Engineering Basis and Assumptions

TUFF+ MgO Structural Insulated Panel (SIP) Compliance Calculator

https://tuffplus.global/SIPcomplianceCALC/

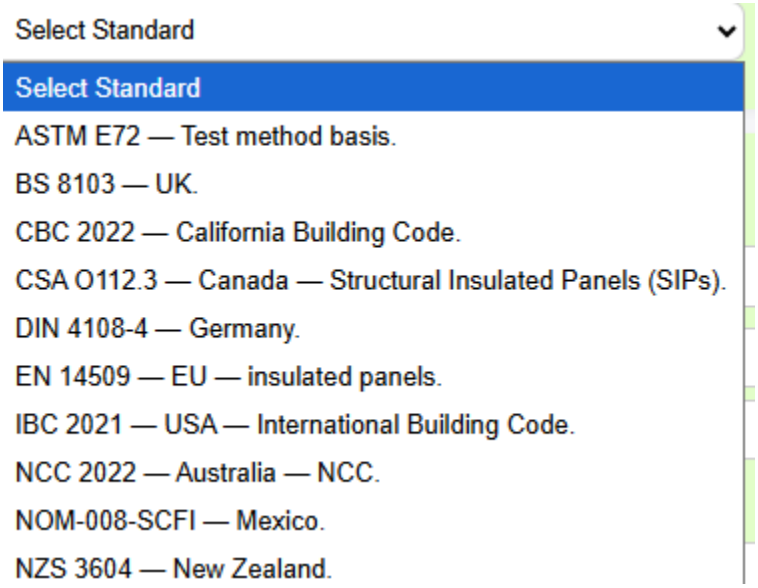
See Appendix A – input form

Appendix B – Example engineering report

1. Purpose

This engineering-based note explains the assumptions, structural idealization, and calculation logic used in the TUFF+ SIP Compliance Calculator and the associated project engineering report.

The calculator is intended to support compliance for SIP panel building codes as listed, internal technical review, and comparative evaluation of SIP configurations. As such it is helpful for engineer assessment.

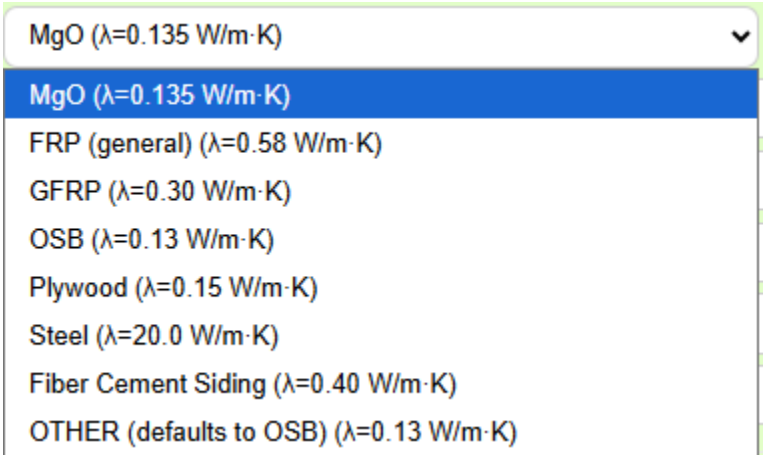


It is not intended to replace project-specific structural design, formal certification, or engineer-of-record services.

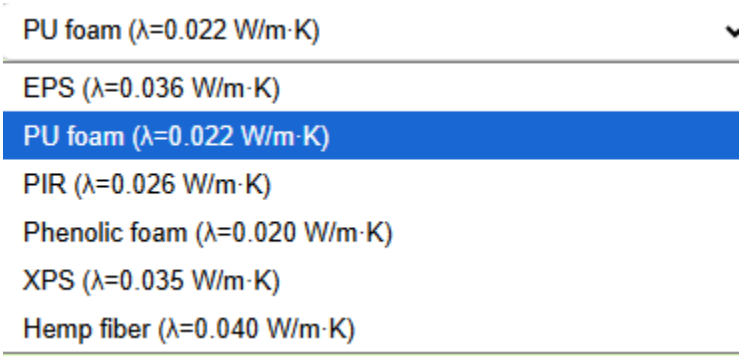
2. SIP Panel System Considered

The panels assessed are structural insulated panels (SIPs) consisting of:

- Chosen face/side sheets:



- Typical face thickness: 10-15 mm each side
- Rigid insulation core:



- Selected core thickness: 80-300 mm
- Continuous structural or adhesive bond between face sheets and core

All calculations are standardized on a **per-meter panel width** basis.

Structurally, the panel is idealized as a **sandwich element**, where:

- The face sheets resist bending stresses
- The core transfers shear and maintains separation between the faces

This approach is consistent with established SIP and sandwich-panel engineering practice.

3. Structural Modelling Assumptions

The following assumptions apply throughout the calculations:

- Linear elastic material behavior

- Full composite action due to adequate bonding
- Uniform load sharing between layers
- Simply supported boundary conditions
- Uniformly distributed loads
- Small deflection theory
- Short-term loading governs

The following effects are **not included** at this stage:

- Long-term creep
- Fire performance
- Seismic loading
- Connection or fixing design
- Secondary elements (finishes, splines, fasteners)

Based on typical SIP behavior and the strength levels used, axial and shear capacities are expected to be well above demand in most wall applications, with **flexure and deflection more likely to govern**.

4. Material Inputs

Material properties entered into the calculator are treated as **material strength values**, not allowable design stresses.

- Face sheet strengths (flexural, compressive, shear):
  Entered in MPa (metric) or psi (imperial)
- Core strengths (compressive and shear):
  Entered in kPa (metric) or psi (imperial)

Values are expected to be sourced from manufacturer data, laboratory testing, or third-party certification where available.

5. Calculation Logic (Summary)

5.1 Flexural Capacity

Flexural capacity is calculated using standard elastic beam theory applied to a transformed composite section.

- The section moment of inertia is calculated for the composite panel
- Bending resistance is limited by the allowable flexural stress of the MgO face sheets
- The governing capacity is taken as the more highly stressed face

This reflects common practice for sandwich-panel flexural analysis.

5.2 Axial Capacity

Axial capacity is calculated as the combined contribution of:

- The two MgO face sheets (based on compressive stress and thickness)
- The insulation core (converted appropriately from kPa)

A confinement factor is applied to reflect composite behavior of the core within the panel. This provides conservative axial resistance suitable for comparative and preliminary assessment.

5.3 Shear Capacity

Shear resistance is calculated as the sum of:

- Shear resistance of the face sheets
- Shear resistance of the foam core

In typical wall applications, shear capacity exhibits substantial reserve relative to governing loads.

5.4 Deflection

Deflection is calculated using classical elastic beam equations for a simply supported member under uniform load.

- Deflection is treated as a serviceability check
- Span-based limits such as **L/180** and **L/240** are used, depending on application

Deflection often governs allowable spans before strength limits are reached.

6. Safety and Reduction Factors

Nominal capacities are reduced to design-level values using:

- A global safety factor (γ), typically 1.6
- A bond efficiency factor, linked to relative shear performance
- A confinement factor applied to axial capacity

The intent is to clearly separate raw material capacity from conservative design values, rather than to optimize capacity.

7. Wind and Lateral Load Considerations

For wall panels, lateral load capacity is assessed based on:

- Panel flexural resistance
- Core shear transfer
- Serviceability deflection limits

The current methodology is suitable for **preliminary wind load comparison and wall performance evaluation**, rather than final jurisdictional wind design.

8. Scope and Limitations

The calculator and associated report do not address:

- Long-term creep or sustained loading effects
- Seismic behavior
- Fire resistance
- Connection detailing
- Project-specific support or boundary conditions

Final acceptance by regulatory authorities remains subject to certified material properties and independent engineering review.

9. Intended Use

The TUFF+ SIP Compliance Calculator is intended as a transparent and structured tool to:

- Compare SIP engineering strengths and application
- Support early compliance and regulatory discussions
- Assist university, research, and pre-engineering review

It provides a rational technical basis for discussion, with **flexure and deflection identified as the most critical governing checks** in most applications.

10. Conclusion

The calculation approach described above applies established elastic sandwich-panel principles in a clear and consistent manner. When supported by certified material properties, the methodology provides a reasonable technical basis for preliminary assessment, comparison of SIP configurations, and early-stage compliance or university-level review.

Further validation, testing, and jurisdiction-specific engineering review would be required for formal certification or project-specific structural design.

Prepared by a qualified Civil Engineer,

January 10, 2026

Appendix A – input form

TUFF+ GLOBAL

SIP Structural Engineering CALCULATOR V2.5
& building Code compliance certification
SIP = Structural Insulated Panel

Engineer & Project Info

Engineer Name:	J. Smith, P.Eng.	[ENG_NAME]
Project ID:	PROJ-2025-001	[PROJ_ID]
Date:	mm/dd/yyyy	[REPORT_DATE]

Unit System - International measurement categories

Units:	Metric (mm, MPa/kPa, kN/m, kN·m/m)	[UNITS]

Changing units converts existing numeric entries and updates field prompts and reports. Run a report in one unit system (say Metric) and then change the unit system (to Imperial) and re-run will then result in reports for each Unit system, Metric and Imperial.

SIP Strength Requirements : International Country & Region Standards

Select **Country** + **Region/State** and the tool will auto-select a suitable standard. You can still override it manually.

Country:	Australia	[COUNTRY]
Region/State/Province:	Select Region	[REGION]
Applicable Standard:	NCC 2022 — Australia — NCC.	[STANDARD]

Australia — NCC.

Design Parameters / Requirements (from SIP Standard selected above)

Design Requirement - Flexural (kN·m/m):	10.00	[REQ_MR]
Design Requirement - Axial (kN/m):	12.00	[REQ_PR]
Design Requirement - Shear (kN/m):	4.00	[REQ_VR]
Deflection Limit:	L/180	[DEF_LIMIT]
Safety Factor (γ):	1	[GAMMA]

NOTE: Factor of Safety (FoS) expresses how much stronger a SIP is - "Over and beyond SIP normal operating standards which ALREADY INCORPORATE an implied safety factor of about 2-3". Read the Global Code review + Safety Factors report before changing this.

SIP Panel Configuration

Default behavior: Side 1 values auto-copy into Side 2 (common symmetric panels).
If you edit a Side 2 field, that field stops syncing (Side 2 never changes Side 1).

Side 1

Material:	MgO (λ=0.135 W/m·K)	[S1_MAT]
Thickness (mm):	10	[S1_THK]
Flexural Strength (MPa):	11	[S1_MR]
Compressive Strength (MPa):	10.1	[S1_PR]
Shear Strength (MPa):	0.5	[S1_VR]
Test Report Link:	https://...	[S1_RPT]

Core

Material:	PU foam (λ=0.022 W/m·K)	[CORE_MAT]
Thickness (mm):	100	[CORE_THK]
Density (kg/m³):	40	[CORE_DENS]
Flexural Strength (kPa):	208	[CORE_MR]
Compressive Strength (kPa):	70	[CORE_PR]
Shear Strength (kPa):	201	[CORE_VR]
Shear Modulus (MPa):	10	[CORE_G]
Test Report Link:	https://...	[CORE_RPT]

Side 2

Material:	MgO (λ=0.135 W/m·K)	[S2_MAT]
Thickness (mm):	10	[S2_THK]
Flexural Strength (MPa):	11	[S2_MR]
Compressive Strength (MPa):	10.1	[S2_PR]
Shear Strength (MPa):	0.5	[S2_VR]
Test Report Link:	https://...	[S2_RPT]

Calculate Compliance | Generate Compliance Report PDF | Generate Engineering Report PDF | SIP Formulas | Global Code review + Safety Factors

⚠️ **Note:** This tool produces a technical summary suitable for engineering review. Final design must be verified by a licensed professional engineer.

COMPLIANCE SUMMARY (Required vs SIP Capacity)

Flexural strength : 10.00 (kN·m/m) required vs 11.19 (kN·m/m) capacity => PASS — 11.9% higher than code requires

Axial strength : 12.00 (kN/m) required vs 210.40 (kN/m) capacity => PASS — 17.5 times higher than code requires

Shear strength : 4.00 (kN/m) required vs 30.10 (kN/m) capacity => PASS — 7.5 times higher than code requires

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Appendix B – Example engineering reports etc

TUFFplus-Engineering-Report-[Example

TUFFplus-SIP-Compliance-[Project ID] (8

Building-Code-SIP-per-meter-standardi

Building-codes-international-review-an

Example deflection table:

DEFLECTION TABLE (computed)
Uses δ = 5wL^4/(384EI) and δ_allow = L/N (N from L/180). Values shown are midspan deflection for a 1m strip under uniform pressure.

	Snow Roof load per meter width (kN)or maintenance Roof load per meter width (kN)									
SIP clear span (m)	0.48	0.72	0.96	1.20	1.44	1.92	2.39	2.87	3.35	3.83
2.00	0.29	0.44	0.58	0.73	0.88	1.17	1.46	1.75	2.04	2.33
2.40	0.61	0.91	1.21	1.52	1.82	2.43	3.02	3.63	4.23	4.84
3.00	1.48	2.22	2.96	3.70	4.44	5.92	7.37	8.85	10.33	11.81
3.60	3.07	4.61	6.14	7.68	9.21	12.28	15.29	18.36	21.43	24.50
4.20	5.69	8.53	11.38	14.22	17.06	22.75	28.32	34.01	39.70	45.39
4.80	9.70	14.56	19.41	24.26	29.11	38.82	48.32	58.02	67.73	77.43

Legend: GREEN = OK (δ ≤ δ_allow) RED = FAIL (δ > δ_allow)
Units shown in table: Deflection (mm). Column headers: Line load on 1m strip (kN/m).

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