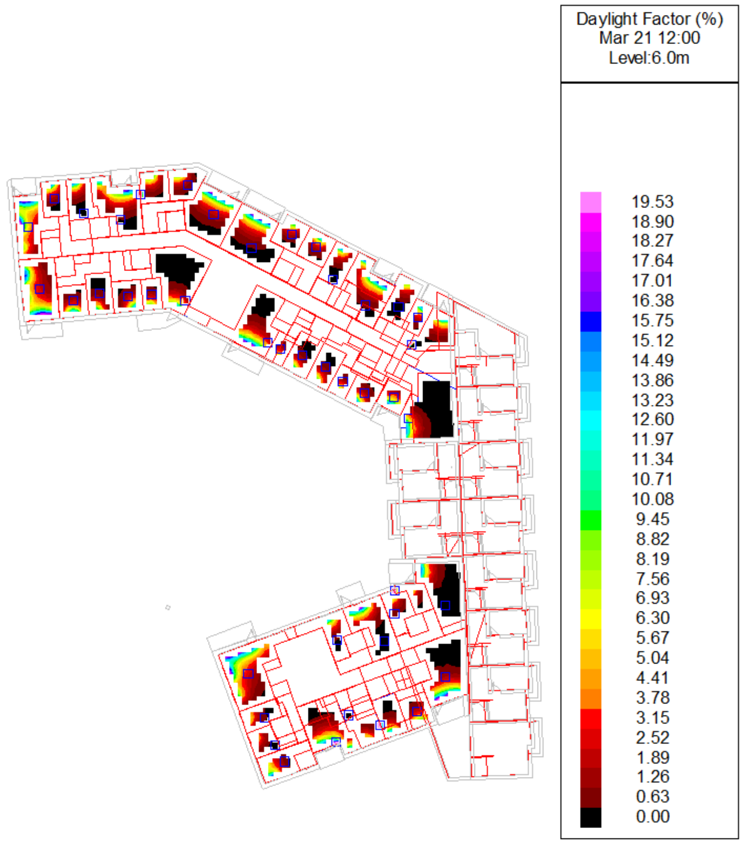
Area	Average Daylight Factor
1st Floor Rotunda Living Room	3.0
1st Floor Rotunda Bedroom	2.5
1st Floor North Block Living Room	4.0
1st Floor North Block Bedroom	3.1
1st Floor South Block Living Room	4.6
1st Floor South Block Bedroom	3.2
Townhouse Living Room	3.4
Townhouse Bedroom	2.9



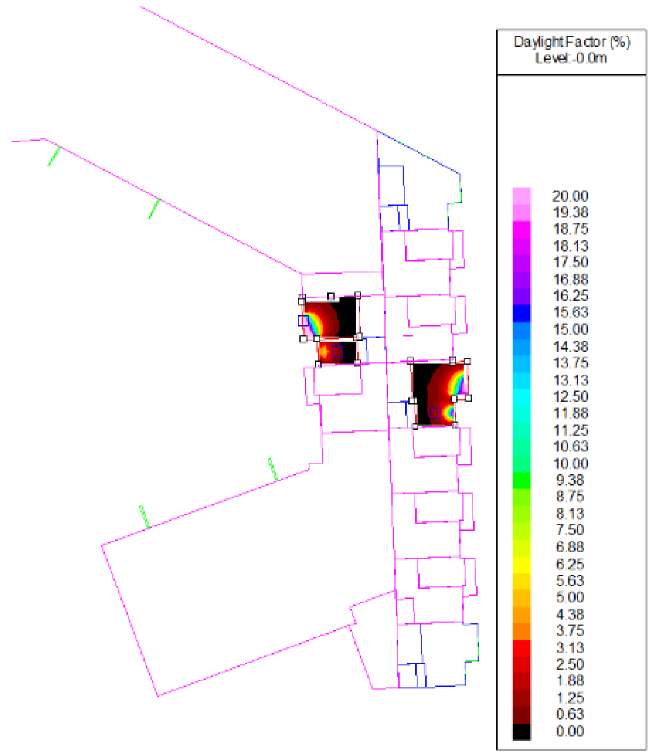
Rotunda 1st Floor Daylight Factors



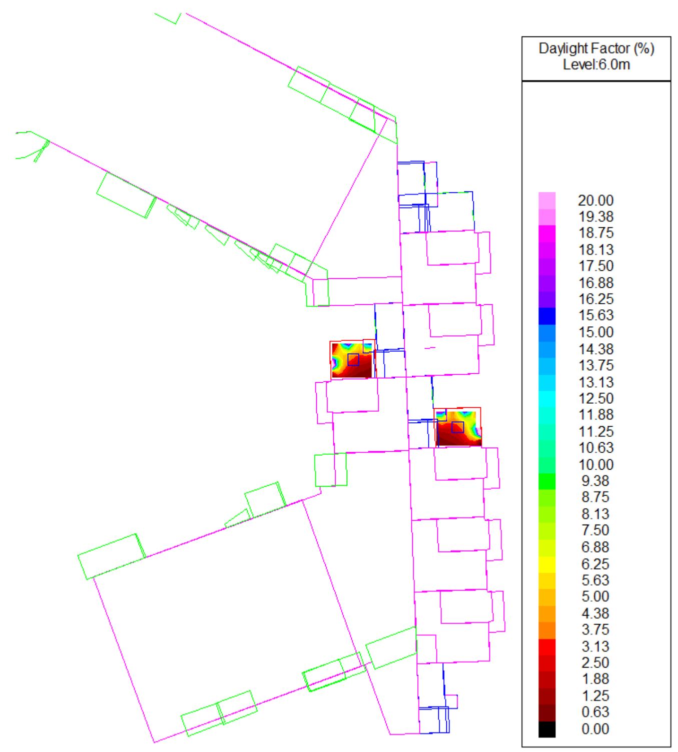
Townhouse 1st Floor Daylight Factors



North and South Block 3rd Floor Daylight Factors



Townhouse Ground Floor Daylight Factors



Townhouse 2nd Floor Daylight Factors

8. WATER CONSUMPTION

Approved Document G of the Building Regulations covers the requirements for water efficiency, setting a maximum of 125 litres of water per person per day; Part G also allows for an optional requirement of 110 litres per person per day, to be set by local authorities. Whilst the 110l/s/person limit is not a requirement, it is being proposed for this project in order to align with emerging policy and sustainable practice. Furthermore, requirements are placed on types of fittings as follows:

Table 2.1 **Maximum fittings consumption**

Water fitting	Maximum consumption
WC	6/4 litres dual flush or 4.5 litres single flush
Shower	10 l/min
Bath	185 litres
Basin taps	6 l/min
Sink taps	8 l/min
Dishwasher	1.25 l/place setting
Washing machine	8.17 l/kilogram

8.1. Reducing Consumption

Efficient sanitary ware is to be used in all dwellings. These include dual flush toilets, low-flow showers, and non-concussive spray taps.

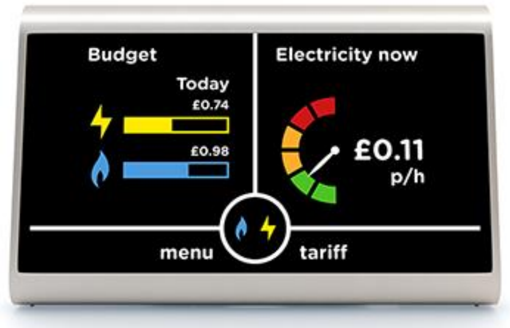
8.2. Monitoring

Bulk supplies to apartment blocks will be metered allowing monitoring of mains water use.

8.3. Rainwater recycling

Rainwater recycling has been considered for this site, however large-scale rainwater recycling with below ground storage tanks is not feasible on this project due to the large site, topography and relatively low density of housing which would require a significant infrastructure of pipework and pumps to transport the stored around the site. Furthermore, there may be complexities with who should operate and maintain such a system.

9. METERING STRATEGY



9.1. Electricity Metering

Each townhouse will be fed directly from the new substation. Where there are blocks of flats, power supplies will be run from the new substation to each individual building. From the intake position the supply will split into individual supplies for each flat, and a landlord supply serving communal lighting, which is to be submetered. Utility meters are to be provided internally, within each flat, considering fire safety requirements.

External lighting is to be supplied from switchboards within apartment blocks, and are to be submetered separately.

9.2. Water Metering

Townhouses are to be fed directly by the utility supplier. Each townhouse is to have a utility meter located in the street outside the front of the property.

Apartment blocks are to be fed from bulk supplies provided by the utility supplier. Metering of the incoming supply will be provided for monitoring by the landlord. Boosted supplies are provided to each apartment unit where utility meters will be located in the risers at each floor level in the communal stairway.

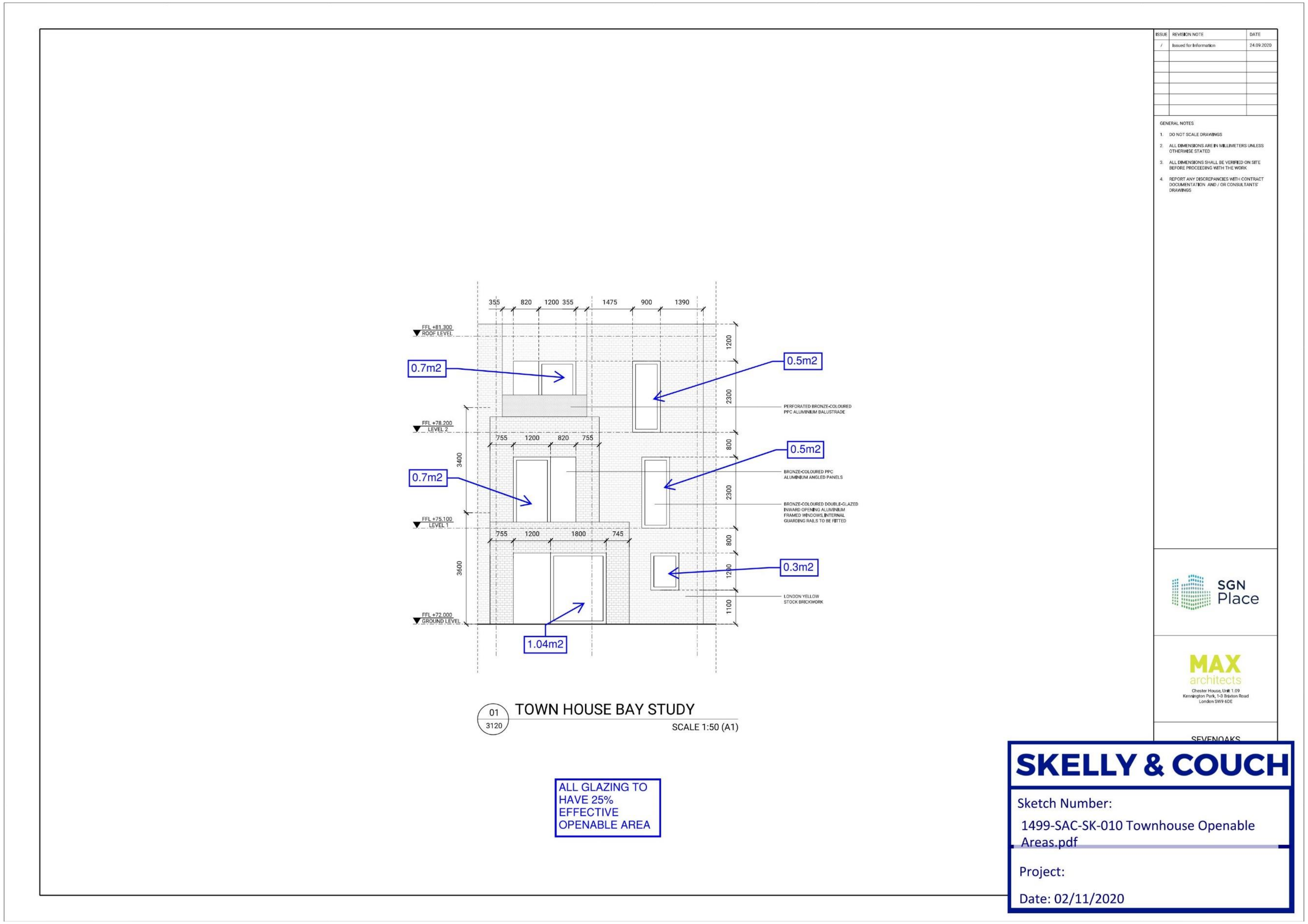
Water supplies for irrigation of shared external spaces, for example, the communal gardens, are to be fed from boosted water supplies serving apartment blocks. These are to be individually submetered.

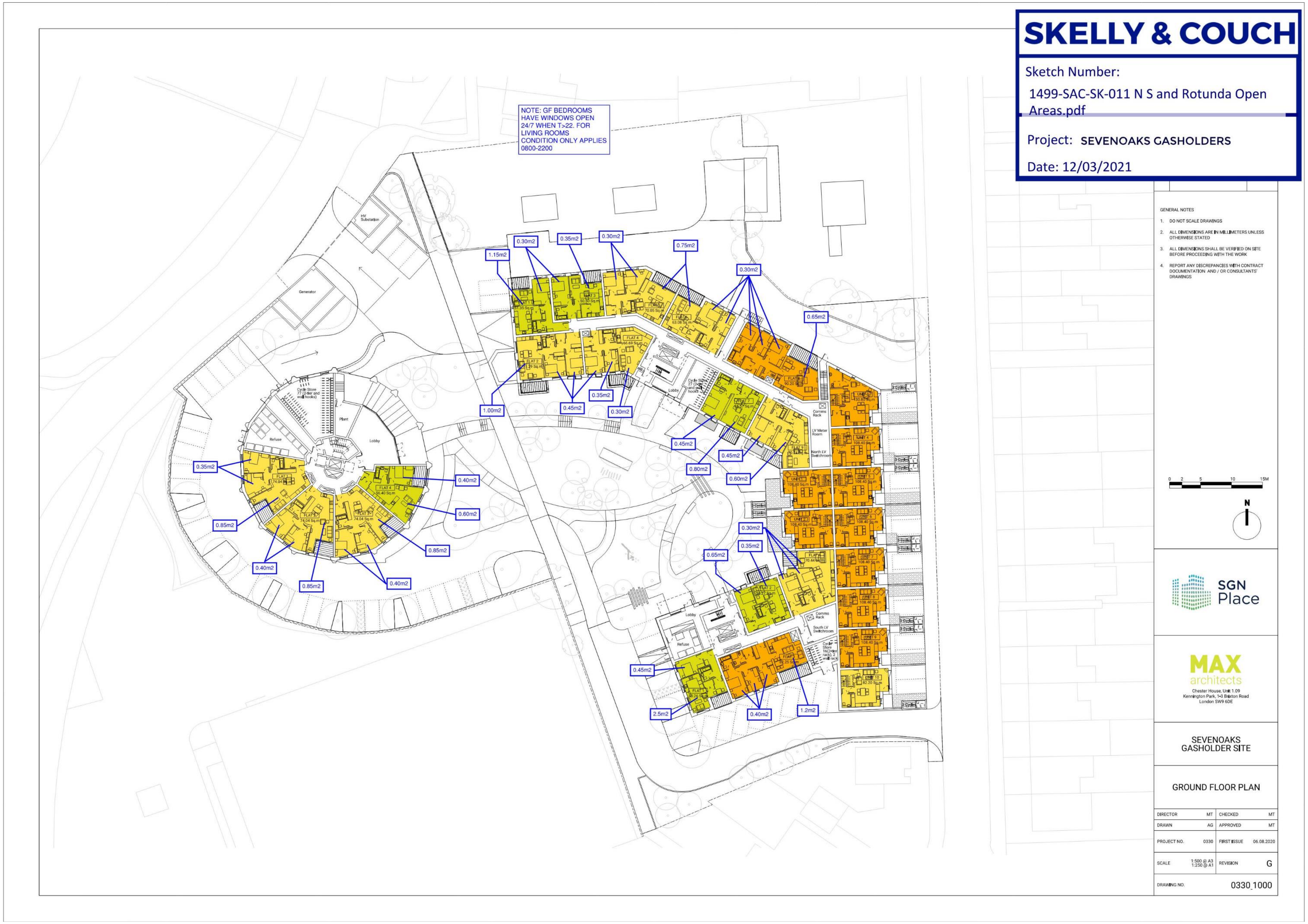
All sprinkler supplies will not be metered.

9.3.Renewables

Photovoltaic panel arrays located on apartment block roofs will be integrated into the switchboards at ground floor level. Each PV array will be submetered.

APPENDIX I: NATURAL VENTILATION FREE AREAS




SKELLY & COUCH
Sketch Number:
1499-SAC-SK-011 N S and Rotunda Open Areas.pdf
Project: SEVENOAKS GASHOLDERS
Date: 12/03/2021
NOTE: GF BEDROOMS HAVE WINDOWS OPEN 24/7 WHEN T>22. FOR LIVING ROOMS CONDITION ONLY APPLIES 0800-2200
1.15m2
0.30m2
0.35m2
0.30m2
0.75m2
0.30m2
0.65m2
1.00m2
0.45m2
0.35m2
0.30m2
0.45m2
0.45m2
0.80m2
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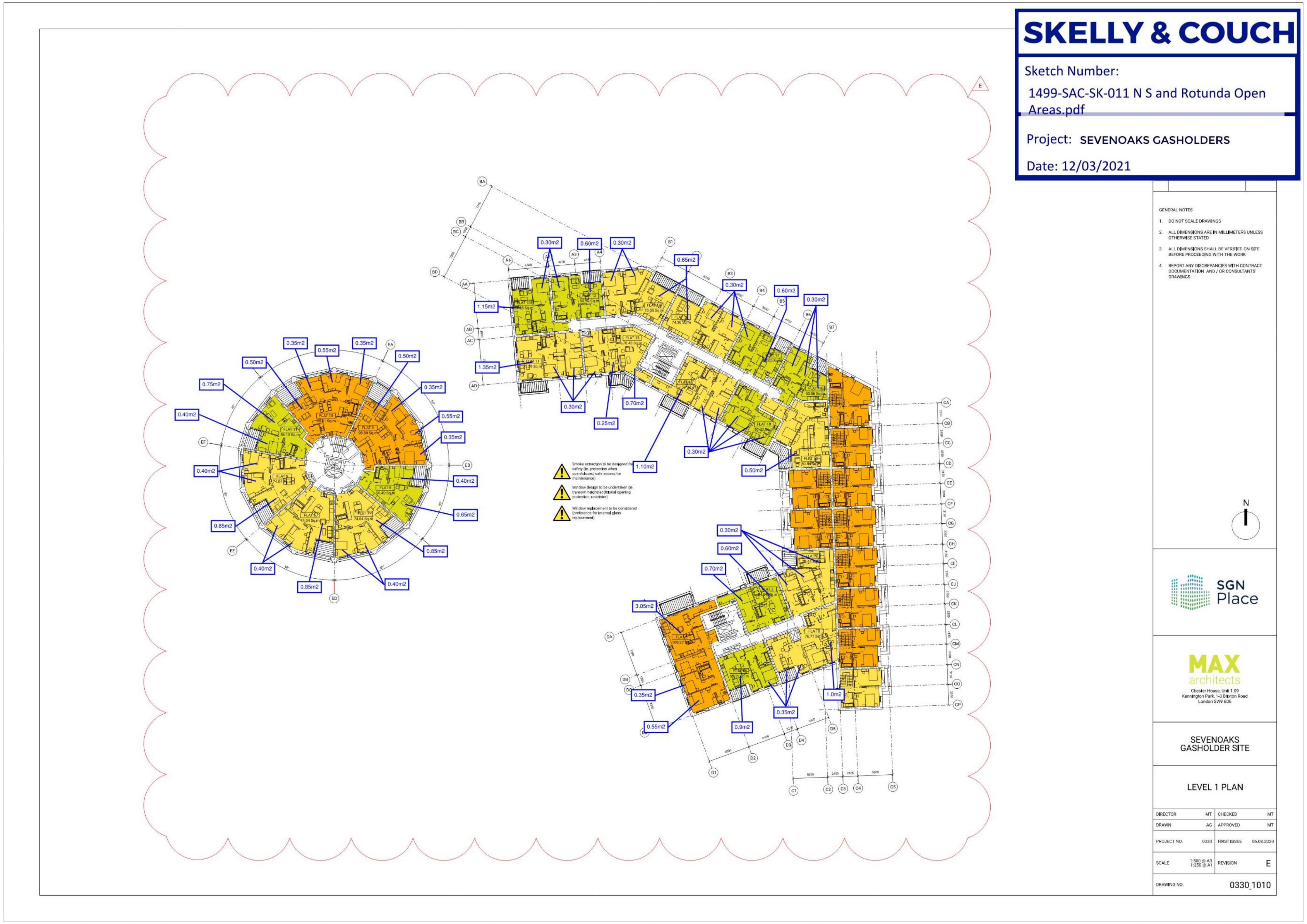
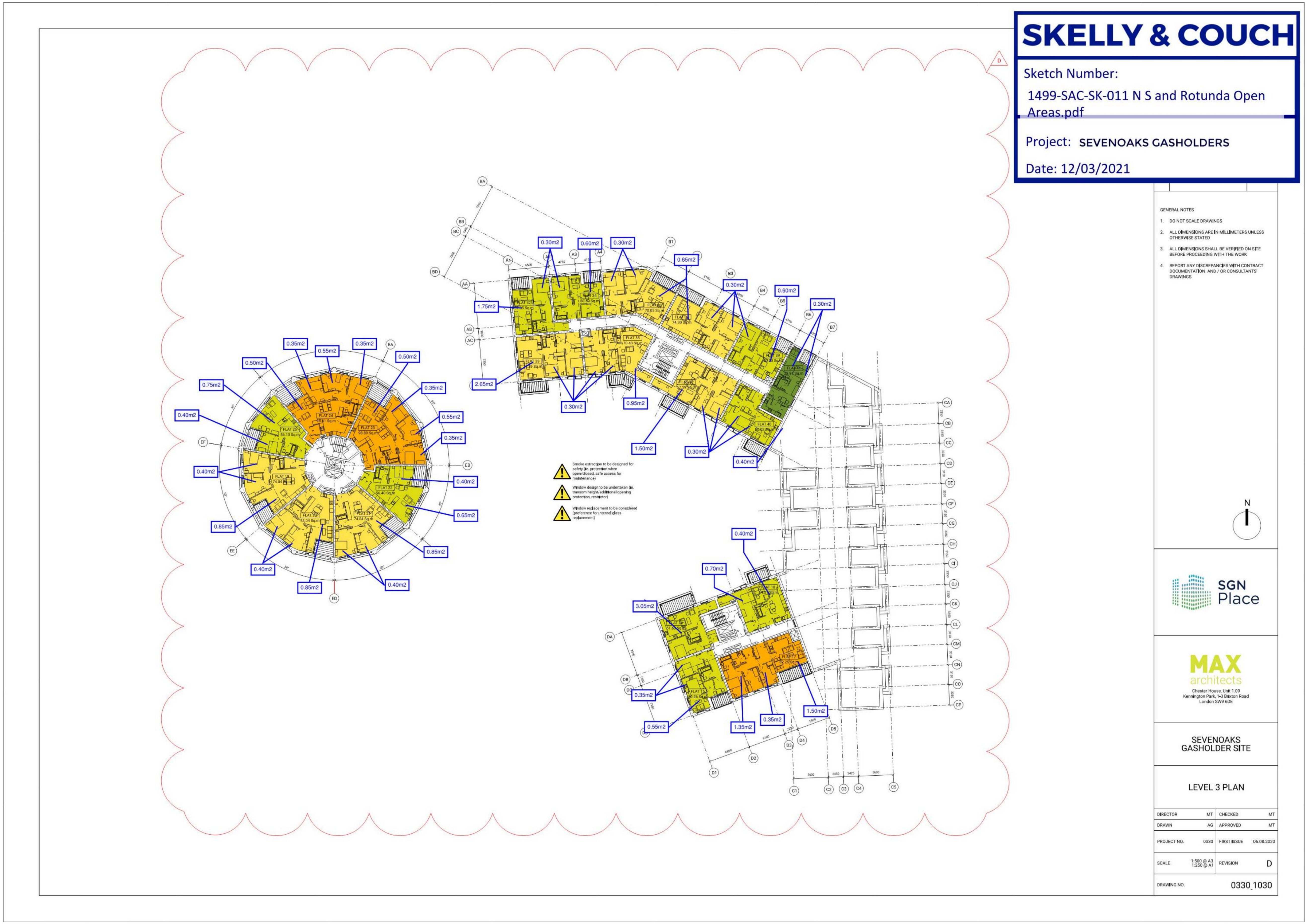
0.40m2
0.85m2
0.40m2
0.30m2
0.35m2
0.65m2
0.45m2
2.5m2
0.40m2
1.2m2
GENERAL NOTES
1. DO NOT SCALE DRAWINGS
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED
3. ALL DIMENSIONS SHALL BE VERIFIED ON SITE BEFORE PROCEEDING WITH THE WORK
4. REPORT ANY DISCREPANCIES WITH CONTRACT DOCUMENTATION AND / OR CONSULTANTS' DRAWINGS
N
SGN Place
MAX architects
Chester House, Unit 1.09 Kennington Park, 1-3 Brixton Road London SW9 6DE
SEVENOAKS GASHOLDER SITE
GROUND FLOOR PLAN
DIRECTOR MT
CHECKED MT
DRAWN AG
APPROVED MT
PROJECT NO. 0330
FIRST ISSUE 06.08.2020
SCALE 1:500 @ A3 1:250 @ A1
REVISION G
DRAWING NO. 0330_1000



Note: Open area requirements for Level 1 and Level 2 are identical.


SKELLY & COUCH
Sketch Number:
1499-SAC-SK-011 N S and Rotunda Open Areas.pdf
Project: SEVENOAKS GASHOLDERS
Date: 12/03/2021
GENERAL NOTES
1. DO NOT SCALE DRAWINGS
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED
3. ALL DIMENSIONS SHALL BE VERIFIED ON SITE BEFORE PROCEEDING WITH THE WORK
4. REPORT ANY DISCREPANCIES WITH CONTRACT DOCUMENTATION AND / OR CONSULTANTS' DRAWINGS
Smoke extraction to be designed for safety (ie. protection when open/closed, safe access for maintenance)
Window design to be undertaken (ie. transom height/additional opening, protection, restrictor)
Window replacement to be considered (preference for internal glass replacement)
N
SGN Place
MAX architects
Chester House, Unit 1.09 Kennington Park, 1-3 Brixton Road London SW9 6DE
SEVENOAKS GASHOLDER SITE
LEVEL 3 PLAN
DIRECTOR MT CHECKED MT
DRAWN AG APPROVED MT
PROJECT NO. 0330 FIRST ISSUE 06.08.2020
SCALE 1:500 @ A3 1:250 @ A1 REVISION D
DRAWING NO. 0330_1030

APPENDIX II : DAYLIGHT FACTORS

Note: Percentage values indicate 'Average Daylight Factor', the proportion of daylight levels inside a building compared to external light levels.