

Container House Climate Adaptability Reference

Regional technical support guide for the sales process | North America · Europe · Middle East

Version 2026-09-29 | Climate normals 1991–2020 | Code values verified against current national editions

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1. How to use this guide

This is a regional reference tool for **sales and technical support staff**. It answers three questions:

- Where does this customer’s climate bite?** Each region opens with a qualitative call, then supplies the quantitative basis.
- What are the numbers, and which code do they come from?** Every code value names its source, so it can be repeated to a customer directly.
- What do I say when the customer pushes back?** Section 8 provides ready-to-use responses.

Three ground rules:

- Wind speeds cannot be compared across countries directly.** North America uses a 3-second gust, Europe a 10-minute mean, and the Middle East local statutory values. For the same physical severity the numbers can differ by more than 30%. The basis column in the tables states which is which.
- Snow loads and frost depths are directly comparable** — all are 50-year return period values.
- The solar geometry in Section 3 is **computed by us using the NOAA algorithm**, with a self-check error of 0.000° on all four key dates, and can be cited as a technical basis. For code values, always defer to the current edition in force in the customer’s country.

Coverage: **11 representative cities across 3 regions** — North America (Miami, Houston, Toronto, Winnipeg), Europe (London, Frankfurt, Madrid, Stockholm) and the Middle East (Riyadh, Dubai, Jeddah). Other cities can be matched by latitude and climate type, or computed individually on request.

2. Climate & design parameters — 11 cities at a glance

The table below is the core dataset of the whole guide. Read this first and you have a quantitative read on how severe the customer’s location is.

2.1 Climate normals

City	Region	Latitude	Coldest month mean low (°C)	Hottest month mean high (°C)	Annual range (°C)	Annual precip. (mm)	Mean RH (%)	Design frost depth (m)
Miami	North America	25.8°N	16.7	32.8	16.1	1,570	75	0.0
Houston	North America	29.8°N	6.5	34.9	28.4	1,317	75	0.0
Toronto	North America	43.6°N	-6.7	27.0	33.7	860	78	1.2
Winnipeg	North America	49.9°N	-21.0	26.0	47.0	520	72	1.8
London	Europe	51.5°N	2.5	23.5	21.0	600	75	0.0
Frankfurt	Europe	50.1°N	-1.0	25.5	26.5	630	75	0.8
Madrid	Europe	40.4°N	1.5	34.1	32.6	478	55	0.6
Stockholm	Europe	59.3°N	-3.0	21.0	24.0	636	77	1.2
Riyadh	Middle East	24.7°N	9.0	43.5	34.5	109	29	0.0
Dubai	Middle East	25.2°N	17.0	41.0	24.0	91	53	0.0
Jeddah	Middle East	21.5°N	21.0	36.0	15.0	109	54	0.0

Climate normals are referenced to 1991–2020 and taken from the published normals of national meteorological agencies (NOAA, Environment and Climate Change Canada, European national meteorological services). Design frost depths are code or common engineering values; specific projects must be verified against local geotechnical data.

2.2 Code design values and corrosivity class

City	Ground snow load (kPa)	Design wind speed (m/s)	Wind basis	Corrosivity (ISO 12944)	Code source
Miami	0 (no snow)	78.2	3-s gust	C5	ASCE 7-22 · HVHZ
Houston	0.24	60.4	3-s gust	C4	ASCE 7-22 · Risk II
Toronto	1.70	26.5	hourly mean	C4	NBCC 2020
Winnipeg	1.90	26.8	hourly mean	C3	NBCC 2020
London	0.40	22.1	10-min mean	C3	BS EN 1991-1-4
Frankfurt	0.65	25.0	10-min mean	C3	DIN EN 1991-1-4
Madrid	0.30	26.0	10-min mean	C3	EN 1991-1-4 NA
Stockholm	1.50	24.0	10-min mean	C3	EN 1991-1-4 NA
Riyadh	0 (no snow)	46.1	3-s gust	C4	SBC 301
Dubai	0 (no snow)	45.0	3-s gust	C5	Dubai Municipality
Jeddah	0 (no snow)	45.0	3-s gust	C5	SBC 301 · coastal

Reading note: Canadian codes (Toronto, Winnipeg) publish a reference wind pressure $q(1/50)$ of 0.44 / 0.45 kPa. These have been converted to an equivalent wind speed so they can be shown on the same axis; the basis is labelled “hourly mean”. The four European cities use a 10-minute mean, and North America and the Middle East use a 3-second gust. **Comparing magnitudes across bases is meaningless.**

2.3 Solar geometry and shading summary

City	Solar noon elevation range	Jun-solstice D/H	Dec-solstice D/H	Highest heat-gain orientations	Days sun north of zenith
Miami	40.8°–87.7°	0.040	1.158	SE · SW	—
Houston	36.8°–83.7°	0.111	1.336	SE · SW	—
Toronto	22.9°–69.8°	0.368	2.364	S · SE	—
Winnipeg	16.7°–63.6°	0.497	3.336	S · SE	—
London	15.1°–61.9°	0.533	3.713	S · SE	—
Frankfurt	16.5°–63.3°	0.502	3.383	S · SE	—
Madrid	26.2°–73.0°	0.305	2.036	S · SE	—
Stockholm	7.2°–54.1°	0.723	7.860	S · SE	—
Riyadh	41.9°–88.7°	0.022	1.116	SW · SE	—
Dubai	41.4°–88.3°	0.031	1.135	SW · SE	—
Jeddah	45.1°–90.0°	0.034	0.997	SW · SE	49

D/H = 1/tan(solar noon elevation): the overhang projection required per 1 m of window height. Smaller values are easier to achieve, larger values are hard or impossible. “Days sun north of zenith” is the number of days each year when the sun at solar noon lies north of the zenith — during that window the **north wall is sunlit**.

3. Solar geometry: orientation, shading and daylight

This section is the **methodological core** of the guide. Climate normals tell you how hot it is; solar geometry tells you which facade, in which season, at what time — and that is what actually drives orientation, glazing and shading decisions.

3.1 Annual solar noon elevation

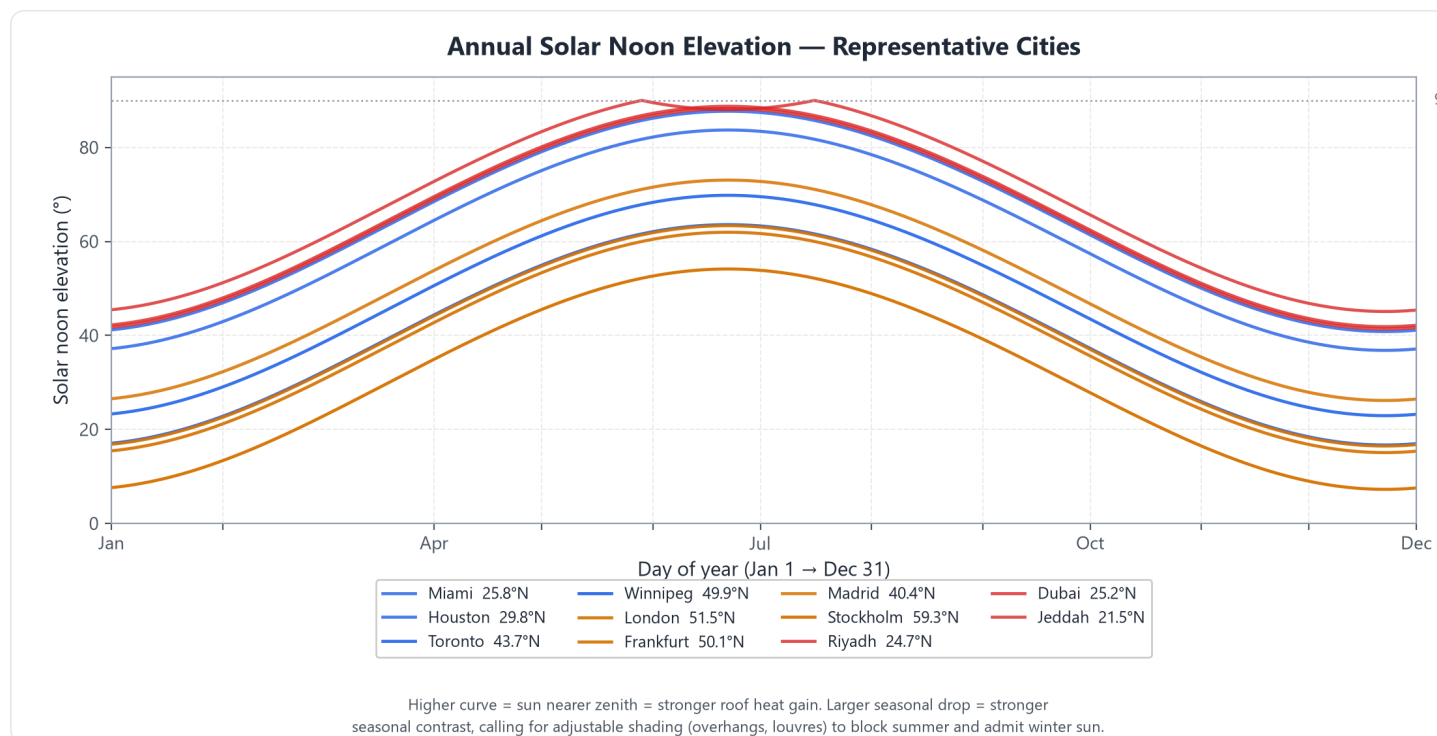


Figure 1 | Annual solar noon elevation for 11 cities. A higher curve means the sun is nearer the zenith and roof heat gain is stronger; a larger seasonal drop means adjustable shading (block summer, admit winter) is more valuable. All curves are computed day by day with the NOAA solar position algorithm; the self-check identity on all four key dates (equinoxes and both solstices) has an error of 0.000°.

What to read from the chart:

- **Low-latitude cities (Jeddah, Riyadh, Dubai, Miami, Houston)** stay above 36° all year, and approach or exceed 88° at the June solstice, so the roof is under strong heat gain year-round. In these markets **roof insulation and reflectance come first**, ahead of thicker walls.
- **High-latitude cities (Stockholm, Winnipeg, London, Frankfurt)** drop to 7–17° in winter. The sun is then shallow and penetrates deeply, making winter solar gain a **free heating resource**; south-facing glazing should be enlarged.
- **Jeddah is the exception.** At 21.49°N there are **49 days** (roughly 29 May to 16 July) when the sun at noon is **north** of the zenith, so the **north wall is sunlit while the south wall is shaded**. This tropical direction reversal means the usual northern-hemisphere assumptions do not hold.

3.2 Annual heat-gain index by orientation

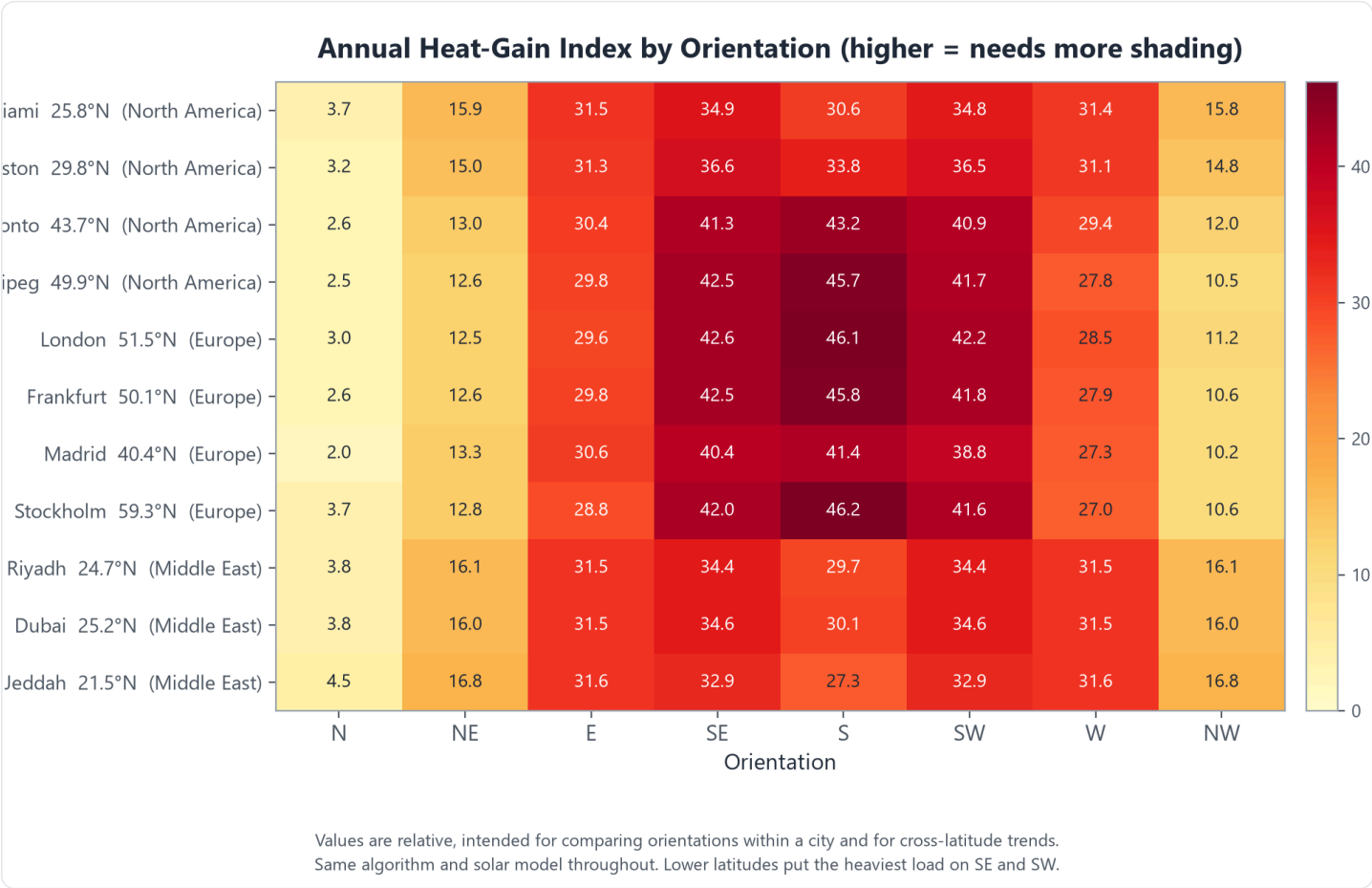


Figure 2 | Annual heat-gain index by orientation (red = high gain, needs shading). Values are relative, intended for comparing orientations within a city and for reading cross-latitude trends.

Two recommendations follow directly, and both can go straight into a proposal:

Low-latitude markets (Miami, Houston, Riyadh, Dubai, Jeddah)

Southeast and southwest are the strongest heat-gain facades, and their strength is nearly equal (Miami: SE 34.86, SW 34.82). Sun on these orientations arrives at a low angle, where **horizontal overhangs are essentially ineffective** — to shade Miami at 08:00 by overhang alone would need D/H = 8.11. The correct response is **vertical shading** (vertical fins, side blades) or a reduced glazed area on those orientations. North gains only about 10% of the southeast value and can serve as the main daylight facade.

Mid- and high-latitude markets (Toronto, Winnipeg, London, Frankfurt, Madrid, Stockholm)

The south wall is the strongest heat-gain surface, and because south sun arrives at a higher elevation, **horizontal overhangs work well**. These markets should use south-facing horizontal overhangs or adjustable shading (block summer, admit winter), with only general control needed on east and west. North can serve as the main daylight facade.

3.3 Required horizontal overhang depth ratio D/H

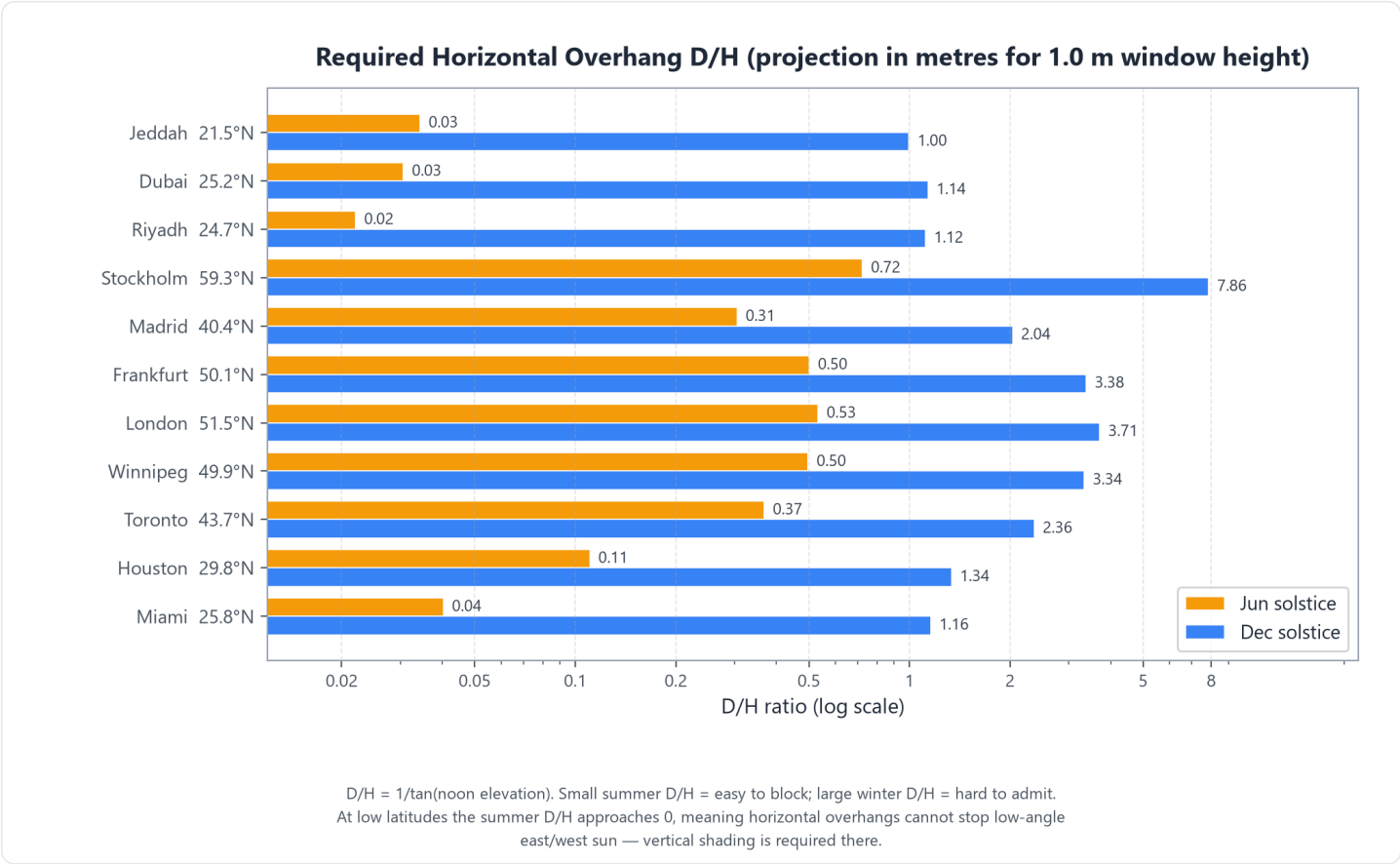


Figure 3 | Required horizontal overhang depth ratio D/H (log scale). A small June-solstice D/H is easy to achieve; a large December-solstice D/H is hard or impossible. At low latitudes the June-solstice D/H approaches 0 — horizontal overhangs work against high-angle sun but not against low-angle sun.

Three points that must be explained to the customer:

1. **“Block summer, admit winter” is unachievable at low latitudes.** Miami has a June-solstice D/H of 0.040 and a December-solstice D/H of 1.158 — a factor of 29 apart. No single fixed overhang satisfies both, so the answer is **adjustable shading** or a **detachable overhang** (summer blades that can be stowed).
2. **At high latitudes, admitting winter sun by overhang is essentially impossible.** Stockholm’s December-solstice D/H is 7.86, meaning 11.8 m of projection for a 1.5 m window. The Nordic strategy must instead be to **enlarge the south-facing glazed area** rather than rely on overhangs.
3. **Overhang depth is constrained by wind uplift.** Large projections conflict with wind-load requirements, and practical limits are around 0.6–0.9 m, verified against the local wind code. This applies with particular force in the hurricane belt.

3.4 Climate severity at a glance

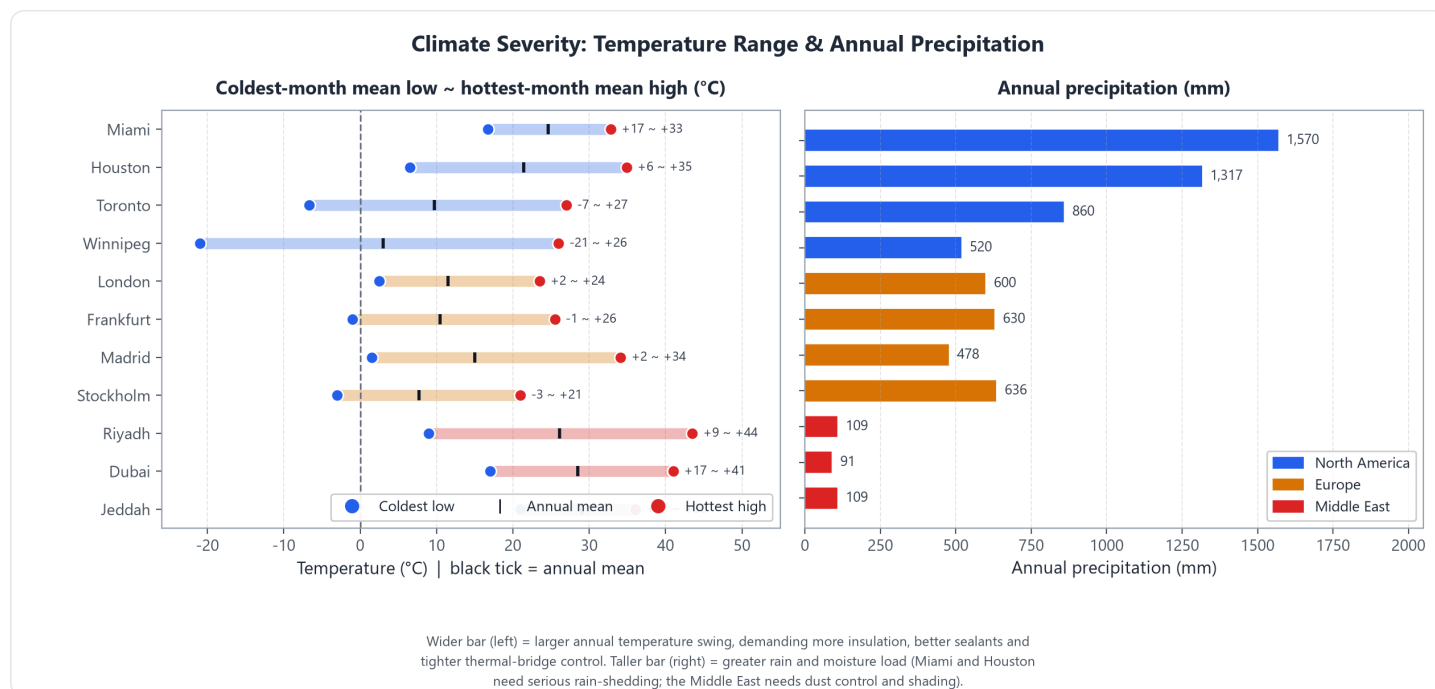


Figure 4 | Left: coldest-month mean low to hottest-month mean high (black tick = annual mean). Right: annual precipitation. A wider bar means a larger annual temperature range and therefore higher demands on insulation, sealants and thermal-bridge control; a taller bar means greater rain and moisture pressure.

4. North America

Climate label: Hurricane belt + severe continental cold

This guide splits North America into two climate extremes: the Gulf Coast hurricane belt (Miami, Houston) and the severe continental cold of Canada (Toronto, Winnipeg). For the first, the governing loads are **wind** and **rain**; for the second they are **snow** and **frost depth**. The two demand almost opposite configurations, so a single specification cannot answer both.

4.1 US Gulf hurricane belt · Miami / Houston

- **Wind governs everything.** Miami lies in the High-Velocity Hurricane Zone (HVHZ). The ASCE 7-22 Risk Category II basic wind speed is approximately **175 mph (78 m/s, 3-second gust)** — the most severe design wind speed in the continental United States. HVHZ also mandates Miami-Dade NOA approval for **every** component (including TAS 201/202/203 impact and cyclic-pressure testing), irrespective of distance from the coast.
- **Houston** (Harris County) sits at roughly **130–150 mph (58–67 m/s, 3-second gust)** under ASCE 7-22. Because the coastal plain offers no terrain to weaken an incoming storm, hurricane wind drives deep inland at strength, so the county remains a hurricane-prone region and wind-borne debris protection is decided project by project.
- **Rain and humidity.** Annual precipitation is about 1,570 mm in Miami and 1,317 mm in Houston, with annual mean relative humidity around 75% and summer values often above 80%. Rain-shedding, drainage, mould prevention and condensation control matter more here than insulation.
- **Salt-spray corrosion.** Coastal projects fall under ISO 12944 category **C5** (very high corrosivity), requiring hot-dip galvanising or a high-durability coating system. Sites more than about 10 km inland may be downgraded to C4.

- Site-specific factors.** Subterranean termites are active around Miami, so timber components need treatment; the hurricane belt also brings wind-driven rain and wind-borne missile impact.

4.2 Canadian severe cold · Toronto / Winnipeg

- Snow load drives the roof and purlins.** NBCC 2020 ground snow load S_g : Toronto **1.7 kPa** (plus associated rain load $S_r = 0.4$ kPa) and Winnipeg **1.9 kPa**. Using the roof snow load expression $S = I_s \cdot [S_g \cdot (C_b C_w C_s C_a) + S_r]$, flat-roof design snow loads land in the 1.4–2.5 kPa range, so **roof reinforcement is mandatory** — a bare container roof rating must not be used for delivery.
- Winnipeg is among the coldest major cities in Canada**, with a January mean low of about **–21 °C** and colder extremes. Design frost depth is about **1.8 m** versus about 1.2 m in Toronto. Foundations must reach below frost depth or use a frost-protected shallow foundation (FPSF); otherwise seasonal freeze–thaw will heave the structure.
- Temperature swing and thermal bridging.** Winnipeg spans from a –21 °C coldest-month mean low to a +26 °C hottest-month mean high — a 47 °C range. That places heavy demands on insulation thickness, sealant elasticity and thermal-break detailing. With a large indoor-outdoor winter differential, **condensation control matters more than heat rejection**: a vapour barrier and controlled ventilation are required.
- Snow drift and rain-on-snow.** Snow accumulates on the leeward side of roofs, and rain-on-snow events occur. Together these are a leading cause of roof failures in Canada.

Representative city parameters for this region

City	Snow load (kPa)	Wind speed (m/s)	Frost depth (m)	Coldest month (°C)	Hottest month (°C)	Precip. (mm)	Corrosivity
Miami	0	78.2	0.0	16.7	32.8	1,570	C5
Houston	0.24	60.4	0.0	6.5	34.9	1,317	C4
Toronto	1.70	26.5	1.2	–6.7	27.0	860	C4
Winnipeg	1.90	26.8	1.8	–21.0	26.0	520	C3

5. Europe

Climate label: Temperate + Nordic

This guide splits Europe into the temperate group (London, Frankfurt, Madrid) and the Nordic group (Stockholm). The defining European feature is that **National Annexes differ enormously**: the same EN 1991 can yield s_k and $v_{b,0}$ values differing by more than 20% between countries, so **there is no single “European value”** that works everywhere.

5.1 Temperate Europe · London / Frankfurt / Madrid

- Snow load is modest.** EN 1991-1-3 characteristic ground snow load s_k is roughly **0.40 kPa** in London, **0.65 kPa** in Frankfurt and **0.30 kPa** in Madrid — among the lowest in Europe, satisfied by a conventional roof. However, the Bavarian foothills in

southern Germany can reach 1.32 kPa, so variation within a single country is large and the National Annex must be consulted for the actual site.

- **Wind load is moderate.** EN 1991-1-4 fundamental basic wind velocity $v_{b,0}$ (10-minute mean at 10 m, 50-year return period) is about **22.1 m/s** in London, **25.0 m/s** in Frankfurt and **26.0 m/s** in Madrid. **Note the basis:** these are 10-minute mean speeds and must not be compared numerically against North American 3-second gusts.
- **Madrid is Europe's dry-heat outlier.** The July mean high reaches **34.1 °C**, annual mean relative humidity is only about **55%** (falling to 35% in July) and annual precipitation is about 478 mm. Shading and insulation are worth far more than moisture protection here — it behaves more like a semi-arid southern climate.
- **London is wet but rarely snowy.** Annual precipitation is about 600 mm spread evenly through the year under persistently overcast skies, so moisture control and ventilation are the priorities. Frost penetration is very shallow and foundation requirements are relaxed.

5.2 Nordic · Stockholm

- **The winter sun is extremely low.** At 59.33°N the winter-solstice solar noon elevation is only **7.24°** — the lowest of all eleven cities. To shade a 1 m window at the winter solstice a horizontal overhang would need **D/H = 7.86** (about 11.8 m of projection for a 1.5 m window), which is **physically impossible**. The conclusion: Nordic projects **should not rely on overhangs for solar control**. Instead, **enlarge south-facing glazing** and use light-coloured, low-reflectance interior finishes.
- **Daylight varies dramatically by season.** Winter sunshine is brief (about 1.2 h/day in December) while summer can approach 6 h/day. Lighting and daylight design must be checked against the winter case, and summer glare control is still needed because the low Nordic summer sun remains harsh.
- **Snow load is moderate to high.** The Swedish National Annex gives s_k of about **1.50 kPa** for coastal lowland Stockholm, but northern Sweden (around Riksgränsen) reaches **5.5 kN/m²**. Stockholm and northern Sweden are not the same order of magnitude — always check the EKS snow map for the specific municipality.
- **Frost depth is about 1.2 m**, so foundations must reach below it, and both concrete and steel must be designed for freeze–thaw cycling.

Representative city parameters for this region

City	Snow load (kPa)	Wind speed (m/s)	Frost depth (m)	Coldest month (°C)	Hottest month (°C)	Precip. (mm)	Corrosivity
London	0.40	22.1	0.0	2.5	23.5	600	C3
Frankfurt	0.65	25.0	0.8	-1.0	25.5	630	C3
Madrid	0.30	26.0	0.6	1.5	34.1	478	C3
Stockholm	1.50	24.0	1.2	-3.0	21.0	636	C3

6. Middle East

Climate label: Hot-arid inland + hot-humid coast

The binding constraints in the Middle East are not loads but **heat and dust**: extreme summer temperatures, intense UV and frequent sandstorms, with high salinity and humidity along the coast. The Saudi and UAE code frameworks (SBC 301 / Dubai Municipality regulations) follow ASCE 7 for wind methodology but use local hazard maps and routinely adopt the most severe exposure category.

6.1 Hot-arid inland · Riyadh

- **Extreme heat and a very large diurnal swing.** The July mean high is about **43.5 °C** with extremes reaching 50 °C, while nights fall to around 20 °C — a swing of up to **30 °C**. Repeated expansion and contraction causes panel distortion, fastener fatigue and roof leaks. Long buildings need expansion joints and sliding connections for cladding.
- **Dry, but not rain-free.** Annual precipitation is only about 109 mm and annual mean relative humidity is about **29%**. Occasional intense rainfall still causes ponding and scour, so roof drainage must be checked against short-duration storm intensity.
- **Dust is the leading cause of wear.** The local Shamal wind can carry fine sand at up to 70 km/h, continuously abrading exposed surfaces. Priorities: seal all joints and laps, use gasketed fasteners, fit removable and washable filters to louvres and air intakes, and specify abrasion-resistant exterior finishes (light-coloured ceramic panels, aluminium, purpose-made coatings).
- **Wind load.** Under SBC 301 the Riyadh basic wind speed is about **166 km/h (46.1 m/s)**, with Exposure C or D applied for open inland terrain.
- **Roof reflectance is the single biggest energy measure.** A light-coloured, high solar-reflectance index (SRI) roof can reduce surface temperature by 20–30 °C; combined with 50–100 mm sandwich insulation panels this typically cuts cooling load by 30–50%.

6.2 Hot-humid coast · Dubai / Jeddah

- **Salt-spray corrosion is at its most severe.** The Dubai and Jeddah coastlines fall under ISO 12944 category **C5** (very high corrosivity) and into the CX range at the extreme, where unprotected carbon steel corrodes rapidly. Countermeasures: hot-dip galvanising to ISO 1461 (85–120 µm), or a full system of zinc-rich epoxy primer plus micaceous iron oxide epoxy intermediate plus polyurethane topcoat (240–400 µm total dry film thickness). Fasteners must be stainless steel A2/A4.
- **Heat combines with humidity.** Dubai's annual mean relative humidity is about **53%**, reaching 50–90% in summer; Jeddah is about 54%. High temperature plus high humidity pushes perceived temperature well above the air temperature, so ventilation and air-conditioning must be sized against wet-bulb rather than dry-bulb conditions.
- **Wind load.** Dubai Municipality specifies a basic wind speed of **45 m/s (3-second gust, about 160 km/h)**. Jeddah on the Red Sea is of the same order at about 45 m/s, and waterfront sites take Exposure Category D (the most severe).
- **Jeddah has a distinctive tropical reversal.** At 21.49°N there are **49 days** each year when the sun at solar noon is **north** of the zenith (roughly 29 May to 16 July). During that window the **north wall is sunlit and the south wall is shaded**, so the usual northern-hemisphere rule that a north wall needs daylight but no shading does not apply.
- **Rain is scarce but concentrated.** Jeddah receives about 109 mm annually, roughly 42% of it in November alone. Short-duration intense rainfall and localised flooding are real risks, so drainage must be sized for peak intensity.

Representative city parameters for this region

City	Snow load (kPa)	Wind speed (m/s)	Frost depth (m)	Coldest month (°C)	Hottest month (°C)	Precip. (mm)	Corrosivity
Riyadh	0	46.1	0.0	9.0	43.5	109	C4
Dubai	0	45.0	0.0	17.0	41.0	91	C5
Jeddah	0	45.0	0.0	21.0	36.0	109	C5

7. Design parameter quick-reference

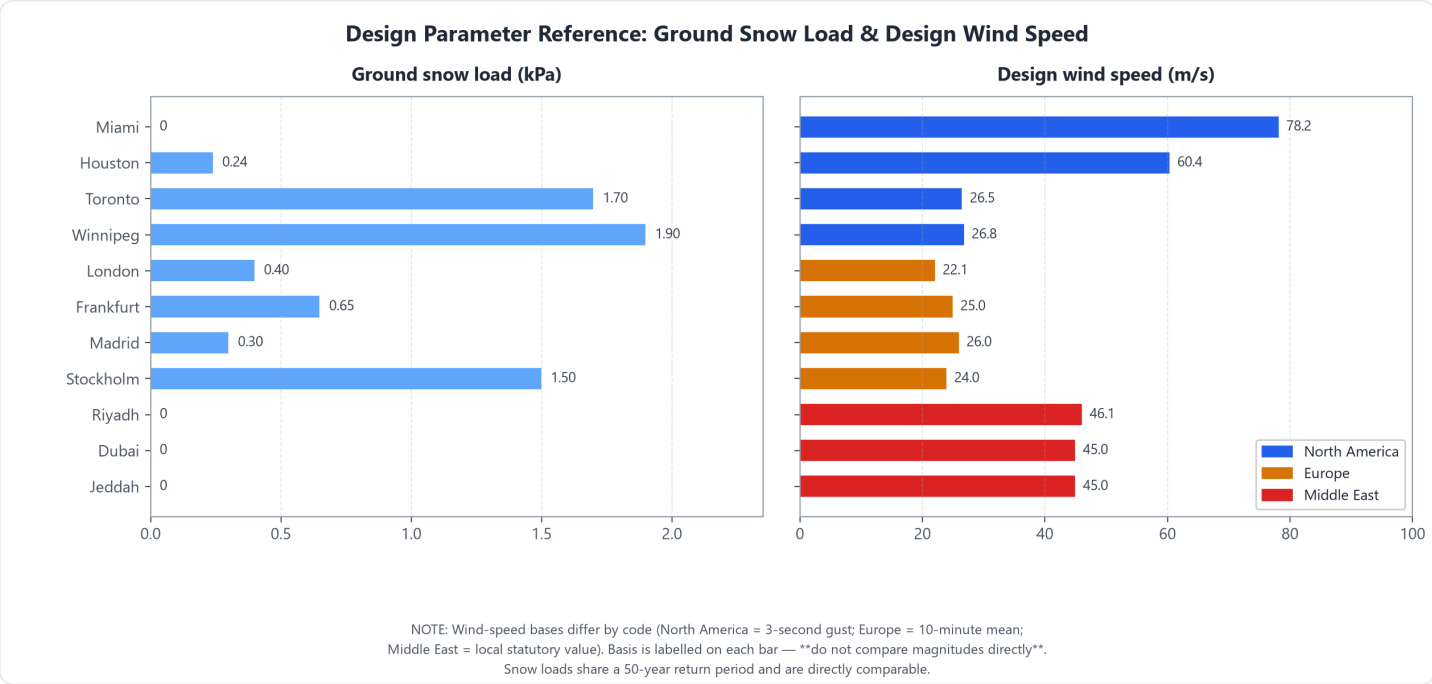


Figure 5 | Left: ground snow load (50-year return period, directly comparable across cities). Right: design wind speed (**bases differ — do not compare magnitudes**).

7.1 Grouped by governing constraint

Governing constraint	Typical markets	Key parameters	Design response
Wind (extreme)	Miami, Houston, Dubai, Jeddah	3-second gust 45–78 m/s; HVHZ needs product approval	Re-check primary frame to local code; cladding and fasteners at the most severe exposure category; wind-borne debris protection; limit overhang depth
Snow + frost depth	Winnipeg, Toronto, Stockholm	Snow load 1.5–1.9 kPa; frost depth 1.2–1.8 m	Roof reinforcement or pitched-roof kit; foundations below frost or FPSF; check snow drift and rain-on-snow
High temperature + strong sun	Riyadh, Dubai, Jeddah, Madrid	Hottest-month mean high 34–44 °C; noon elevation 88°+	High-reflectance roof (SRI) + 50–100 mm sandwich insulation + ventilated cavity; vertical shading on east and west
Salt-spray corrosion	Miami, Dubai, coastal Jeddah	ISO 12944 C5	Hot-dip galvanising 85–120 µm or a full coating system at 240–400 µm; stainless A2/A4 fasteners
Sand and dust abrasion	Riyadh, Dubai	Shamal wind carrying sand at up to 70 km/h	Sealed joints, gasketed fasteners, removable washable filters, abrasion-resistant finishes, replaceable panels
Rainfall and humidity	Miami, Houston, London	Annual precipitation 600–1,570 mm; RH 75%+	Roof and detail waterproofing, condensation and mould control, ventilation; size drainage for peak storm intensity
Annual range and thermal bridging	Winnipeg, Riyadh	Annual range 47 °C	Thermal-break detailing, elastic sealants, expansion joints, sliding connections

7.2 Formulas and conversions

Item	Formula	Notes
Solar noon elevation	$h = 90^\circ - \varphi - \delta $	φ is latitude, δ is declination (+23.44° at the June solstice, −23.44° at the December solstice). Our values are solved day by day with a 0.000° self-check error
Horizontal overhang ratio	$D/H = 1 / \tan(h)$	h is the solar noon elevation. For a 1.5 m window the projection is $1.5 \times D/H$
Roof snow load (Canada)	$S = I_s \cdot [S_s \cdot (C_b C_w C_s C_a) + S_r]$	NBCC 2020; I_s importance factor, C_b basic roof factor, C_w wind exposure factor, C_s slope factor, S_r rain load
Flat roof snow load (US)	$p_f = 0.7 \cdot C_e \cdot C_t \cdot I_s \cdot p_g$	ASCE 7-22 Section 7.3; low-slope roofs must also satisfy $p_f \geq 20 \cdot I_s$ psf
Design snow load (Europe)	$s = \mu_i \cdot C_e \cdot C_t \cdot s_k$	EN 1991-1-3; $C_e = 0.8$ windswept, 1.0 normal, 1.2 sheltered
Velocity pressure (US)	$q_z = 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2$ (psf)	V in mph; metric form $q_z = 0.613 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2$ (N/m², V in m/s)
Exposure category	B urban / C open / D water	Open waterfront sites take D (most severe). At 30 ft the K_z for D is about 63% higher than for B, which is why coastal projects almost always take D

8. Handling customer objections

The twelve items below cover the most frequent climate-related objections. Each is organised as **customer’s words** → **response framework** → **trigger condition** → **ready-to-use script**. The scripts can be used as written, and every figure in them traces back to Sections 2 and 7.

Customer says: Can your container house withstand a typhoon?

Framework: Yes — but I first need the **project location and its distance from the coast**, because design wind speeds differ by more than a factor of two between regions.

Trigger: Customer answers “Miami”

Script: Under ASCE 7-22 Risk Category II, Miami is in the High-Velocity Hurricane Zone with a basic wind speed of about 175 mph. Our approach: (1) re-check the primary frame against the governing local code; (2) specify cladding, openings and fasteners only in configurations that carry the required local product approval; (3) issue a third-party structural calculation. Send me the project address and I will look up the design wind speed for that exact point.

Customer says: It drops to minus thirty here in winter. Can people actually live in your container?

Framework: Yes, but two separate things must be settled: **structural capacity** (snow load, frost depth) and **thermal performance** (insulation thickness, thermal bridging, condensation control).

Trigger: Customer in Winnipeg or northern Canada

Script: Winnipeg has an NBCC 2020 ground snow load of $S_s = 1.9 \text{ kPa}$, so the roof must be reinforced — it cannot be delivered at bare container-roof rating. The January mean low is about -21°C and design frost depth is about 1.8 m, so foundations must reach below frost or use a frost-protected shallow foundation. On insulation we size the thickness for the local climate and detail the thermal breaks; the winter priority is condensation control, which needs a vapour barrier and controlled ventilation. Both items can be issued as a configuration list.

Customer says: It is fifty degrees in the Middle East. Will the container not be an oven?

Framework: A bare container would be. A container house is not a bare container. Cooling comes from three things — **shading, a reflective roof and ventilation** — not from air-conditioning alone.

Trigger: Customer in Riyadh or Dubai

Script: Take Riyadh: the July mean high is 43.5°C but humidity is only about 29%, so this is dry heat, which is far easier to handle than humid heat. We do three things: (1) a light-coloured high-reflectance roof (high SRI) that can cut surface temperature by $20\text{--}30^\circ\text{C}$; (2) 50–100 mm sandwich insulation panels; (3) roof ventilators plus louvres for stack ventilation, which can hold the interior $8\text{--}12^\circ\text{C}$ cooler than a sealed dark unit. Add air-conditioning on top of that and the load drops by thirty to fifty percent.

Customer says: Will heavy snow not crush the roof?

Framework: This is exactly where we differ from an ordinary second-hand container. The ISO 1496-1 roof requirement is a single 300 kg patch load — it was written for ocean shipping, not for four months of accumulated snow.

Trigger: Customer in Canada or the Nordics

Script: Toronto under NBCC 2020 has a ground snow load of 1.7 kPa , plus a rain load of 0.4 kPa ; Winnipeg is 1.9 kPa . A standard container roof does not satisfy that. We reinforce the roof (additional purlins or internal stiffeners), add a pitched-roof kit where required, and check both snow drift and rain-on-snow cases. All of that is priced into the configuration and the quotation.

Customer says: We are on the coast. Will it not rust through in two years?

Framework: Bare steel would. A system built to ISO 12944 C5 will not. The decisive factor is the coating system, not the steel itself.

Trigger: Customer in Dubai, Jeddah or coastal Miami

Script: Coastal sites fall under ISO 12944 category C5 (very high corrosivity). Our specification: abrasive blast to Sa 2.5 → zinc-rich epoxy primer 80–120 µm → micaceous iron oxide epoxy intermediate 80–160 µm → polyurethane topcoat 60–120 µm, giving 240–400 µm total dry film thickness; or hot-dip galvanising at 85–120 µm. Every fastener is stainless A2/A4 — no carbon steel components are left in the assembly. In a C5 environment this system corresponds to a durability class of 15–25 years or more.

Customer says: Will sand not get in through the gaps?

Framework: It will — which is why the approach in dusty regions is different. The priorities are **sealing, filtration and replaceability**.

Trigger: Customer in Saudi Arabia or the UAE

Script: The Shamal wind carries fine sand at up to 70 km/h, which continuously abrades any gap. We do four things: (1) sealant and gaskets at all panel joints and laps; (2) gasketed fasteners; (3) filters on air intakes and louvres, specified as removable and washable; (4) abrasion-resistant exterior finishes, with high-wear areas detailed as replaceable panels.

Customer says: Why do you recommend this orientation for us?

Framework: Because the sun's elevation at your latitude is a fixed geometric fact, not a matter of experience. We compute it day by day using the NOAA solar position algorithm.

Trigger: Customer asks about orientation

Script: For example: Miami's solar noon elevation is 87.7° at the June solstice and 40.8° at the December solstice, while Stockholm is only 7.2° at the December solstice. The same "glaze to the south" advice needs shading in Miami but much larger glazing areas in Stockholm. I can send you the solar noon elevation curve for your city and the configuration recommendation becomes self-evident.

Customer says: How deep does the overhang need to be?

Framework: There is a formula: $D/H = 1/\tan(\text{solar noon elevation})$. But once it is computed it has to be traded off against wind-uplift requirements.

Trigger: Customer asks about shading dimensions

Script: Take Miami: the June-solstice D/H is only 0.04 while the December-solstice value is 1.16; Houston runs 0.11 in June and 1.34 in December. If you want “block summer, admit winter” you need adjustable shading or a detached overhang. One further warning: **horizontal overhangs are essentially useless against low-angle east and west sun** — Miami at 08:00 would need $D/H = 8.11$ — so those orientations require vertical shading.

Customer says: Should we make the windows bigger?

Framework: It depends on latitude. Low latitudes want less glass and more shading; high latitudes want more glass and solar admission.

Trigger: Customer weighing up window-to-wall ratio

Script: In low-latitude cities such as Madrid, Riyadh and Dubai, east and west glazing should be limited and shaded. In high-latitude cities such as Stockholm and Winnipeg, south-facing glazing should actually be enlarged, because the winter sun sits at only 7–17° and penetrates deeply — the heat that comes in through the glass is free heating. We can provide an orientation-by-window-ratio recommendation table.

Customer says: How deep do the foundations need to go?

Framework: To the local design frost depth — not to a rule of thumb. If the footing sits above the frost line it will heave within two or three winters.

Trigger: Customer in Canada, the Nordics or Germany

Script: Toronto is about 1.2 m, Winnipeg about 1.8 m, Stockholm about 1.2 m and Frankfurt about 0.8 m. Either excavate below frost depth or use a frost-protected shallow foundation (FPSF), which uses insulation to keep the frost line outside the footing. Both need sign-off from a local engineer; we can supply the foundation load conditions.

Customer says: Will it not feel like an oven inside in summer?

Framework: If you insulate the walls but leave the roof alone, yes. The roof is the largest heat-gain surface — the cosine of the solar incidence angle at noon is close to 1.

Trigger: Customer worried about thermal comfort

Script: In Miami, for example, the sun is almost perpendicular at the June solstice, so the roof heat-gain coefficient reaches 0.999 out of a maximum of 1. So the roof build-up matters more than the walls: a high-reflectance coating, sufficient sandwich insulation thickness and a ventilated cavity. Thickening the wall panels without touching the roof yields far less benefit.

Customer says: Have you done projects in a climate like ours?

Framework: This is precisely why we like to work climate zone by climate zone — the right configuration is genuinely different in each one.

Trigger: Customer asking for references

Script: We can provide a configuration matched to your climate type together with the parameter basis (snow load, design wind speed, frost depth and corrosivity class, each with its source code), plus a performance statement for that configuration. That also gives you solid documentation for local permit review.

9. Climate clauses for quotations

The clauses below can be lifted directly into a quotation or proposal to demonstrate climate competence while keeping the responsibility boundary clear. Commercial terms remain as company policy (EXW factory, excluding freight and customs clearance; quotation valid 7 days).

Clause	Wording
Design basis to code	Roof snow load, basic wind speed and foundation frost depth can all be stated with the value and source code of the project country (ASCE 7-22 / NBCC 2020 / EN 1991 / SBC 301) for the customer's local permit submission.
Tiered climate-adapted configuration	Each house type is offered in a standard and an enhanced climate configuration. The enhanced tier includes roof reinforcement, high-reflectance coating, increased insulation, a C5-grade anti-corrosion coating system and stainless-steel fasteners.
Specifiable coating system	Coastal and high-corrosivity projects can specify the ISO 12944 coating class (C3 / C4 / C5) and a hot-dip galvanising option, listed as a separate line item in the quotation.
Orientation and shading advice included	A solar noon elevation curve and orientation/shading recommendation for the project latitude are supplied as an additional technical annex to the proposal at no extra charge.
Locally verified wind and seismic design	Primary-structure wind and seismic design must be verified and sealed by an engineer licensed in the project country under the local code. We supply the structural load conditions and member parameters.
Delivery and climate windows	For regions subject to extreme climate (severe cold, hurricane season, monsoon or rainy season), we recommend agreeing in the contract to avoid unfavourable local weather windows for shipment and installation, subject to the shipping schedule confirmed by both parties.

10. Applicability and disclaimer

10.1 Data sources and bases

- **Solar geometry** is computed by us with the NOAA solar position algorithm, solving solar noon day by day rather than assuming a fixed 12:00. The self-check identity for solar noon elevation ($h = 90^\circ - |\varphi - \delta|$) is satisfied to **0.000°** on all four key dates. Time zones are set per city with daylight-saving rules applied. Suitable for proposal annexes and technical discussion.
- **Climate normals** use the 1991–2020 reference period and are taken from published normals of national meteorological agencies (NOAA, Environment and Climate Change Canada, European national meteorological services).
- **Code design values** — ground snow load, basic wind speed, frost depth and corrosivity class — each name their source code and edition. These values change between editions (the ASCE 7-16 to 7-22 wind maps changed significantly), so formal design must follow the edition currently in force at the project location and the requirements of the authority having jurisdiction.

10.2 Limits of use

This document is a sales technical support tool, not a structural design document.

1. The parameters here support **proposal discussion and configuration decisions**; they do not replace a structural calculation.
2. Wind, seismic and snow verification of the primary structure must be performed and sealed by an engineer licensed in the project country under the local code in force.

3. The cities listed are **representative values**. Variation within a country can be large (northern Germany 0.65 kPa against the Bavarian foothills at 1.32 kPa; southern Sweden 1.5 kN/m² against northern Sweden at 5.5 kN/m²). Actual projects must use site-specific values.
4. Frost depth and foundation design must be determined together with local geotechnical investigation data.
5. This guide does not replace the local building permit process.

10.3 From climate requirement to product configuration

This guide states the **climate requirement**; the deliverable is a **configuration option**. We recommend confirming the link between them in this order: (1) confirm the project city → (2) consult Sections 2 and 7 to identify the governing constraint → (3) consult the relevant regional section for the design response → (4) build the configuration list (insulation thickness, roof build-up, coating system, foundation scheme, shading detail) → (5) price the quotation.

10.4 Sharing this reference with your customers

This reference is prepared in both English and Chinese. **The English version is the one to send to customers**, and it is published online so your customer can open it directly and download the PDF themselves:

Live page:

<https://www.huaying1.com/container-house-climate-adaptability/>

The page carries the full text plus a download button for the 20-page PDF. Paste the link straight into an email or a WhatsApp message.

Suggested use: when a customer asks “will this work in my country?”, send this link first, then add one sentence of city-specific conclusion drawn from the Section 2 overview table or the Section 8 objection scripts. The Chinese edition is for internal use only — **do not send the Chinese version to overseas customers**.

HUAYING INTEGRATED HOUSING CO., LTD.

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