

Irish Climate Conditions and HUAYING Modular Housing — Product Adaptation Guidance

A quantified assessment against Ireland 1991–2020 climate normals, TGD Part L 2021 energy thresholds and IS EN 1991-1-4 wind actions

Version 2026-10-18 | Site datum: Dublin 53.35°N / 6.26°W (national ranges in Chapter 2)

Methods: IS EN ISO 6946 1-D series resistance + 2-D control-volume thermal bridge solver + EN ISO 13788 moisture criteria

All figures reproducible; calculation scripts archived with this report

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Summary — three conclusions first

CONCLUSION 1 · COMPLIANCE

A 100 mm panel cannot comply in Ireland.

TGD Part L 2021 sets a backstop of $U \leq 0.18 \text{ W/(m}^2\cdot\text{K)}$ for walls. Our current 100 mm PIR double-skin steel panel achieves $U = 0.221$ (0.229 including joints), a shortfall of 23%. Meeting 0.18 with PIR requires **124 mm** of insulation; with EPS, **215 mm**. This is not an engineering problem — it is arithmetic on the thickness budget.

CONCLUSION 2 · THE ONLY ROUTE

Do not build a thicker single-layer panel. Build a "factory panel + site-applied internal lining" composite wall.

Stack a 100 mm factory PIR panel with 50 mm of site-applied internal insulation for 150 mm total; actual U falls to **0.152**, clearing both the 0.18 and 0.15 thresholds in one step. Shipping volume is unchanged (still a standard 2.2 m wide module), one extra site operation buys a 15% performance margin.

CONCLUSION 3 · WHAT MAKES IRELAND DIFFERENT

The dominant issue here is moisture, not thermal performance.

National average rainfall is 1,288 mm, rising to 1,430 mm in the west; winter external relative humidity stays above 85% for long periods, and the metal skin is completely impermeable. Once the wall is closed it has **no drying capacity — weathertightness must come from the skin and the joints, not from the wall drying out**. This is why joint detailing matters more than insulation material.

0.18

Part L wall limit
W/(m²·K)

0.152

Measured U of
recommended build-up

1,430

Wettest region
mm/yr (Valentia)

0.79

Flap uplift ÷
module self-weight

The four questions this report answers

Question	Answer	Reference
What does the Irish climate mean for a container house?	Small temperature range (annual mean 9.8 °C), but high humidity, strong wind, and frequent driving rain — failures are moisture ingress and wind uplift, not frost	Chapter 1
Can the current product be sold as-is?	Yes, but not as a permanent dwelling . Site offices, construction camps and ancillary buildings are entirely viable	Ch. 3, 7
What must change to enter the housing market?	Wall to 150 mm (100 factory + 50 site), joints to Class A tongue-and-groove, continuous vapour barrier on the warm side	Ch. 5, 6

Is the change worth it?

Yes. Wall material cost rises about **+41%** (CNY 198 → 280 per m² with plasterboard lining), but it opens the Irish housing and ancillary dwelling (Class 3A) market

Chapter 7

1. Climate: mild, but far from benign

Ireland has a temperate maritime climate (Cfb), moderated by the North Atlantic Drift — **no severe winters, no hot summers**. That apparent mildness is deeply misleading: three other parameters decide whether a building performs.

1.1 Temperature: almost no design stress, but 40 frost days

Indicator	National mean	Notes
Annual mean temperature	9.8 °C	Range 8.5–10.8 °C; mildest on the coast
Coldest month (January)	5.4 °C	Seasonal mean; inland daily minimum about 2.5 °C
Warmest month (July)	14.6 °C	Seasonal mean; inland daily maximum 18–20 °C
Extreme minimum (winter)	–5 to –10 °C	Inland frost, rare on the coast; design external temperature taken as –2 °C
Annual frost days	40+ days	Kilkenny reaches 53 days; fewer on the coast

What this means for a container house

Temperature is not the dominant issue. A design external temperature of –2 °C means **condensation risk far exceeds frost-heave risk**: any internal wall surface below 10.2 °C (the dew point at 21 °C / 50% RH) will run with condensation. On a 100 mm PIR wall, the internal surface at a panel joint measures as low as 6.3 °C with Class C joints — that is where mould starts.

1.2 Rainfall: the west receives 1.7 times the east

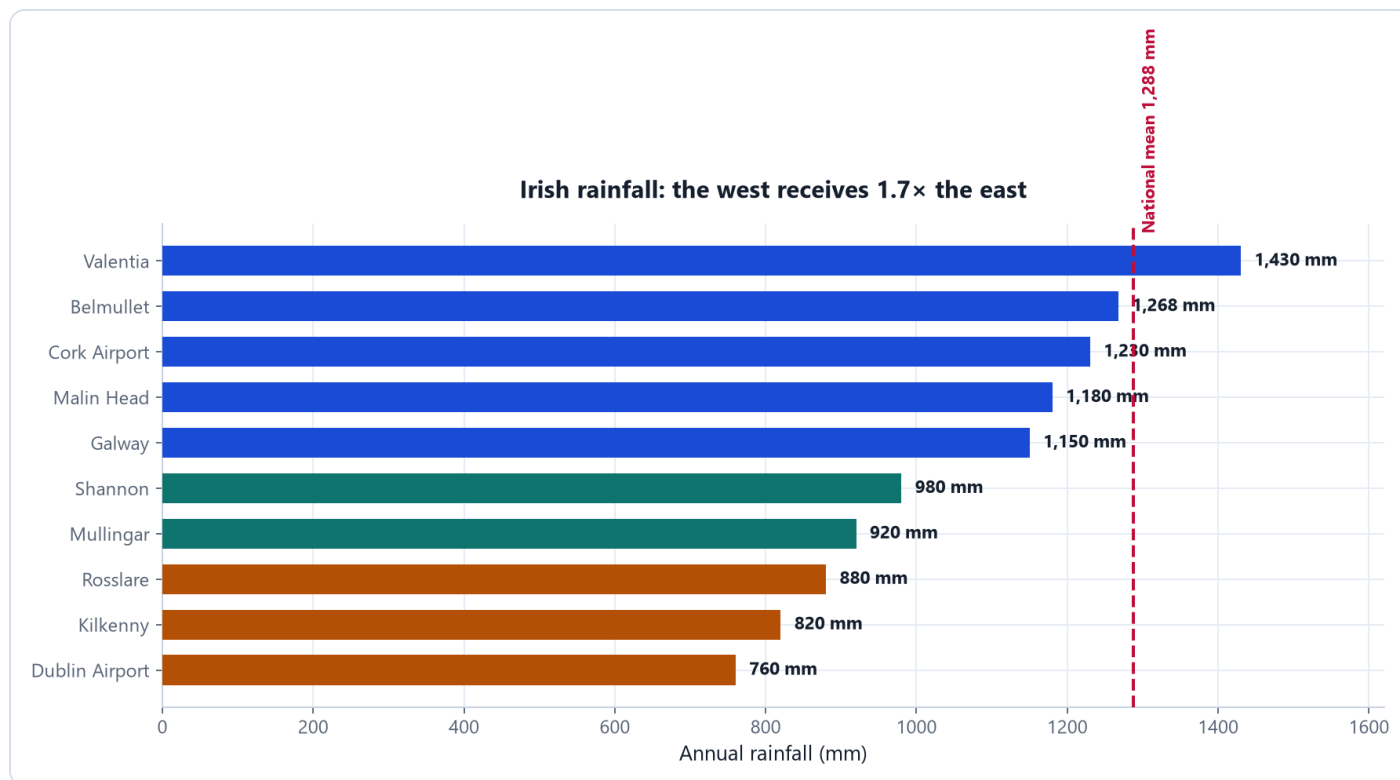


Figure 1 Annual precipitation across Ireland. National mean 1,288 mm; Dublin in the east 760 mm; Valentia in the south-west 1,430 mm. A 1.7-fold variation within one country — pricing and specification must follow the site region, not a single national figure.

The 1991–2020 climate normals give a national average of **1,288 mm**, with a pronounced west-to-east gradient: 878 mm on the east coast, 2,045 mm in the south-western uplands. Winter and autumn are wettest (about 370–380 mm each), spring driest (256 mm). Annual "wet days" (≥ 1 mm) reach 225 in the west and 151 in the east.

More important is the **form of precipitation**. Irish rain arrives on Atlantic fronts, almost always accompanied by strong wind, so it falls as **driving rain** rather than vertically. Met Éireann's driving rain index, prepared to I.S. EN ISO 15927-3, shows annual driving rain of **800–900 L/m²** on the west coast, against about **400 L/m²** at Dublin Airport. TGD Part C accordingly divides the country into **moderate exposure** and **severe exposure** zones, the boundary running broadly along the west and north-west coasts. In addition, **any building on a hill or slope, or standing proud of its surroundings, is treated as severely exposed**.

The single most important climate conclusion in this report

Driving rain creates locally high-pressure water ingress at **panel joints, window openings and internal corners**. A container house has 5–10 times the joint density of conventional construction (one panel joint every 1.15 m, plus a vertical joint at every corner), which means **the probability of weathertightness failure is inherently higher than in masonry**. In Ireland, one badly executed joint will show as mould staining on the internal lining within two winters — and the client will read it as "a quality problem with Chinese buildings".

1.3 Wind: it decides whether the module can be "opened up"

Ireland has one of Europe's richest wind resources. The prevailing direction is **west-south-west**, with annual mean speeds from 3 m/s in the south-east to 8 m/s on the northern coast. Inland stations such as Carlow record fewer than 2 gale days a year, while Malin Head on the north coast exceeds 50.

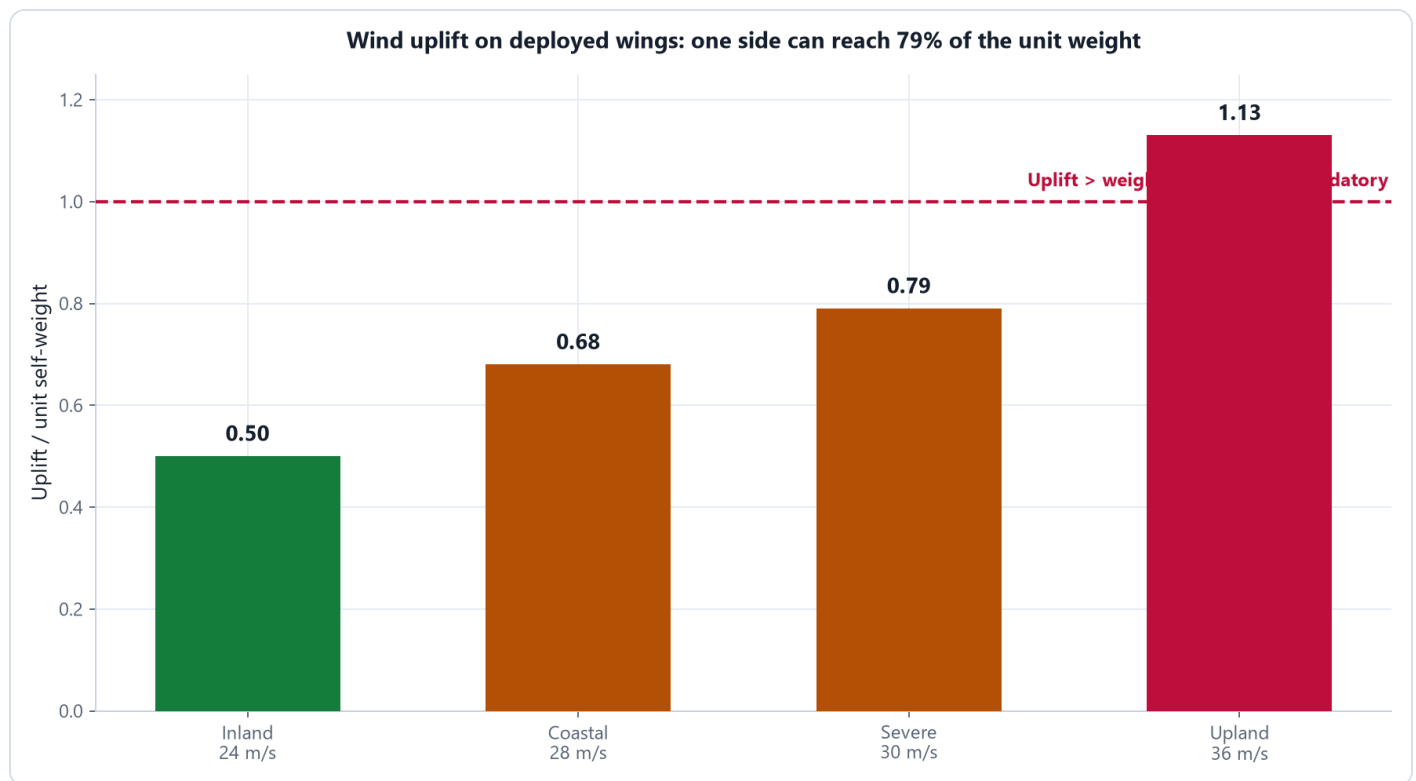


Figure 2 Ratio of wind uplift on one flap to total module self-weight, for a 20 ft double-wing container house in the deployed state. Calculated to EN 1991-1-4 Irish National Annex ($v_{b,map}$ 24–30 m/s, $c_{alt}=1+0.001A$) with flat-roof $c_{p,e}=-2.0$.

Site category	$v_{b,0}$ (m/s)	q_p (kN/m ²)	Uplift per flap (kN)	Uplift / self- weight	Assessment
Inland sheltered (Laois, Offaly)	24	0.68	22.2	0.50	Usable, standard anchoring
Inland exposed (Meath, Kildare)	26	0.80	26.0	0.59	Usable
Coastal moderate (Dublin, Wicklow)	28	0.93	30.2	0.68	Reinforced anchoring required
Coastal severe (Cork, Kerry, Galway, Donegal)	30	1.06	34.7	0.79	Project-specific anchor design mandatory
Upland (above 200 m)	36	1.53	49.9	1.13	Uplift exceeds self-weight; do not deploy

A technical boundary that belongs in the contract

In severe coastal zones, uplift on one flap reaches **34.7 kN** (about 3.5 tonnes), equal to **79%** of the module's self-weight. Resisting wind by self-weight alone is no longer safe; **foundation anchoring is mandatory**. Above 200 m altitude or on exposed ridges, uplift exceeds self-weight and the deployed state **cannot be treated as a permanent condition** — in such locations only folding or flat-pack units should be offered, and the anchorage must be designed by a local structural engineer.

2. Solar geometry: shade in summer, harvest in winter

Dublin sits at 53.35°N, so its solar geometry bears no resemblance to lower latitudes: **noon solar altitude varies from 13.2° at the winter solstice to 60.1° at the summer solstice — a swing of 46.9°**. For all 365 days the noon sun lies south of the zenith, so there is no tropical "shading reversal period"; shading can be fixed and oriented **due south**.

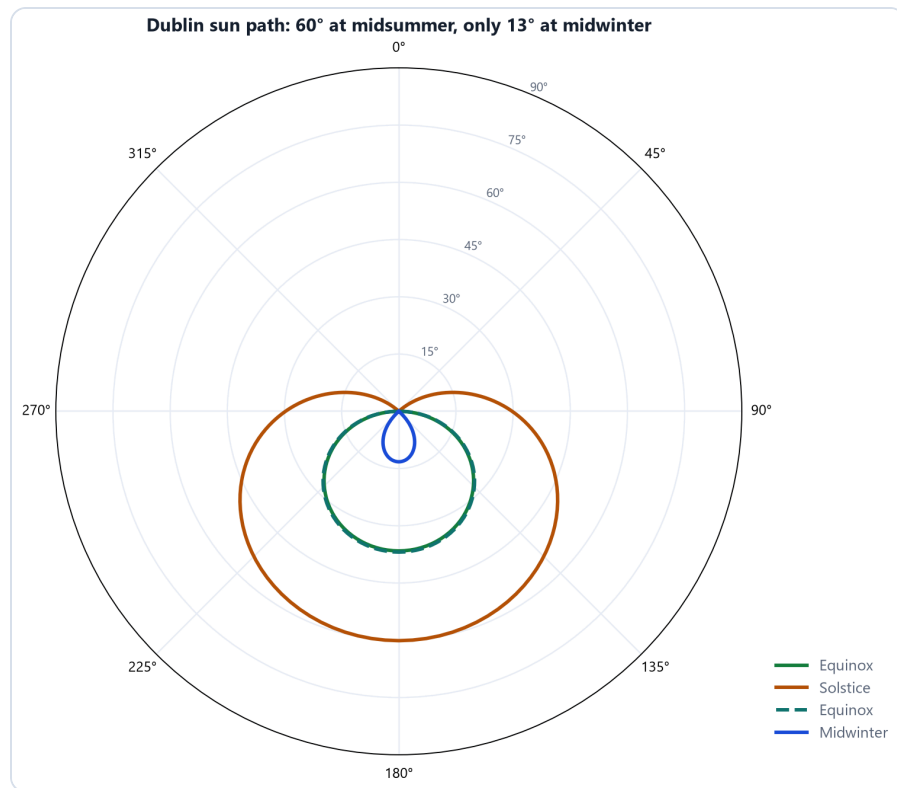


Figure 3 Polar sun-path diagram for Dublin. Radius is altitude, circumference is azimuth. At the summer solstice the sun rises in the north-east (48.6°) and sets in the north-west (311.6°) over a 16.7-hour day; at the winter solstice it runs only from south-east (132.3°) to south-west (228.2°) over 7.2 hours.

2.1 Key geometric parameters

Solar event	Noon altitude	Day length	Horizontal overhang D/H	Implication
Spring equinox	36.58°	11.9 h	1.347	Transition season; south wall sunlit 11.9 h/day
Summer solstice	60.10°	16.7 h	0.575	Peak shading demand, yet south wall sunlit only 9.5 h
Autumn equinox	36.90°	12.0 h	1.332	South wall sunlit 12.0 h — the annual maximum
Winter solstice	13.23°	7.2 h	4.253	Sun very low; admit as much as possible

This is decisive for shading design

Fully shading the noon sun at the winter solstice would require $D/H = 4.25$ (a 6.4 m overhang for a 1.5 m window) — impossible on any building, and **undesirable even if it were possible**. During the heating season (October–March) a south-facing vertical surface receives **92 kWh/m²** of solar radiation in Ireland; this is free heating energy. The correct approach is to **shade summer only and admit winter**: the summer solstice needs D/H 0.575, so a 1.5 m window needs just a **0.86 m overhang** to be fully shaded at noon.

2.2 Solar gain index by orientation

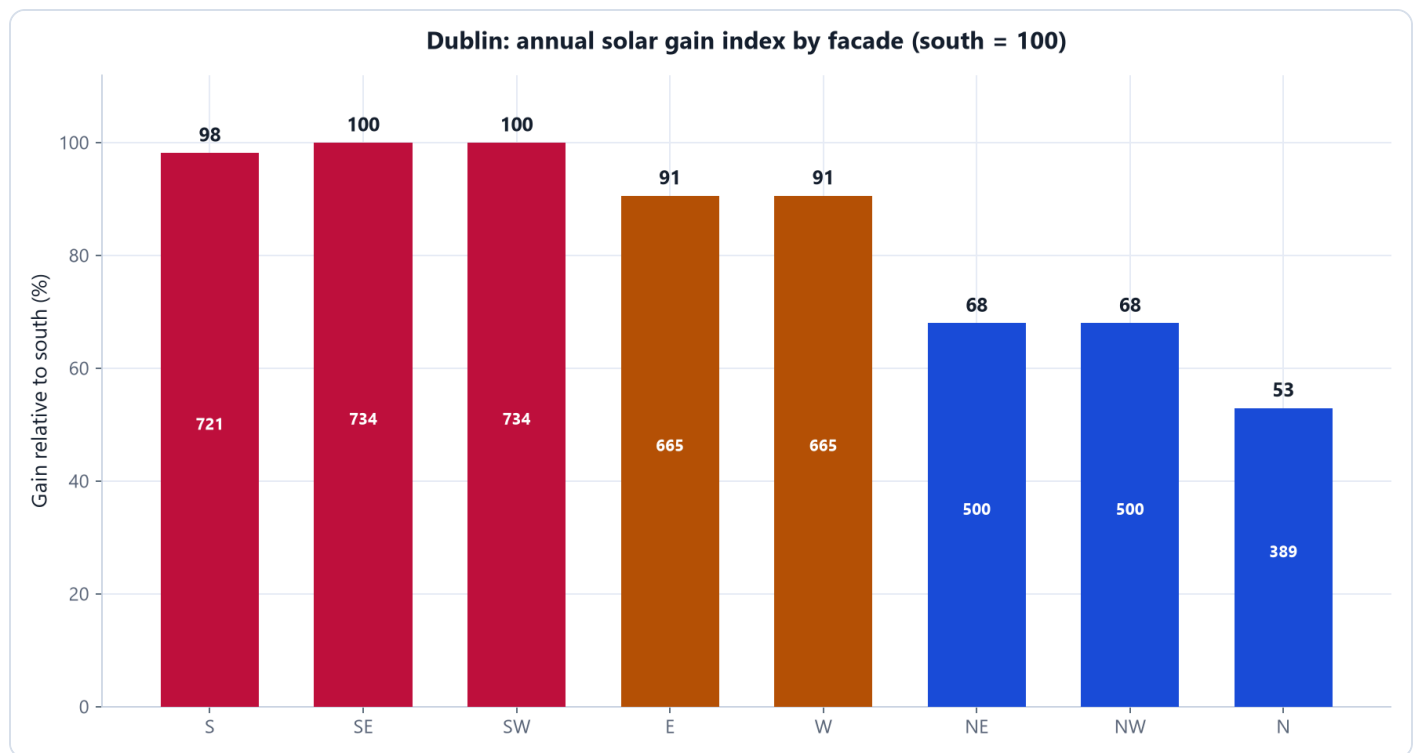


Figure 4 Annual solar gain index by orientation for Dublin. Values are annual irradiation on the vertical plane (kWh/m²-yr), expressed as a percentage of south. South 721; south-east and south-west 734 each; east and west 665 each; north 389.

Ranking the orientations by annual vertical-plane irradiation: **SE ≈ SW (734) > S (721) > E = W (665) > NE = NW (500) > N (389)**. This tells us two things:

- **South-east and south-west slightly outperform due south.** Dublin has high cloud cover and a low direct-beam fraction, so diffuse radiation dominates, and tilted or oblique surfaces intercept more sky diffuse. In practice south remains the preferred daylight orientation (best winter gain), but SE and SW are equally good — layouts need not be forced to true south.
- **East and west are not low (665 each, 92% of south),** and their gain is concentrated at low sun angles. In Ireland, low afternoon sun from the west causes glare and local overheating, but the total is modest —

adjustable external shading is sufficient; fixed vertical fins are unnecessary. This is the exact opposite of tropical and subtropical practice.

Façade	Spring h/day	Summer h/day	Autumn h/day	Winter h/day	Strategy
South	11.9	9.5	12.0	7.1	Primary daylight façade; 0.6–0.9 m overhang
SE / SW	8.5	10.1 / 8.4	8.5	6.9	Secondary daylight façade; adjustable shading on the west
E / W	5.9	8.3 / 6.6	5.9	3.5	Moderate glazing; watch western glare
North	0.0	5.4	0.0	0.0	Small windows for daylight; almost no gain penalty

The container house constraint: the roof is the primary gain surface

Annual horizontal irradiation is **942 kWh/m²** — 1.3 times the south vertical plane (721). A 37.2 m² roof intercepts **15847 kWh** between June and August. Container roofs are essentially flat (roof pitch is minimal), so **roof insulation and ventilation repay investment better than wall shading**. The roof is also the best host for PV: Ireland's 942 kWh/m²-yr horizontal irradiation yields about 188 kWh/m²-yr at 20% system efficiency.

2.3 Summer overheating: not a hypothetical problem

Ireland has historically needed no cooling, but recent research is a warning: monitoring of 50 Irish near-zero-energy dwellings found that **26% failed the CIBSE TM59 overheating criteria**, and 48% exceeded the WHO recommended maximum temperature for at least 10% of the year. The cause is precisely the combination of "high insulation + high airtightness + no shading" — which is exactly the default configuration of a container house.

TGD Part L requires a TM59 assessment where DEAP identifies an overheating risk. For our product this means: **south and west glazing must have external shading or low-g glass**, and openable openings must be provided for night purging. A container house has very low thermal mass (see 5.4), so night ventilation is the only effective passive cooling measure.

3. Compliance thresholds: Ireland's hard limits

3.1 TGD Part L 2021 minimum performance (dwellings)

Element	Max U W/(m ² ·K)	Our current (100 mm PIR)	Assessment
External wall	0.18	0.221 / 0.229 incl. joints	Non-compliant
Roof	0.16	Achievable by thickening	Must thicken
Ground floor	0.18	Depends on foundation detail	Project-specific design
Windows / doors	1.40	Thermal-break double glazing ~2.4–2.8	Triple or Low-E required
Airtightness	≤ 5 m ³ /(h·m ²) @50Pa	Not tested	Blower-door test mandatory

Three whole-dwelling metrics apply in addition: **EPC ≤ 0.30** (energy performance coefficient), **CPC ≤ 0.35** (carbon performance coefficient) and **RER ≥ 20%** (renewable energy ratio). Even with a fully compliant envelope, a heat pump or PV is still required to pass the DEAP calculation.

3.2 The critical point: Part L does not exempt modular buildings

The most commonly misjudged point

Ireland's **planning exemption** (for example Class 3A rear ancillary dwellings, 32–45 m²) and the **Building Regulations** are two entirely separate regimes. A planning exemption is **not** a building regulation exemption — any structure intended for human habitation must satisfy Parts A to M of the Building Regulations 1997–2021, must file a Commencement Notice, must obtain a BER assessment, and must have an Assigned Certifier. A CE mark certifies the factory product's declared performance only; **it does not substitute for site-stage and whole-building compliance.**

In practice this means we cannot simply sell a box: we must supply a **TGD compliance dossier** containing U-value calculations, joint thermal-bridge ψ values, an airtightness strategy, a declaration of performance (DoP) for fire class, and the ventilation design basis. This is not a cost burden but a competitive moat — most Chinese suppliers cannot produce these documents.

3.3 Other mandatory requirements

Requirement	Content	Our action
Radon (TGD C 2023)	All new buildings nationwide require a standby radon sump ; high-radon areas (about one third of the country) also require a full-floor sealed membrane	Foundations must incorporate a sump and extract pipe; this is frequently overlooked in container buildings
Fire (TGD B)	Dwellings must satisfy fire separation and escape requirements; EPS is Class B1 combustible	For dwellings use phenolic (A2) or stone wool (A1) ; avoid EPS
Ventilation (TGD F)	Airtight buildings need controllable ventilation, in practice mechanical ventilation with heat recovery	Allow space for MVHR ducting; the 2.26 m internal height is the constraint
Acoustics (TGD E)	Separation and external wall sound insulation	Double-board lining with a stone wool core achieves both
Access (TGD M)	Door widths, turning circles, sanitary dimensions	Standard door widths are often insufficient; check each layout

4. Product gap analysis: where and by how much

Holding the Chapter 3 thresholds against the current product reveals three gaps of fundamentally different nature: **thickness is arithmetic** (thicken it, but shipping width constrains you), **joints are geometry** (same material, different joint detail, threefold difference in U-value), and **form factor is innate** (a container's surface-to-floor ratio is inevitably higher than a house, and no material can compensate). Confusing the three leads to misdirected spending — the commonest error is pouring money into changing insulation material when the real leak is at the panel joint.

What follows is ordered by gap magnitude against remediation difficulty. First, the item that is easiest to overlook and easiest to calculate: thickness.

4.1 Gap one: insufficient thickness (arithmetic, not engineering)

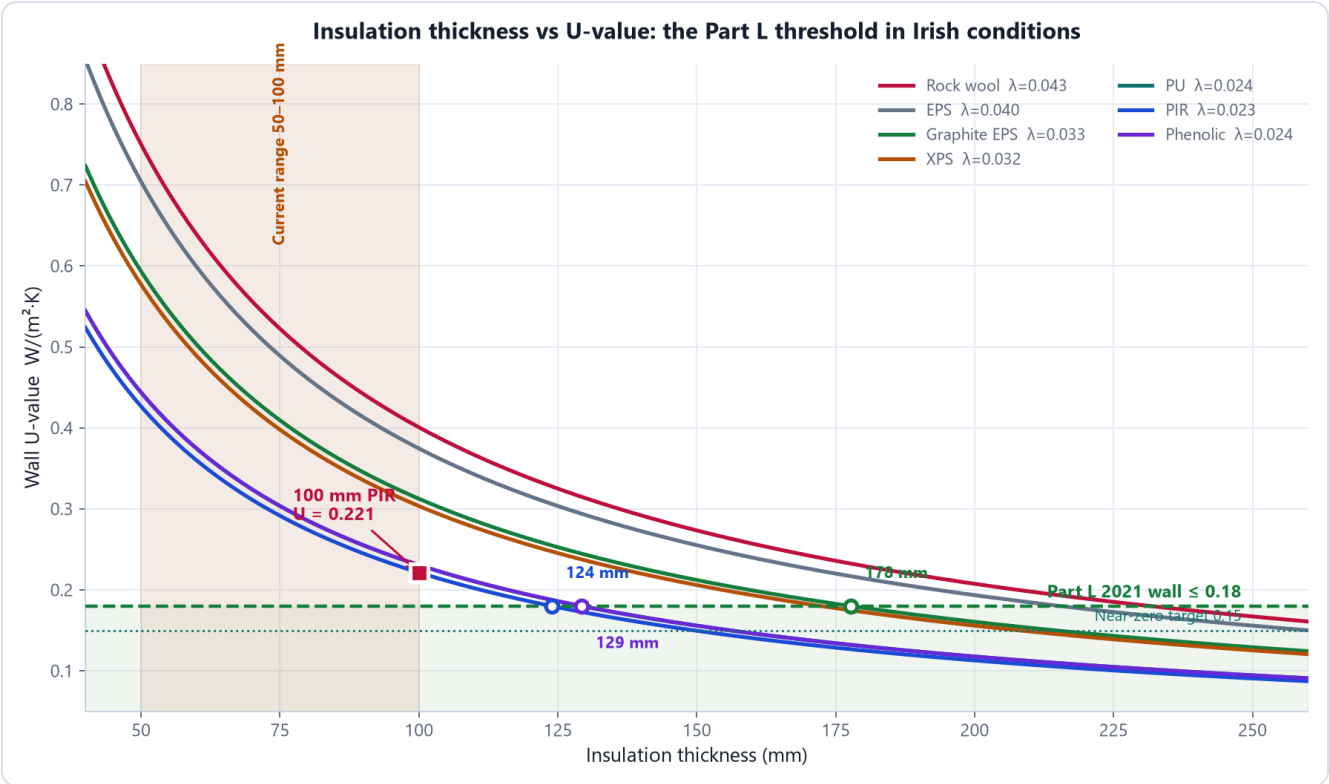


Figure 5 Insulation thickness against wall U-value. The green dashed line is the TGD Part L 2021 backstop of 0.18; the teal dotted line is the 0.15 near-zero-energy target; the orange band is the current product range of 50–100 mm. PIR needs 124 mm to reach 0.18, phenolic 129 mm, graphite EPS 178 mm, EPS 215 mm, stone wool 232 mm.

Insulation	λ W/(m·K)	Thickness for 0.18	Thickness for 0.15	U at 100 mm
PIR	0.023	124 mm	149 mm	0.221
PU	0.024	129 mm	156 mm	0.231
Phenolic	0.024	129 mm	156 mm	0.231
Graphite EPS	0.033	178 mm	214 mm	0.312
XPS	0.032	172 mm	208 mm	0.303
EPS	0.040	215 mm	260 mm	0.375
Stone wool	0.043	232 mm	279 mm	0.401

A straightforward commercial judgement

PIR and phenolic need only **124–129 mm**, whereas EPS needs **215 mm**. When a client compares against "a Chinese quote with 50 mm EPS", the real difference is not price — **that 165 mm gap decides whether the building is lawful in Ireland**. This sentence can be used directly in negotiation.

4.2 Gap two: form factor — the container's innate disadvantage

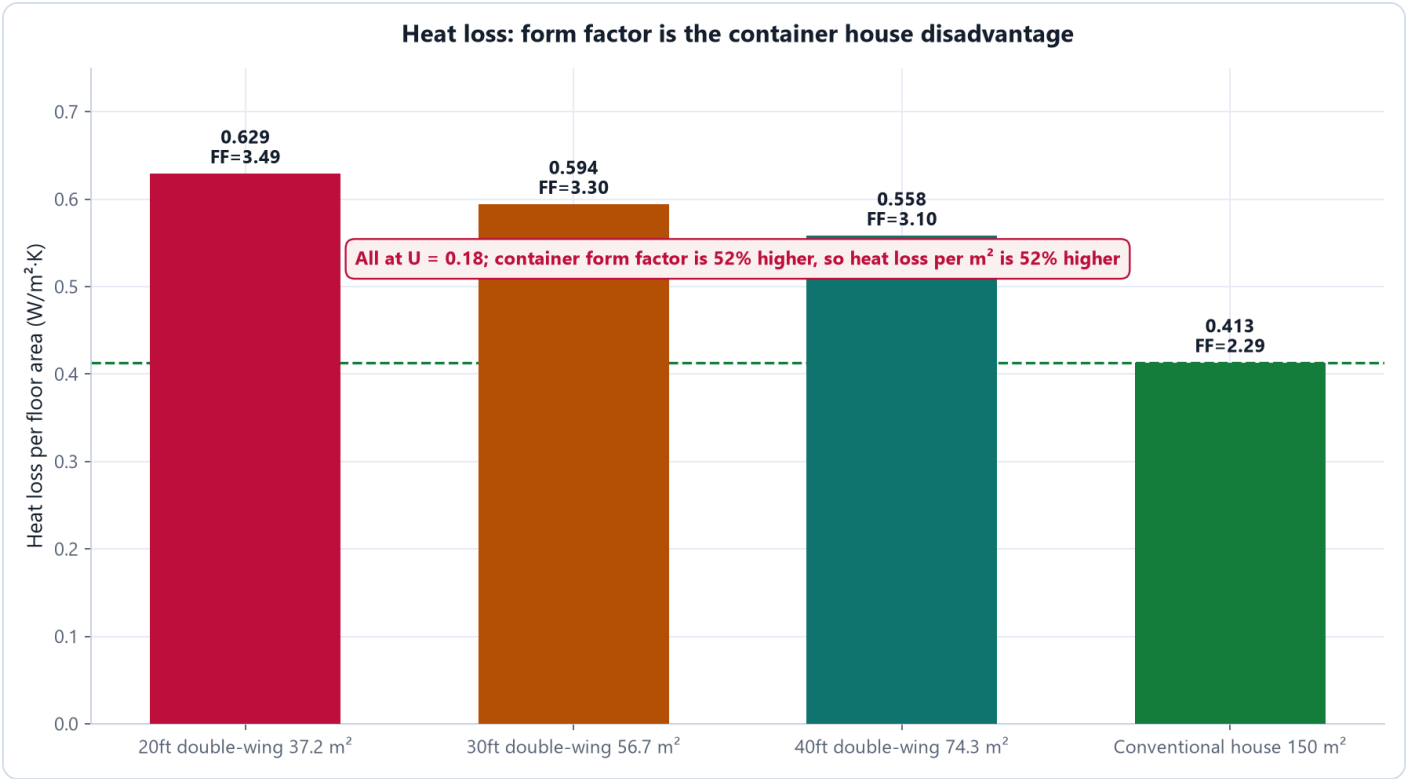


Figure 6 Heat loss per unit floor area at the same U-value (0.18) for different building forms. A container house has a markedly higher form factor (surface area / floor area) than a conventional dwelling; this is geometric and cannot be fully offset by thicker insulation.

Type	Floor area m²	Form factor	Heat loss W/(m²·K)	Relative to a house
20 ft double-wing	37.2	3.49	0.629	+52%
30 ft double-wing	56.7	3.30	0.594	+44%
40 ft double-wing	74.3	3.10	0.558	+35%
Conventional house (two storeys, 150 m²)	150	2.29	0.413	Baseline

Even with every element at $U = 0.18$, a 20 ft container house loses 52% more heat per unit floor area than a conventional dwelling. To match a house's heat loss, the wall would need $U = 0.118$ — 1.5 times stricter than Part L, and physically unattainable within 150 mm.

So the right product strategy is not to fight head-on

Do not attempt to make a 20 ft container house equivalent to a 150 m² masonry dwelling in a DEAP calculation. There are three viable routes: ① use 40 ft or linked units to improve form efficiency; ② use PV and a heat pump to satisfy RER and EPC; ③ the more realistic option — position the product as an **ancillary dwelling (Class 3A) or a non-residential building**, bypassing the full DEAP threshold for dwellings.

4.3 Gap three: joint thermal bridging (the largest hidden loss)

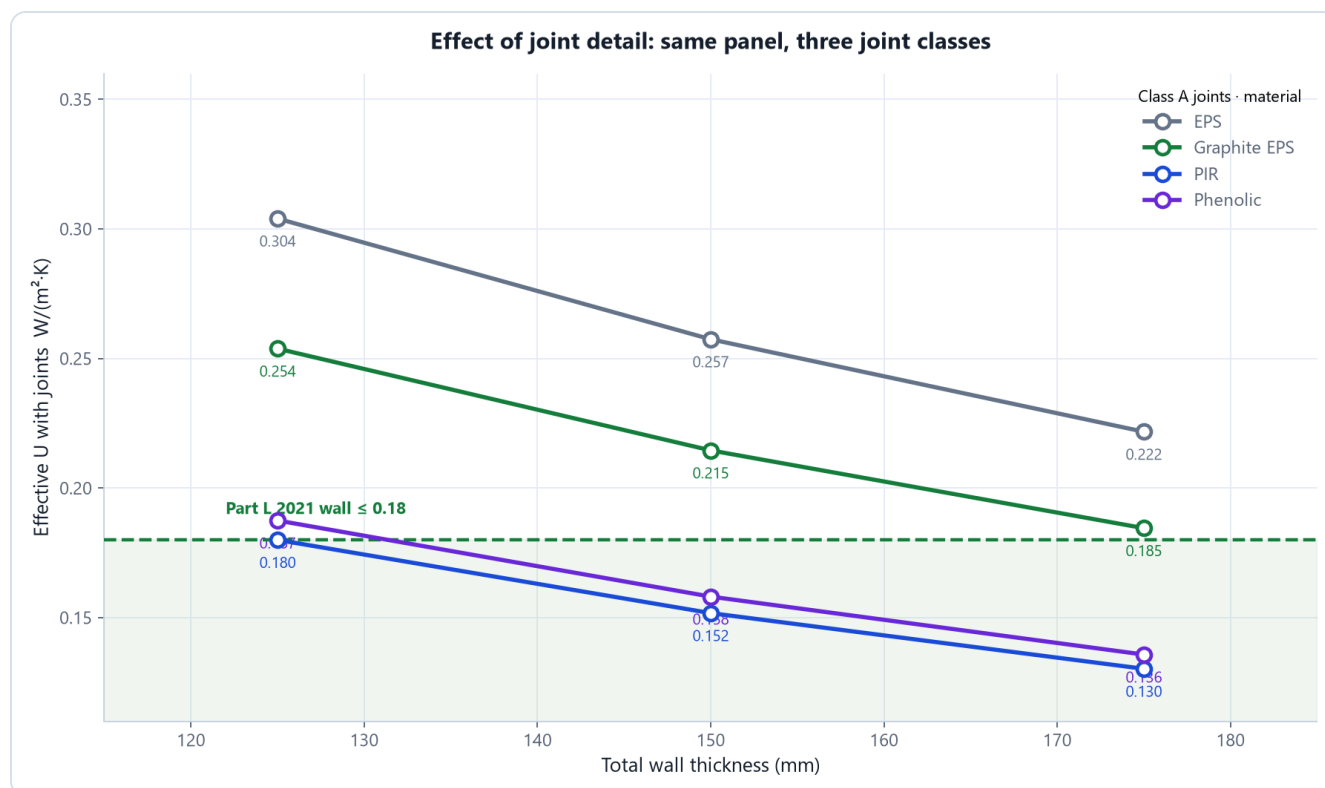


Figure 7 Actual U-values achieved by composite walls of different insulation materials and thicknesses with Class A joints. PIR at 150 mm total (100 factory + 50 site) gives 0.152 and phenolic 0.158, both inside 0.18; graphite EPS needs 175 mm to reach 0.185.

Joint type	ψ W/(m·K)	U incl. joints	vs clean panel	Joint surface temp.	Assessment
Class A tongue-and-groove + eccentric lock	0.009	0.229	+3.5%	20.1 °C	Safe
Class B plain interlock	0.041	0.257	+16.0%	19.2 °C	Marginal (fRsi 0.92)
Class C metal through- penetration	0.556	0.705	+218%	6.3 °C	Severe mould risk

With the same 100 mm PIR panel, degrading the joint from Class A to Class C worsens U from 0.229 to **0.705** — the equivalent of turning a 100 mm panel into a 32 mm one. Worse, the joint surface temperature drops to **6.3 °C**, far below the 10.2 °C internal dew point, and fRsi = 0.36, well below the 0.75 mould criterion. **This is not an energy problem; it is a mould problem.**

The value ranking of joints is the inverse of materials

At this 100 mm thickness: switching from PIR to stone wool moves U from 0.223 to 0.404 (a difference of 0.18); switching the joint from Class A to Class C moves U from 0.229 to 0.705 (a difference of 0.48). **A wrong joint costs 2.7 times as much as the wrong insulation material.** Hagglng over the unit price of insulation while saving CNY 20/m² on joints is a classic miscalculation.

5. Adaptation options: three configurations

Three options follow from the diagnosis above. All share one feature: a **"factory panel + site-applied internal lining" composite build-up** — the only route that reaches 0.18 within 150 mm without changing the shipping envelope.

5.1 Option comparison

Option	Build-up (outside to inside)	Total	Actual U	fRsi	Application
A · Standard dwelling ★ Recommended	Colour steel 0.45 + PIR 100 + colour steel 0.40 + PIR 50 (site) + foil vapour barrier + plasterboard/integrated panel	150 mm	0.152	0.98	Permanent and ancillary dwellings; Part L compliant
B · Enhanced fire	As above with phenolic core (A2 non-combustible)	150 mm	0.158	0.98	Multi-unit linking, public buildings, stringent fire review
C · Economy	Graphite EPS 100 + graphite EPS 75 (site)	175 mm	0.185	0.98	Cost-sensitive, non-residential, temporary buildings

Why not simply build the factory panel to 150 mm?

Technically possible, but it triggers three knock-on problems: ① shipping width grows from 2.2 m to 2.7 m, reducing 40HC container payload; ② panel weight rises to about 18 kg/m², making lifting and manual handling harder; ③ **most importantly — a 150 mm single-layer panel is still a "metal inside and out" build-up, so the risk of metal through-penetration at joints is unchanged.** The split build-up offsets the factory layer against the site layer, which **inherently interrupts the metal thermal bridge path**, lifting fRsi from 0.96 to 0.98.

5.2 Roof and floor

Element	Build-up	U-value	Key points
Roof	PIR 150 + ventilated air layer + waterproofing	0.154	Highest horizontal gain; 150 mm recommended; provide PV mounting cast-ins
Floor	PIR 100 + 100 mm concrete slab + DPM/radon membrane	0.221	Needs independent levelling; the module chassis does not carry insulation
Windows / doors	Thermal-break aluminium triple glazing, Low-E, g = 0.5–0.6, whole-unit U ≤ 1.4	1.3–1.4	South glazing may relax g to 0.6 to capture winter gain
Thermal bridges	Insulating washers on all metal connectors; thermal breaks at anchor points	$\psi \leq 0.05$	Follow the acceptable construction details in TGD L Appendix D

5.3 Moisture control: the most critical chapter for Ireland

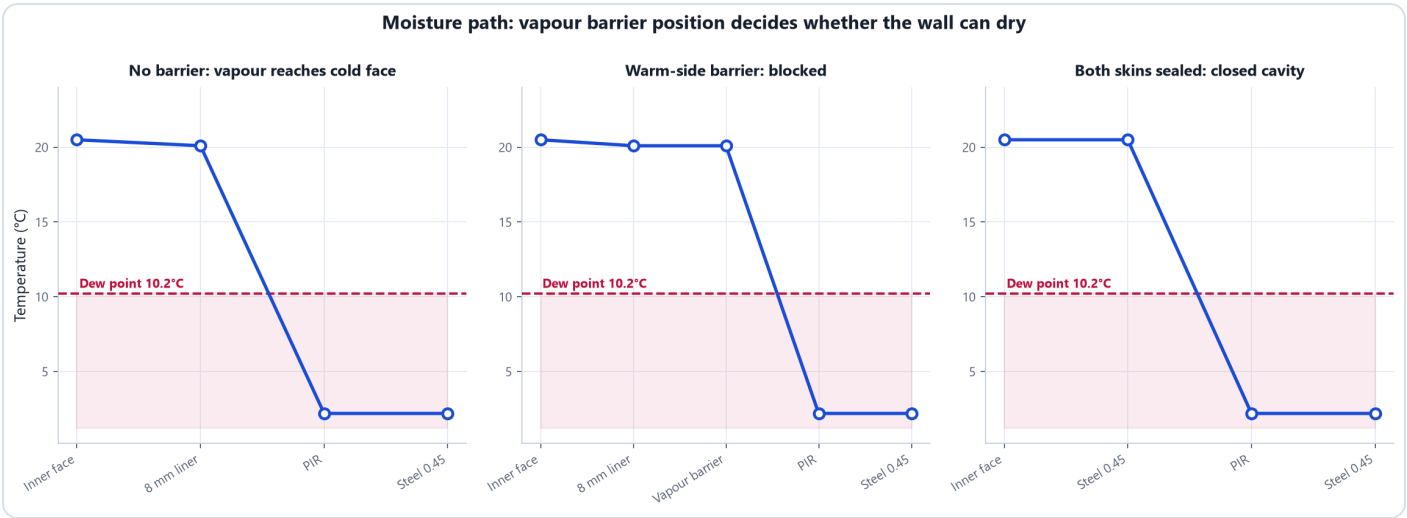


Figure 8 Temperature profiles and internal dew point (10.2 °C) for three build-ups. Left: no vapour barrier — internal moisture reaches the 2.2 °C steel inner face, guaranteeing condensation. Centre: a continuous vapour barrier on the warm side blocks the vapour path. Right: double-skin steel, sealed on both faces to form a closed cavity.

Build-up	Total Sd	Vapour path	Drying capacity	Assessment
C · Single steel + PIR + no vapour barrier + integrated panel	450,005 m	Direct to the 2.2 °C cold interface	Inward only, not outward	Prohibited
B · Single steel + PIR + warm-side foil + integrated panel	500,005 m	Blocked by warm-side vapour barrier	Inward only, not outward	Recommended
A · Double-skin steel sandwich (current)	900,005 m	Sealed both sides; diffusion flux is zero	Neither direction	Usable but cannot dry

Three non-negotiable moisture principles

1. **The vapour barrier must be on the warm side and continuous.** Aluminium foil or a dedicated membrane both work, but it must be lapped and sealed continuously at window and door openings, sockets and panel joints. Placing it on the cold side is equivalent to omitting it — the vapour is already inside.
2. **Never build "single steel skin + permeable lining + no vapour barrier".** In Ireland this build-up will mould within two winters, and because the staining appears on the internal lining we would have no evidential defence in a claim.
3. **Built-in moisture must be controlled at the factory.** A double-skin metal panel has no drying capacity, so PIR must leave the factory at $\leq 2\%$ moisture content, and site-applied foam must be installed below 18%; both must be measured and recorded before closing up. This belongs in the factory inspection procedure.

5.4 Thermal mass: low enough to need specific design

A container house has a surface density of only about 11 kg/m^2 , giving a whole-unit effective thermal mass of roughly **1.6 MJ/K** ($42 \text{ kJ}/(\text{m}^2 \cdot \text{K})$) for 37.2 m^2 . With a 100 mm concrete floor this rises to **263 kJ/(m²·K) — 6.3 times that of a purely lightweight build-up.**

Build-up	Thermal capacity $\text{kJ}/(\text{m}^2 \cdot \text{K})$	Consequence
Purely lightweight (steel + insulation + timber floor)	42	Large temperature swings, rapid night-time cooling, summer overheating
+ 100 mm concrete floor	263	Stable temperatures; night ventilation can store coolth

Recommendation: dwelling applications **must have a concrete floor**, left as exposed as possible (no thick carpet). This is not a comfort preference — it is the **only low-cost solution** to both summer overheating and winter temperature swings.

6. Joints and site control: turning paper performance into real performance

6.1 Panel joints: Class A is a hard requirement

Control item	Standard	Verification
Joint form	Tongue-and-groove + eccentric lock; metal penetration into core ≤50%	First-off sample; section inspection
Metal penetration	Self-tapping screws must never penetrate both steel faces	Visual check every joint + destructive sampling
Sealant	Neutral silicone or MS polymer, two-stage (internal baffle + external seal)	30-minute hose test
Joint tolerance	≤2 mm	Feeler gauge

6.2 Weathering details (against driving rain)

- **Pressure-equalised cavity design:** the outer skin need not be perfectly sealed; instead, any water that penetrates must be able to drain out of the cavity. Provide drainage openings in the outer skin and a secondary barrier behind.
- **Window openings:** sills with ≥5° fall; use a **backer rod + sealant** two-stage detail between frame and opening. Single-bead sealing is prohibited.
- **Internal and external corners:** vertical corners must use a folded single sheet or a purpose-made corner section. Butting two flat panels and sealing the joint is not acceptable.
- **Base flashing:** keep the module base at least 150 mm above finished floor level, with a drip edge, to prevent rain climbing the wall and entering the floor edge.

An easily overlooked detail

Irish wind is strong and usually accompanied by rain, so **water climbs wall surfaces upward under capillary action and wind pressure**. If the module base sits directly on concrete with no drip edge and no cavity, water will migrate in from the floor perimeter. A detail costing a few tens of yuan per metre is one of the leading causes of rectification work on western coastal projects.

6.3 Construction sequence (site-applied internal insulation option)

1. Foundations: strip or raft foundation with cast-in anchors designed for the wind load, plus a radon sump and extract pipe.
2. Installation: deploy and level the module, then **apply temporary anchoring immediately** to prevent wind uplift in the deployed state.
3. Joint treatment: external sealant plus continuous internal vapour tapes.
4. Site insulation: inject or fit 50 mm PIR/EPS, **ensuring tight contact with the factory panel and studs with no voids**.
5. Vapour barrier: laid continuously, all laps ≥ 100 mm, dedicated tape, reinforcement at window and door openings.
6. Internal lining: plasterboard or integrated wall panel; **fixings must not penetrate the vapour barrier** (or must be sealed where they do).
7. Airtightness test: blower-door test targeting $\leq 5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ @50Pa, with a formal report.
8. Concealed works inspection: photograph every seal as part of the compliance dossier.

7. Market positioning and commercial recommendations

7.1 Three product lines for three markets

Market	Compliance requirement	Recommended product	Commercial notes
Temporary / site (construction camps, project offices)	Part L does not apply, but site safety and fire requirements do	Current 75/100 mm panel, Class C joints acceptable	Price-driven; emphasise delivery speed and container payload. This is the main battlefield for the current product
Ancillary dwelling (Class 3A, 32–45 m ²)	Building Regulations + BER required; planning may be exempt	Option A (150 mm, 0.152) + heat pump/PV	The most realistic growth market. Higher margin per unit than site camps, and policy-supported
Permanent dwelling (detached, community)	Full TGD + DEAP + BER + Assigned Certifier	Option A/B + 40 ft or linked units	Requires a local design team; long cycle but high unit value — suitable for flagship projects

7.2 Wall cost increment (material basis)

Build-up	Insulation mm	Material CNY/m ²	vs current	U incl. joints	Conclusion
Current 100 mm double-skin PIR	100	198	Baseline	0.229	Non-compliant
Single-layer 150 mm double-skin PIR	150	257	+30%	≈0.15	Compliant but joint risk unresolved
Composite 100+50 + plasterboard (Option A)	150	280	+41%	0.152	Compliant and joints improved
Composite 100+50 + integrated wall panel	150	305	+54%	0.152	Compliant, higher finish level

On a 20 ft double-wing external wall area of 55.5 m², Option A adds about **CNY 4,550 per unit** (roughly USD 640) in wall materials. That is under 5% of a complete unit price, yet it decides whether the product can enter the housing market — **the best-value investment in the whole package.**

7.3 Pricing strategy

- **Price by climate zone.** The west (Galway, Mayo, Kerry, Donegal) and the east (Dublin, Louth) differ completely in driving rain, wind pressure and corrosion requirements; the price differential should be **8–15%**. A single national price makes eastern clients feel overcharged while leaving western projects exposed.
- **Treat the compliance dossier as a value-added item, not a cost.** U-value calculations, joint details, DoP, airtightness strategy — local traders cannot supply these, and they support a **3–5% premium**.
- **Grade corrosion protection by site:** within 10 km of the coast, fluorocarbon coating and 316 stainless fixings are mandatory; inland, standard galvanised with 304 is acceptable. Do not specify fluorocarbon across the board — that wastes margin; and do not economise on the coast — that is a claim three years from now.
- **State the technical boundary and put it in the contract:** above 200 m altitude, on exposed ridges, or on sites with $v_{b,0} \geq 30$ m/s, the deployed state requires project-specific anchorage design, or a switch to folding/flat-pack units. Explaining this in advance is far cheaper than explaining it afterwards.

One sentence for the front page of a proposal

"What we sell in Ireland is not a container — it is **an envelope solution that can pass Irish Building Regulations review**. U-value 0.152, fRsi 0.98, with a complete thermal-bridge calculation report: those three things decide whether a project can proceed, more than price does."

8. Design parameter quick reference

Parameter	Value	Conditions / notes
Design external temperature	−2 °C	Coastal; −5 °C inland
Design internal temperature	21 °C	Dwellings
Design internal RH	50%	Corresponds to a 10.2 °C dew point

Parameter	Value	Conditions / notes
Heating degree days HDD(15.5)	2,500 K·d	Dublin; about 2,700 in the west
Wall target U	≤ 0.18	TGD Part L 2021 backstop; 0.15 recommended
Roof target U	≤ 0.16	0.14 recommended
Floor target U	≤ 0.18	0.15 with underfloor heating
Window whole-unit U	≤ 1.40	1.1–1.3 recommended
Airtightness	$\leq 5 \text{ m}^3/(\text{h}\cdot\text{m}^2)\text{@}50\text{Pa}$	Target 3.0
Mould criterion fR _{si}	≥ 0.75	Joint internal surface temperature factor
South overhang D/H	0.575 (summer)	0.86 m overhang for a 1.5 m window
Roof PV potential	942 kWh/m ² ·yr	Horizontal irradiation; about 188 kWh/m ² at 20% efficiency
Annual rainfall (Dublin / west)	760 / 1,430 mm	Pricing must follow the zone
Basic wind speed v _{b,map}	24–30 m/s	Per IS EN 1991-1-4 Figure NA.1
Altitude factor c _{alt}	1 + 0.001A	A = altitude in metres

9. Scope and limitations

9.1 Boundaries of this report

- **Site:** Dublin (53.35°N) is used as the solar geometry datum, with national 1991–2020 normals and representative stations for climate data. Solar altitude varies very little across Ireland (about 4° of latitude), but **rainfall and wind pressure vary enormously** — always verify against the actual site.
- **Building type:** applies to single-storey modular container buildings with eaves height ≤ 12 m. Multi-storey or composite buildings require separate review.
- **Calculation method:** one-dimensional series resistance plus a two-dimensional control-volume thermal bridge solution. The ψ values are parametric model results; **formal submissions must be recalculated in accredited 2-D heat transfer software (e.g. THERM, Psi Therm) using the actual joint geometry.**

- Wind actions:** simplified values to EN 1991-1-4 and the Irish National Annex. The shape coefficient for the flap in the deployed state requires wind tunnel testing or numerical simulation; this report adopts $c_{p,e} = -2.0$ as a deliberately conservative estimate.

9.2 Items not covered, requiring further verification

Item	Why it matters	Recommended action
Wind fatigue of the deployment mechanism	Repeated folding plus long-term wind vibration may fatigue hinge points	1,000-cycle deployment test plus wind vibration rig test
Measured leakage at joints under driving rain	This study is theoretical only; no test data	Hose and airtightness testing to EN 12155 / EN 1027
Practical radon protection detail	The sealing path from chassis to foundation differs from conventional construction	Confirm sump detailing with an Irish groundworks contractor
Specific CE marking and DoP entries	Must cover EN 14509 (sandwich panels) and other harmonised standards	Verify the existing DoP covers the intended use
Actual BER assessment score	Compliance is ultimately decided by the DEAP calculation	Commission a trial calculation by an SEAI registered assessor

Data sources

Climate data from Met Éireann, *Ireland's Climate Averages 1991–2020*, and Climatological Note No.17 (driving rain distribution); regulatory basis: TGD Part L 2021 (dwellings), TGD Part C 2023 amendment, TGD Part F; wind actions per IS EN 1991-1-4:2005 and the Irish National Annex; calculation methods per IS EN ISO 6946, EN ISO 13788 and EN 14509. All calculation scripts (thermal, solar geometry, moisture) are archived with this report and can be re-run independently.

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This document is technical guidance and does not constitute a structural design document. Each project must be verified by a locally registered structural engineer against actual site conditions.