The Pallet & Freight Sheet

The shipping math on one page — cases to pallets to trucks. Unit → case → pallet → trailer: small inefficiencies at one link multiply down the whole chain, and most of the cost is fixed while the package is still a drawing.

TI-HI — CASES PER PALLET

Ti (tier) = cases in one layer on the deck. **Hi** (high) = layers stacked. Ti is a tiling problem (case footprint vs. deck); Hi is capped by height limits and by what the bottom boxes can carry.

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cases per pallet = Ti × Hi
Ti ≈ how the case footprint tiles 48 × 40 in
Hi ≈ load-height cap ÷ case height
```

Worked example (illustrative — yours will differ): a 12 × 10 in case on a 48 × 40 deck → 48÷12 = 4 across, 40÷10 = 4 deep → **Ti = 16**, full deck coverage. At 9 in tall with a ~54 in product-height cap → **Hi = 6**. 16 × 6 = **96 cases per pallet**.

- **No overhang.** Cases past the deck edge lose their corner support — a commonly cited estimate is up to about a third of compression strength, even at roughly an inch.
- **Minimal underhang.** A load smaller than the deck ships empty pallet, and it shifts and leans more freely.

THE GMA PALLET — 48 × 40 FACTS

- Footprint **48 × 40 in** (≈1219 × 1016 mm); deck ≈ 1,920 sq in per layer.
- Typically ~5–6 in tall and ~40–50 lb empty; four-way forklift entry.
- A 53-ft dry van holds roughly **26–30 floor positions** (straight vs. pinwheeled), with about 3,800 cu ft of usable space and a payload ceiling in the neighborhood of 45,000 lb — typical figures; confirm your equipment.
- Other footprints in use: 42 × 42, 48 × 48 (drums), Euro 1200 × 800 mm. If nobody specified one, assume 48 × 40 — but confirm the deck and max load height your receiver mandates.

STACKING PATTERN — STRENGTH VS. STABILITY

PATTERN	TRADE
Column	Strongest — load runs corner-over-corner down the box's stiffest posts. Less stable; usually unitized with stretch wrap / corner boards.
Interlocked	Rotated layers bridge seams: more stable, but commonly cited to give up roughly a third to half of column compression strength.
Pinwheel	Between the two; suits certain footprints, can leave a small center void.

Common compromise: column-stack for strength and interlock only the top layer or two to lock the cap.

CUBE OUT VS. WEIGH OUT

Every trailer has two ceilings — volume and legal payload — and a load stops at whichever comes first. Light, bulky freight **cubes out** (optimize size); dense freight **weighs out** (optimize weight). Know which ceiling you hit before you optimize.

BOX COMPRESSION — BCT & THE MCKEE ESTIMATE

ECT (edge crush, lb/in) rates the board; **BCT** (box compression, lbf) rates the finished box top-to-bottom — the number that governs stacking. (Mullen/burst rates puncture — a different spec.) Estimate BCT before the box exists:

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BCT ≈ 5.87 × ECT × √(caliper × perimeter)
caliper = board thickness (in) · perimeter = 2×(L+W) (in)
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The constant is empirical (sources put it around five to six) and assumes a clean, sealed RSC under short-term lab load. Treat McKee as a ceiling, not a spec.

REAL-WORLD DERATE	TYPICAL EFFECT
Humidity	Board is hygroscopic; near saturation a box can hold roughly half its dry strength — a typical rule of thumb.
Time (creep)	Weeks under load fail well below the seconds-long lab number.
Overhang	Unsupported corners; commonly cited up to about a third lost.
Pattern	Interlocking misaligns the corner posts vs. a column stack.
Condition	Vents, hand holes, heavy print, reused board all subtract.

Design rule: apply a safety factor — rated BCT at a multiple of the actual static load, typically in the range of about 3× to 7×, higher for humid or long-term storage.

DIMENSIONAL (DIM) WEIGHT — PARCEL

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DIM weight = (L × W × H) ÷ divisor
billable weight = max(actual, DIM)
```

The divisor (cubic inches per pound) is set by carrier and service — 139 is the UPS and FedEx daily rate, and USPS moved from 166 to 139 on 12 Jul 2026; since 18 Aug 2025 UPS and FedEx round each fractional dimension up to the next inch first — and it changes over time and is often negotiable. **Use the divisor in your own contract.**

Sources (verified 30 Sep 2026): USPS — Governors' Decision 26-2, Federal Register doc. 2026-09584 (Priority Mail Express, Priority Mail, Parcel Select and Ground Advantage, 166 → 139, effective 12 Jul 2026); UPS and FedEx — each carrier's current service guide.

Worked example (illustrative divisor): 20 × 16 × 12 in = 3,840 cu in; ÷ 139 ≈ 28 lb DIM vs. 8 lb actual → billed at **28 lb**. Right-size to 16 × 12 × 6 in and DIM falls to roughly 9 lb — an inch off one dimension removes a whole layer of cube.

NMFC FREIGHT CLASS — LTL IS PRICED ON DENSITY

LTL freight is classed by the **NMFC** (maintained by the NMFTA) on density, stowability, handling, and liability — density dominates for most packaged goods. Since NMFC Docket 2025-1 (effective 19 Jul 2025) density alone places freight on a **13-step scale** from class **50** (dense, cheaper) to **400** (light, bulky, costlier). Compute it before you book:

```
density (lb/cu ft) = total shipment weight ÷ total cubic feet — pallet included
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LB/CU FT	CLASS
< 1	400
1–2	300
2–4	250
4–6	175
6–8	125
8–10	100
10–12	92.5
12–15	85
15–22.5	70
22.5–30	65
30–35	60
35–50	55
≥ 50	50

This is the NMFC density scale (Docket 2025-1, NMFTA Disposition Bulletin 1371, effective 19 Jul 2025) — guidance, not gospel. Each band runs up to (not including) the next. Item-specific NMFC codes govern, and some commodities carry a fixed class regardless of density; getting it wrong invites a carrier reweigh-and-reclass. Confirm your class with your carrier or the NMFTA.

Rules of thumb on this sheet are typical published values, labeled as such — real strength, class, divisors, and height/weight limits vary by board, carrier, facility, and contract. Verify freight class with your carrier or the NMFTA, DIM divisors against your rate agreement, and pallet/load limits with your receiving DCs. Condensed from the PackOS logistics library: packos.ai/blog/packaging-logistics-guide.html

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