

INDIAN METAL BUILDING FORUM

IMBF

Connecting India's Metal Building Ecosystem

5C FRAMEWORK: CONNECT • COLLABORATE • CREATE • CONSTRUCT • CERTIFY+

RESOURCE CENTRE

Technical Knowledge Series

TECHNICAL GUIDE

Bracing Systems in Steel Buildings

How longitudinal and lateral stability is provided, and how to choose the system

Brace First
Keep It Tight
Never Cut a Brace

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SERIES:	Series E: Design Optimization (IMBF-DO)
COVERS:	Roof, wall, portal, knee and diaphragm bracing
FOR:	Designers, detailers, erectors and owners

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Vendor-neutral guide. Values are typical industry practice; the project design and the governing codes decide.

About this guide. An explanation of how steel buildings are braced along their length, the systems available and the points to check in design, erection and service. Status: draft for IMBF technical review.

1 WHY BRACING MATTERS

- Main frames resist loads across the building by frame action. Along the building they have almost no strength of their own.
- Wind on the endwalls, earthquake, crane braking and erection loads along the building must be carried by bracing.
- Bracing also keeps frames plumb, holds compression flanges in line through purlins and flange braces, and makes the structure stable during erection.
- Missing, slack or removed bracing is one of the most common causes of steel building collapse, especially during erection.

2 LOAD PATH FOR WIND ON THE ENDWALL

- Endwall cladding passes wind to the girts and then to the wind columns.
- Each wind column spans from its base to the roof, where its top reaction enters the roof bracing.
- Roof bracing carries the force along the roof to the braced bays.
- Wall bracing in those bays takes it down to the foundations.
- All braced bays share the force. Their number depends on the width and length of the building.

3 BRACING SYSTEMS COMPARED

System	Description	Use when	Limits
Diagonal rod or cable	Crossed tension members in roof and wall bays	Walls and roof are free of obstructions	Works in tension only; must be tensioned; blocks openings
Diagonal angle	Angles bolted between frames	Higher forces; crane buildings	Heavier; connection eccentricity to be designed
Portal frame	Rigid beam-and-column frame inside a sidewall bay, pinned at the base, set just below the haunch	Bay must stay open for doors or traffic	Reduces clear width and height; more steel; larger foundation force
Knee brace	Eave-level beam with diagonal braces to the columns	Diagonals not allowed and a portal does not fit	Bends the main columns about the weak axis; lower stiffness
Diaphragm	Fastened wall or roof sheeting acting in shear	Small buildings, bearing endwalls, lean-tos	Needs a minimum unbroken sheeted length; sensitive to openings and later changes
Fixed-base columns	Columns cantilever from the foundation	Open-sided buildings with no room for other bracing	Large foundations; higher sway

4 DESIGN AND DETAILING POINTS

- Place roof and wall bracing in the same bay so that the load path is direct. Where they must be in different bays, provide a strut such as the eave strut to connect them.
- Design the eave strut, purlins or dedicated struts that carry bracing force in compression.
- Check anchor bolts and foundations in braced bays for the horizontal force and uplift from the bracing.
- In crane buildings, provide separate bracing in the plane of the crane beams for longitudinal crane forces.
- For diaphragm bracing, state on the drawings which sheeted areas are structural, so they are not removed or cut later.
- A typical tension bracing cable in light buildings is a galvanized seven-wire strand of about 12 mm diameter; rods of similar capacity are also common. Size is by design.

5 ERECTION AND SERVICE

- Erect the braced bay first, plumb and tension it, then build the other bays from it.
- Use temporary guys or bracing until permanent bracing is complete. Do not remove them to make room for other trades.
- Tension rods and cables evenly; a slack brace does nothing until the frame has already moved.
- Never cut or remove a brace for a new door, duct or machine without a structural check and a replacement system.
- Inspect bracing after storms, impacts and modifications.

6 BRACING CHECKLIST

Item	Check	Done
Design	Bracing system shown for roof and both sidewalls; forces calculated	☐
Design	Braced bays chosen clear of doors and future openings	☐
Design	Struts between roof and wall bracing provided and designed	☐
Detailing	Connections designed for brace force; gusset eccentricity checked	☐
Foundations	Anchors and footings in braced bays designed for shear and uplift	☐
Erection	Braced bay erected and tensioned first	☐
Erection	Temporary bracing kept until permanent system is complete	☐
Handover	Structural sheeting and bracing identified on as-built drawings	☐

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