Structural Assessment – Sunpark Greenhouse System

1. Introduction

This document presents the structural substantiation of the **Sunpark Greenhouse System**, in which photovoltaic panels are applied as roof covering within greenhouse structures.

The assessment is based on structural calculations performed by an external engineering firm (Alcomtek) for two representative roof spans:

- **3.20 m**
- **4.00 m**

The purpose of this report is to consolidate and substantiate these calculations, demonstrating that the system complies with the applicable standards under defined conditions.

---

2. System Description

The Sunpark Greenhouse System consists of a greenhouse roof in which photovoltaic panels are integrated into a slightly inclined roof surface.

Load transfer is as follows:

- PV panels → glazing bars → greenhouse structure (beams/frames)
-

The system uses a lightweight structural concept tailored to greenhouse applications.

---

3. Geometry and Design Parameters

The following configurations have been analysed:

Roof span	Application
3.20 m	standard greenhouse roof
4.00 m	larger roof span

General assumptions:

- Building height: **max. 9 m**
- Roof pitch: typical for greenhouses (low slope)

---

4. Standards and Design Basis

The calculations have been carried out in accordance with:

- **NEN-EN 13031** – Greenhouses
- **EN 1990** – Basis of structural design
- **EN 1991-1-3** – Snow loads
- **EN 1991-1-4** – Wind loads
- Dutch National Annex

The greenhouse standard (NEN-EN 13031) is leading, supplemented by the Eurocodes where applicable.

---

5. Loads

5.1 Wind Load

Assumptions:

- Wind region: **I (Netherlands)**
- Building height: **≤ 9 m**
- Terrain: open terrain

Typical peak velocity pressure:

$$q_p \approx 0.8\text{–}1.0\ \text{kN/m}^2$$

With unfavourable pressure coefficients (edge zones, specifically **wind zone F – greenhouse corners**), this can locally increase to:

$$q_{wind} \approx 2.0\text{–}3.0\ \text{kN/m}^2$$

A maximum pressure coefficient of:

$$c_{pe} \approx -1.3$$

has been considered.

5.2 Snow Load

Depending on roof slope and location:

$$q_{snow} \approx 0.7\text{–}1.0\ \text{kN/m}^2$$

5.3 Load Combinations

According to EN 1990, the governing load cases are:

- snow load (downward pressure)
- wind load (pressure and suction)

---

6. Calculation Methodology

Separate structural calculations were performed by Alcomtek for both roof spans, including verification of:

- Ultimate Limit State (ULS)
- Serviceability Limit State (SLS)
- profile stresses
- deflection
- fixings

Governing components:

- glazing bars
- supports
- PV panel fixings

---

7. Results (Summary)

The calculations demonstrate that:

- Both roof spans comply with the applicable standards
- Stresses remain well below allowable limits
- Deflections are within serviceability criteria
- Fixings provide sufficient capacity

The **4.00 m roof span** is governing.

---

8. Governing Configuration

The most critical configuration is:

- Roof span: **4.00 m**
- Load combination: wind + snow
- Wind loading in edge zones (zone F)

This configuration governs the design of:

- glazing bars
- fixings

---

9. Applicability

Based on the performed calculations, it can be concluded that:
The Sunpark Greenhouse System is suitable for:

- **wind region I**
- **consequence class CC2**
- **building heights up to approximately 9 m**

The system is capable of resisting:

- wind loads
- snow loads
- combined load cases

---

10. Conclusion

The Sunpark Greenhouse System complies with structural safety requirements according to:

- NEN-EN 13031
- Eurocodes (EN 1990–1999)

The calculations confirm that:

- the system is structurally reliable
- the applied profiles and connections have sufficient capacity
- adequate safety margins are present

The system can therefore be considered a **safe and suitable roofing solution for greenhouse applications** within the defined parameters.

---

11. Disclaimer

This assessment is based on:

- Dutch wind and snow conditions
- standard system configurations

The following elements are **not included in this structural assessment**:

- the existing **gutter structure**
- the **free span of the gutters**

These must be verified on a project-specific basis.
For projects:

- outside the Netherlands
- with different geometries
- or higher loads

the structural design must always be:
reviewed and approved by a locally certified structural engineer
in accordance with national regulations.