

# Resistance of materials

Structural provisions and loading



## TOOLBOX

GREENHOUSE CONSTRUCTION AND SAFE OPERATION

Structural reliability is an overall concept covering structural actions, response and resistance, workmanship and quality control, all of which are dependent on each other.

The National Construction Code (NCC) outlines a number of important considerations for the resistance of materials used in the construction of greenhouses and grow structures in Australia. These are outlined below.

### Structural resistance of materials

The structural resistance of materials and forms of construction must be determined using five percentile characteristic material properties. This includes:

1. Known construction activities
2. Type of material
3. Characteristics of the site
4. Degree of accuracy inherent in the methods used to assess the structural behaviour
5. Action effects arising from the differential settlement of foundations, and from restrained dimensional changes due to temperature, moisture, shrinkage, creep and similar effects (BP1.2).

### Glazing impact resistance

Glass or glazing that are at risk of being subjected to human impact must have glazing that resists a reasonably foreseeable human impact without breaking (BP1.3).

### Structural reliability

#### Overview

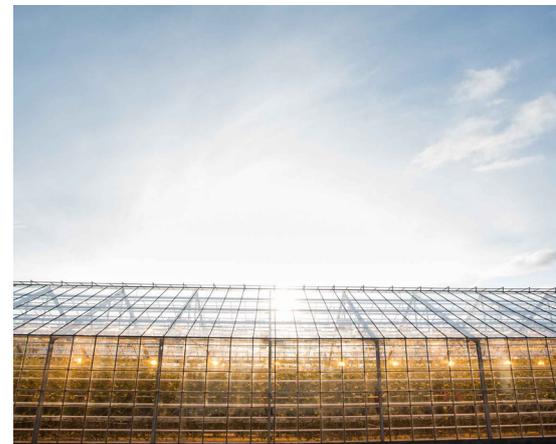
Structural reliability can be quantified by failure probability ( $pF$ ) or reliability index ( $\beta$ ), which are connected by the relation  $\beta = -\Phi^{-1}(pF)$ .

#### Reliability indices

Target reliability indices, or 'safety factors', are set for structural components and connections in the NCC. These indices are found in current design practice for steel, concrete and timber. Reliability indices are quantified using verification methods, specifically BV1 and V2.1.1. Verification methods may be used to demonstrate compliance with Performance Requirements BP1.1 and BP1.2 in the NCC.

## KEY MESSAGES

- It is important to understand the structural resistance of materials that you use
- Engage a suitably qualified structural engineer to provide advice and input to the structural reliability of your greenhouse in accordance with national standards
- It's important to consider structural resistance of materials and glazing impact resistance covered under BP1.2 and BP1.3 of the National Construction Code



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## Primary and secondary structural components

Structural components and connections can be classified as primary or secondary. Put simply, primary components or connections are responsible for structural integrity and their failure could result in a collapse of the protected cropping structure, whereas secondary components are not. Primary components and connections must meet unadjusted reliability indices, whereas these can be reduced for secondary components and connections when it does not affect the building, structure or other property.

## Probabilistic models

The reliability index takes actions and resistances, and represents these as random variables in probabilistic models.

The peaks in the curve models represents the most frequent value, and the distance between the action and resistance curves is the performance of the component under question, shown in Figure 1. These are in accordance with AS/NZS 1170 and follow a lognormal distribution.

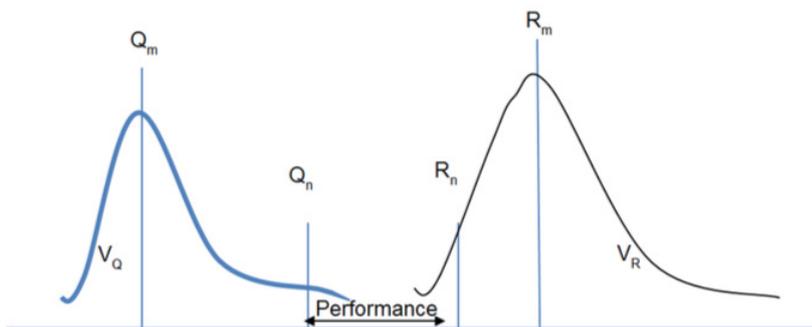


Figure 1: Action (left) and resistance (right) models

## REFERENCES AND FURTHER READING

Australian Building Codes Board (2016) National Construction Code 2016; Volume 1; Building Code of Australia; Class 2 to Class 9 Buildings, Commonwealth of Australia and States and Territories of Australia – Part B1 Structural Provisions, BP1.2 and 1.3, pp. 71

Australian Building Codes Board (2015) Structural Reliability Handbook, Section 3: Structural Reliability pp. 7, <https://www.abcb.gov.au/-/media/Files/.../Handbook-Structural-Reliability-2015.pdf>

## IMPORTANT QUESTIONS TO ASK

- Do I understand the structural resistance of different materials?
- Who is my local qualified structural engineer? What is their experience with protected cropping structures?
- What materials will I need to develop my new or modify my existing greenhouse?
- Has my engineer adequately considered the reliability indices of the primary structural components and connections in the greenhouse?