Planning Advice Note

Solar Convergence

Guidelines and best practice for assessing solar convergence in the City of London

CITY OF LONDON

Planning Advice Note
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Guidelines and best practice for assessing solar convergence in the City of London

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The City of London Corporation is the Local Authority for the financial and commercial heart of Britain, the City of London.

Introduction

This Planning Advice Note is one of a series of Advice Notes being prepared by the City Corporation covering microclimatic issues in the City of London. The Notes will provide clarity of advice on potential microclimatic impacts arising from development and how they need to be considered as part of the planning process.

Solar convergence occurs when a building, or other reflective structure such as a sculpture, focuses the sun's rays. This can cause localised areas of concentrated solar radiation which can sometimes result in safety hazards and damage. The potential for a structure to cause solar convergence should be assessed as part of development proposals at the early planning stage; this will enable applicants and architects to address any potential impact at an early phase of design and will avoid the need to retrospectively address unforeseen impacts.

This Planning Advice Note contributes to the City's key objectives to protect amenity, maintain a high quality public realm and ensure safety on the highways.

Policy Context

The planning policy framework, which comprises the context for the development of the advice note, is set out below. The framework includes the documents below as well as other documents produced by the City Corporation e.g. the Public Realm Supplementary Planning Document which gives guidance on the City's street scene and public realm.

City Corporation Corporate Plan

The overall vision seeks to support, promote and enhance the City of London as the world leader in international finance and business services. The relevant Key Policy Priority aims to support and promote the UK financial based services sector by encouraging quality developments in the built environment.

National Planning Policy

The National Planning Policy Framework (NPPF) sets out the Governments planning policies for England and how they are to be applied. The NPPF establishes a presumption in favour of sustainable development and seeks to establish a strong sense of place using streetscapes and buildings to create attractive and comfortable places to live, work and visit.

London Plan

The London Plan is the Mayor's spatial development strategy which forms part of the development plan for Greater London. The Mayor's vision is that London should excel among global cities, achieving the highest environmental standards and quality of life, and leading the world in its approach to tackling the urban challenges of the 21st century, particularly that of climate change. (Relevant London Plan policies are listed on Page 9).

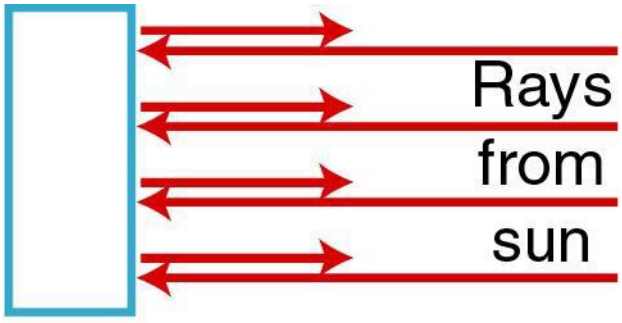
City of London Local Plan

The Local Plan was adopted in 2015, and provides a spatial framework that brings together and co-ordinates a range of strategies prepared by the City Corporation, its partners and other agencies and authorities. The strategic objectives of the Plan include maintaining the City's position as the world's leading international financial and business centre, and seeking to promote a high quality of architecture and street scene appropriate to the City's position at the historic core of London. (Relevant Local Plan policies are listed on Page 9).

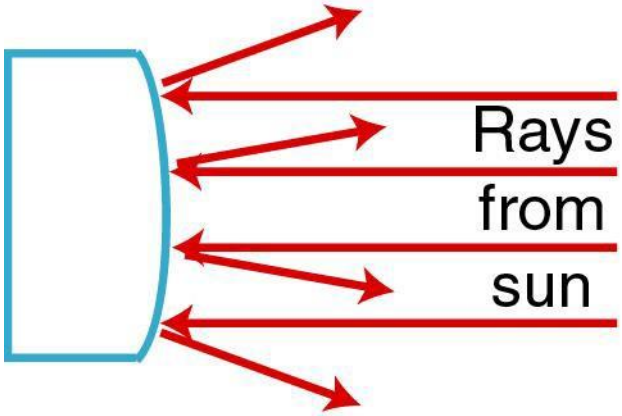
Guidance

Causes of solar convergence

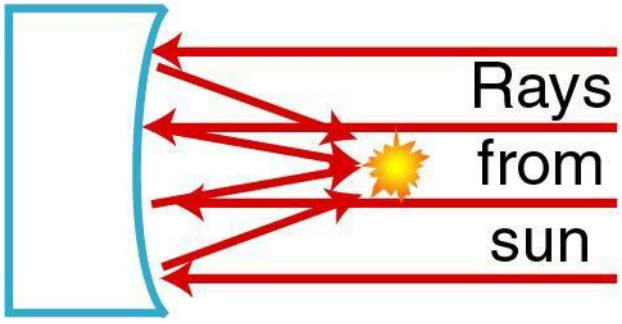
Solar convergence is very rare. Outdoors, it only happens when a reflective structure has a concave arrangement of elements which focus the sun's rays. The structure can be concave on plan, in section, or both. Flat and convex facades can still cause glare or dazzle which can be hazardous and disturbing (see the separate Planning Advice Note 'Solar glare'), however they do not concentrate the sun.



A flat face of a building or other structure reflects the sun but does not focus or concentrate it.



A convex face reflects the sun, but the reflected rays diverge; they are not concentrated and solar convergence cannot happen.



Only a concave face can focus and concentrate the sun.

The photograph shows a concave mirror focussing the sun's rays. Focussing of the sun can also happen in buildings, with the old-fashioned 'bulls-eye' types of glass. However in this case the sun is focused inside the building, not outside.

When incorporated in a concave façade, glass and shiny metals can reflect the sun's rays towards each other, and provide a sharp focus. The amount of solar radiation reflected depends on the specular (mirror-like) reflectance of the material. Some glass types, particularly those used in highly glazed commercial buildings, reflect a lot of infra-red heat radiation to keep the building cool. Matt surfaces like brick and concrete, and non-shiny cladding, give a diffuse reflection which does not cause solar convergence issues.

Effects of solar convergence

Solar convergence creates a relatively small area of concentrated solar radiation. Within this area, various adverse effects could occur:

- damage to people's eyes (particularly the retina), from looking at the reflected sunlight;
- burns to people's skin, either directly from the radiation or from touching hot objects like metal railings or door handles;
- local overheating, for example if someone is in a parked car;
- damage to materials (including melting and deformation). These could include plastics, rubber, bitumen and asphalt. Plastic items can include waste bins and other street furniture, signs and parts of vehicles;
- in extreme circumstances, materials could smoulder or catch fire.

Predicting solar convergence

If a concave reflective façade or other building element is proposed, a detailed study should be carried out to predict whether solar convergence can happen, where it occurs, and the maximum solar radiation levels. This is a specialist type of assessment and expert advice should be sought. Modelling of reflection should be carried out for the full range of days and times of year when the sun can shine on the façade.
The intensity and location of the concentrated solar radiation will depend on the curvature of the façade and its size. A smaller, heavily curved building element will concentrate solar radiation over a limited area which will be close by. A large, gradually curved façade will concentrate solar radiation over a wider area which may be some distance away. This is potentially more difficult to control.

Recommendations of concentrated solar radiation

The amount of solar radiation is given by the irradiance, measured in kilowatts per square metre (kW/m2). On a sunny summer's day in London, irradiances of 0.5kW/m2 are common, but they never exceed 1kW/m2. Damage to the eyes can occur at irradiances as low as 1-1.5kW/m2 if people are looking at the reflecting building. These irradiances can also soften low melting point materials like plastics, bitumen and asphalt, if they are exposed for long enough. Irradiances above 2.5kW/m2 can give rise to skin damage and burns, within 30 seconds of exposure. Much higher irradiances, above 10kW/m2, are needed for common materials like timber, plastic, fabrics and paper to catch fire.

Overall, it is recommended that no area, even at roof level, should receive a solar irradiance of 10kW/m2 or above. Areas where people are likely to be present (including windows to occupied rooms) should not receive a solar irradiance of more than 2.5kW/m2 for more than 30 seconds. For areas at street level where people are present, areas with reflected irradiances above 1.5kW/m2, and preferably those above 1kW/m2, should be minimised.

Avoiding solar convergence

At the design stage, it is possible to avoid solar convergence by reconfiguring the building or structure. For example, the problem can be avoided entirely by replacing a concave reflecting element with a flat or convex one.

If a concave element is still required, it may be possible to redesign it so that the convergence occurs in mid-air, or in an inaccessible location; or to limit the amount of concentrated solar radiation by reconfiguring individual façade components so that a sharp focus is avoided. Careful modelling of the reflected solar radiation is needed to check that the solution works.

Another way to avoid solar convergence is to use matt or diffusing materials instead of mirror-like ones like glass and shiny metal. It is also possible to use low reflectance glazings; these should have a low reflectance in the infra-red as well as the visible spectrum.

Once the building or structure has been constructed, solar convergence is more difficult to control. If it occurs over a limited area, it may be possible to control access to this area, at least during the days and times when sunlight is predicted to be reflected there. Another solution is the installation of external shading like louvres and fins, or motorised external blinds, to intercept the sunlight and stop it being reflected. These measures can provide additional benefits such as reducing overheating in buildings.

External shading was used to prevent solar convergence on 20 Fenchurch Street

Contacts

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Policies

Relevant London Plan policies relating to the microclimate

5.3 Sustainable Design and Construction
7.5 Public Realm
7.6 Architecture
7.7 Location and Design of Tall and Large Buildings

Relevant City of London Local Plan policies relating to the microclimate

CS 3 Safety and Security
CS 10 Design
CS 14 Tall Buildings
CS 15 Sustainable Development and Climate Change
DM 10.1 New Development
DM 10.4 Environmental Enhancement
DM 10.7 Daylight and Sunlight