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CIRCULAR TO PROFESSIONAL INSTITUTES

Who should know

Building owners, architects, engineers, contractors, licensed electrical workers, and solar photovoltaic (PV) suppliers/ system integrators

Advisory Note on Best Practices for Installing Solar Panels on Building Rooftops

1. As part of the national drive towards greater environmental sustainability in the built environment, solar panels may be installed on the rooftops of buildings to help generate renewable energy and reduce reliance on utility power. Building owners and industry practitioners overseeing such installations should install these solar panels in a manner that maximises energy harvest and minimises glare to neighbouring buildings.
2. To achieve this, it is recommended to adopt a 10 to 15 degrees tilt angle of the panel to the horizontal plane. This range of tilt angles optimises the performance of solar panels by maximising energy harvest. Panels installed at less than 10 degrees may lose performance as rain trapped by the panel frame could cause dirt to be deposited on the panel as it evaporates. Tilting beyond 20 degrees also reduces the absorption of overhead equatorial sunshine (refer to Annex A for more information on tilt angle and reflection) and may cause glare to the buildings in the vicinity.
3. We would appreciate it if you could inform the members of your organisation on the above, and encourage them to familiarise themselves with the good practices listed in the Handbook for Solar PV Systems published by BCA and EMA.

4. If you or your members have any queries concerning this advisory note, please contact us at the following channels:

	Enquiry Line	Email
BCA	1800 342 5222	bca_enquiry@bca.gov.sg
EMA	6835 8000	ema_enquiry@ema.gov.sg
URA	6223 4811	ura_dcd@ura.gov.sg

5. For other information on the master plan, urban design guidelines, private property use and approval, car park locations and availability, private residential property transactions, and conservation areas and buildings, use URA SPACE (Service Portal and Community e-Services). This is an online portal packed with useful data and visualisation to help building professionals, business operators and the general public in their decision-making. It consolidates detailed information on land use and private property into a one-stop platform presented on geospatial maps. For feedback or enquiries, please [email](#) us.

Thank you.

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Annex A

When light hits a transparent and smooth medium such as glass, part of it will travel into the medium and part of it will be reflected from the surface depending on the medium's reflectivity. While reflectivity of the medium remains unchanged, the reflectance from the medium increases exponentially with increasing angle of incidence¹, as illustrated in Figure 1 below.

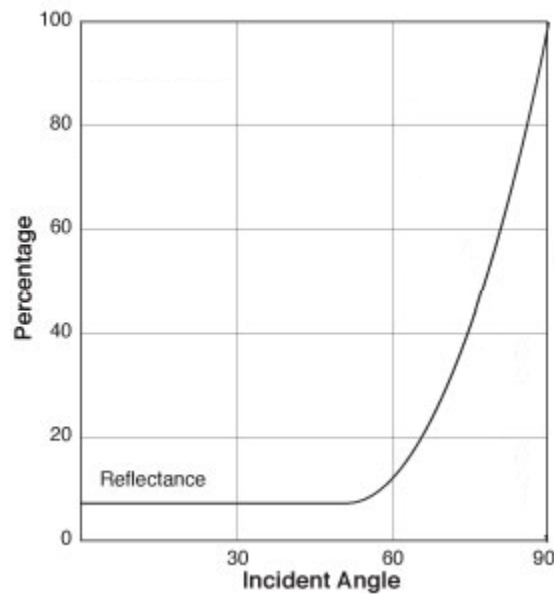


Figure 1 – Chart showing relationship between reflectance percentage and angle of incidence of typical glass. Chart courtesy of Solar Energy Research Institute of Singapore (SERIS)

When solar panels are installed at high inclination, not only will the amount of electricity generated be reduced, there is also likelihood that light can be reflected into homes of nearby vicinity resulting in discomfort from glare. Figure 2 below illustrates a case scenario for solar panels installed on inclined roof of house B.

¹ Angle of incidence is measured from “normal” incidence in which light strikes the glass straight on.

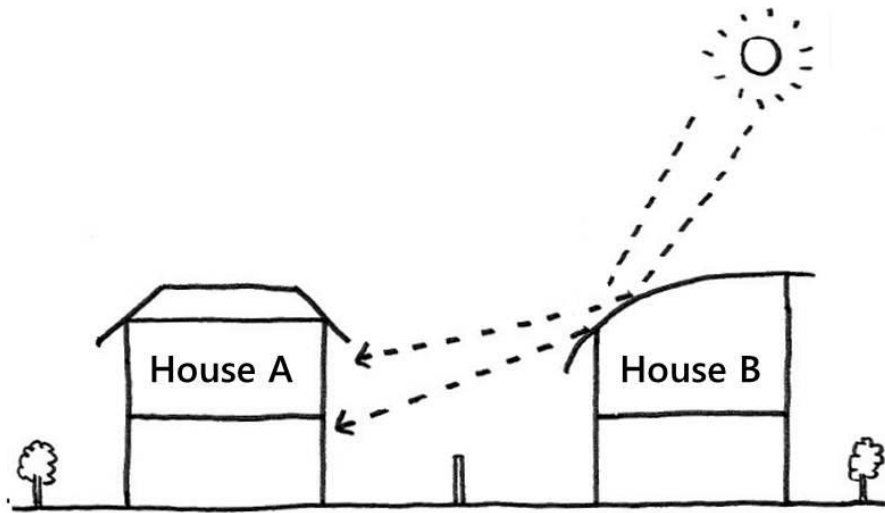


Figure 2 – Illustration of glare resulted due to installation of solar panels on inclined surface

To mitigate these glare concerns, homeowners and industry players are advised to limit the tilt of their solar panels to not more than 15 degrees from the horizontal plane, as illustrated in Figure 3. Solar panels on flat roofs are preferred, however, any proposal for solar panels on pitched roofs should also be guided by the maximum 15 degree tilt angle from the horizontal plane.

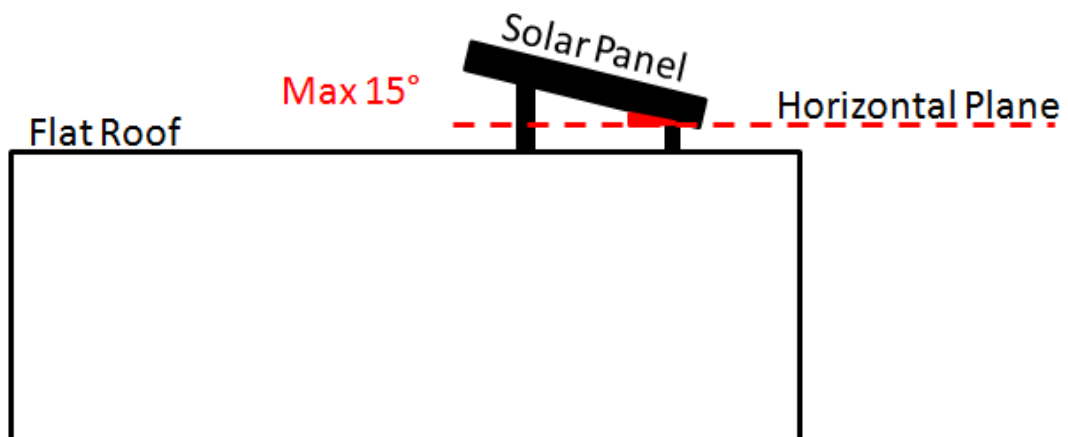


Figure 3 – Illustration of the 15 degrees maximum tilt angle of the solar panel in relation to the horizontal plane.