BRACING SYSTEM TABLE OF CONTENTS

BRACING INFORMATION

The following information is intended to provide general guidelines regarding longitudinal bracing and lateral endwall bracing options.

For specific questions related to individual projects please contact your engineering team for guidance.

STANDARD LONGITUDINAL BRACING OPTIONS

Longitudinal bracing is a required part of the building system, resisting forces due to wind, earthquakes, cranes, and other stability considerations.

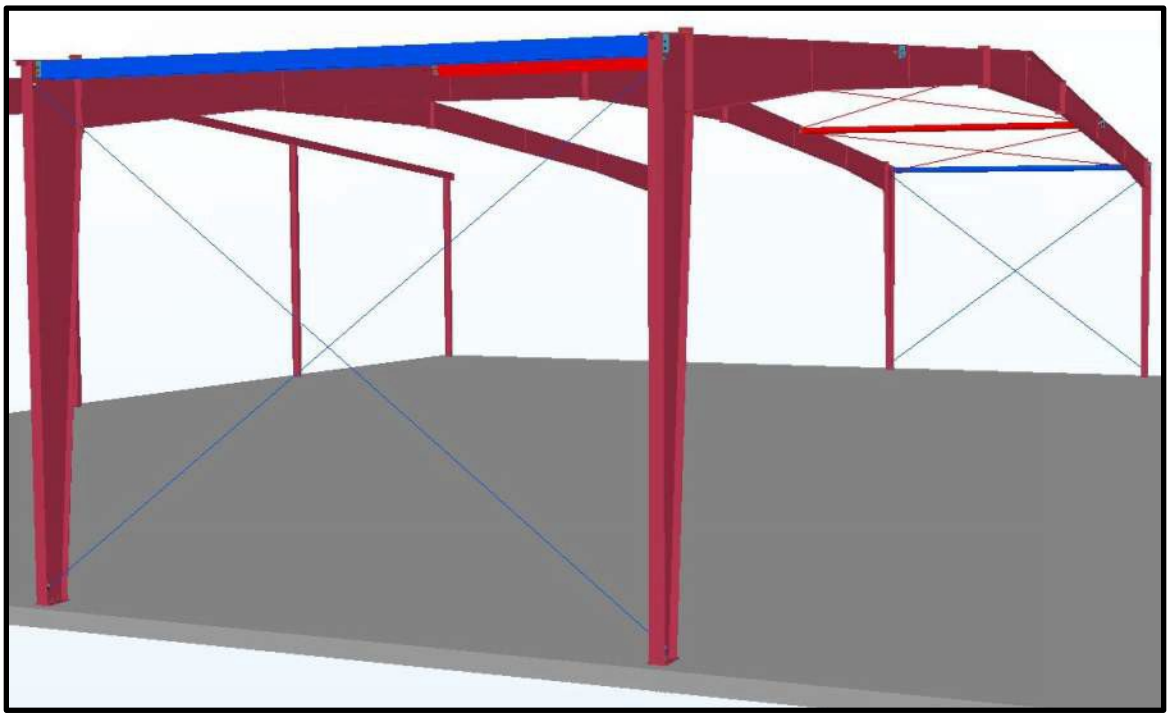
The standard product consists of threaded rod or high strength cable used alone or in conjunction with Girts, Purlins, and strut members, to create a truss system. Typically, the compressive forces are resisted by purlins, eave struts or girts until the load carrying capacity is exceeded. When axial loads exceed capacities, additional strut members are provided to transfer the axial loads. The chords for the assembled truss typically consist of the primary rigid frame rafters and columns.

NOTE: For certain loading situations, structural angle may be used in wall bracing applications.

The below guidelines are intended to provide guidance for longitudinal bracing systems.

1. If a roof transverse expansion joint is specified, at least one braced bay must occur on each side of the expansion joint location.
2. Field slotting of girts is required for the bracing to pass through on inset and flush girt conditions.
3. Two-bay and one-bay buildings with Post & Beam endwalls are required to have bracing in both endwalls and at least one sidewall. If bracing is not allowed in the endwalls of this type project, the endwall frames must be changed to rigid frames.
4. It is very important that bracing type and bays where bracing is not allowed be provided on all quote and order documents.
5. **DO NOT** mix bracing systems along any given wall. For example, Standard X-Bracing and Portal Frames cannot be located along the same sidewall of a building.
6. Always provide the wall weight for walls **NOT** by Nucor Building Systems. Examples include Concrete Masonry Units (Hollow versus Filled), Stucco, Tilt-Up and Pre-Cast Wall Panels, etc.
7. Full Height X-Bracing is the most economical Longitudinal Bracing solution.

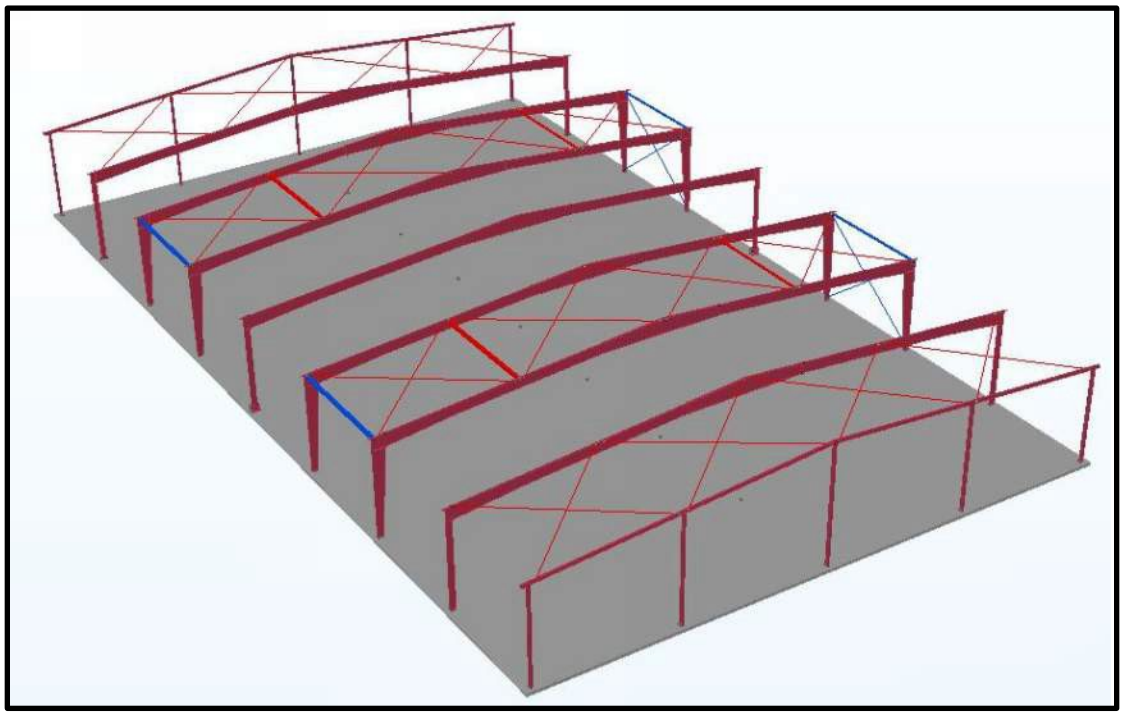
FULL HEIGHT X-BRACING



Full height X-Bracing is the standard Nucor Building System solution to longitudinal strength and stability and is the lowest cost option. The below guidelines are intended to provide guidance when utilizing full height X-Bracing.

1. The standard location for longitudinal bracing is in the first interior bay on buildings three bays or longer. Two bay buildings can have bracing in either end bay.
2. Standard bracing is not recommended in adjacent bays, as this causes detailing and erection difficulty.
3. Standard rules of thumb for Full Height X-Bracing is shown below:
    a. Provide one bay of bracing for every five bays or 150’-0”, whichever is less.
    b. Provide one bay of bracing for every 80’-0” of building width.
4. X-Bracing may be relocated to avoid walk doors by providing partial bay (K-Bracing) based on geometry considerations.
5. For wide modular buildings, X-Bracing should be considered, as it reduces sidewall column bracing reactions and brace sizes, while adding a longitudinal reaction to the interior column foundation at braced bays. Recommendations for using interior column line bracing include:
    a. When the width of the modular frame is ≥ 220’-0”.
    b. When full height masonry is used in high seismic regions for modular frames ≥ 150’-0.

TORSIONAL X-BRACING

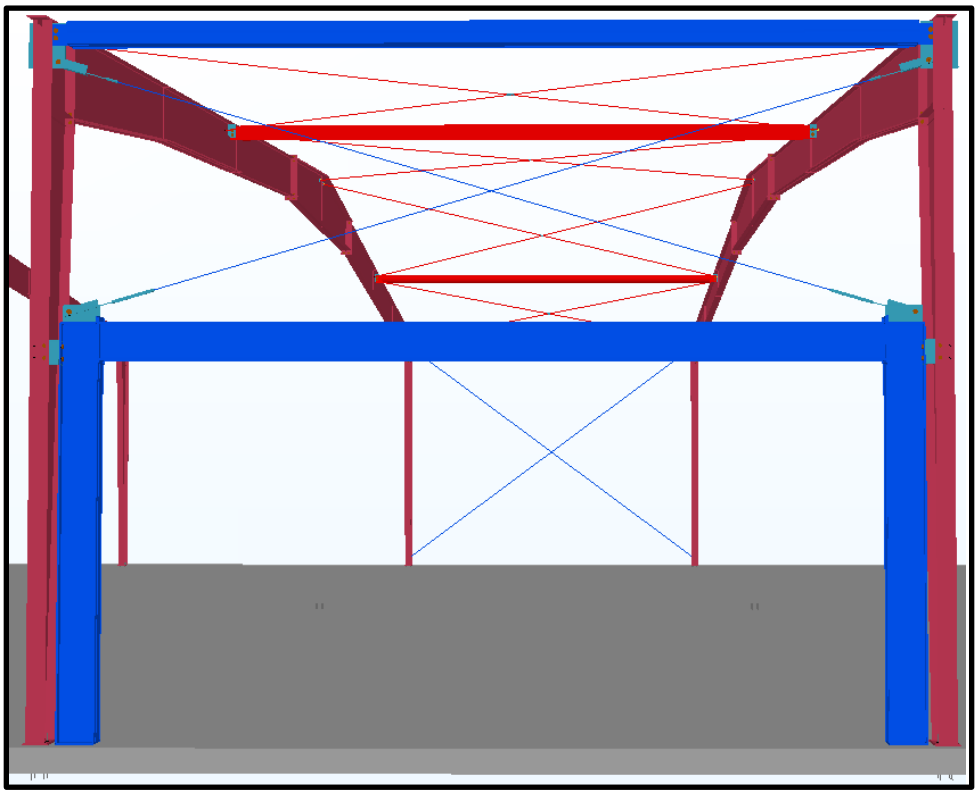


Torsional X-Bracing is an alternative longitudinal bracing solution that functions with bracing in only one sidewall, allowing for additional framed openings or horizontal clearances that cannot be met with standard X-Bracing or Portal Frames. When torsional bracing is utilized, the longitudinal loads acting on the building are resisted by bracing in one sidewall only. Due to increased forces in the remaining braces and forces introduced into the adjacent rigid frames due to the removal of the sidewall X-Bracing, Torsional X-Bracing is a more expensive and flexible longitudinal Bracing option than full height X-Bracing.

Due to the inherent flexibility of Torsional X-Bracing, care should be taken when combined brittle materials and/or large seismic masses. The below guidelines are intended to provide guidance when utilizing Torsional X-Bracing.

1. Torsional X-Bracing systems are **NOT** available in end bays with Post & Beam endwall framing without endwall X-Bracing.
2. Standard Parameters for Torsional X-Bracing include:
    a. Low Eave height of building ≤ 20’-0”
    b. Building width ≤ 70’-0”
    c. Building Roof Slope ≤ 1:12
3. Torsional X-Bracing is **NOT** available for buildings with cranes, mezzanines, or in areas with high seismic loads.
4. Sidewall Bracing may be full height X-Bracing or Portal Frame, or partial height Portal Frame.
5. Torsional Bracing with Portal Frames is **NOT** recommended for projects with hardwall systems.

PORTAL FRAME

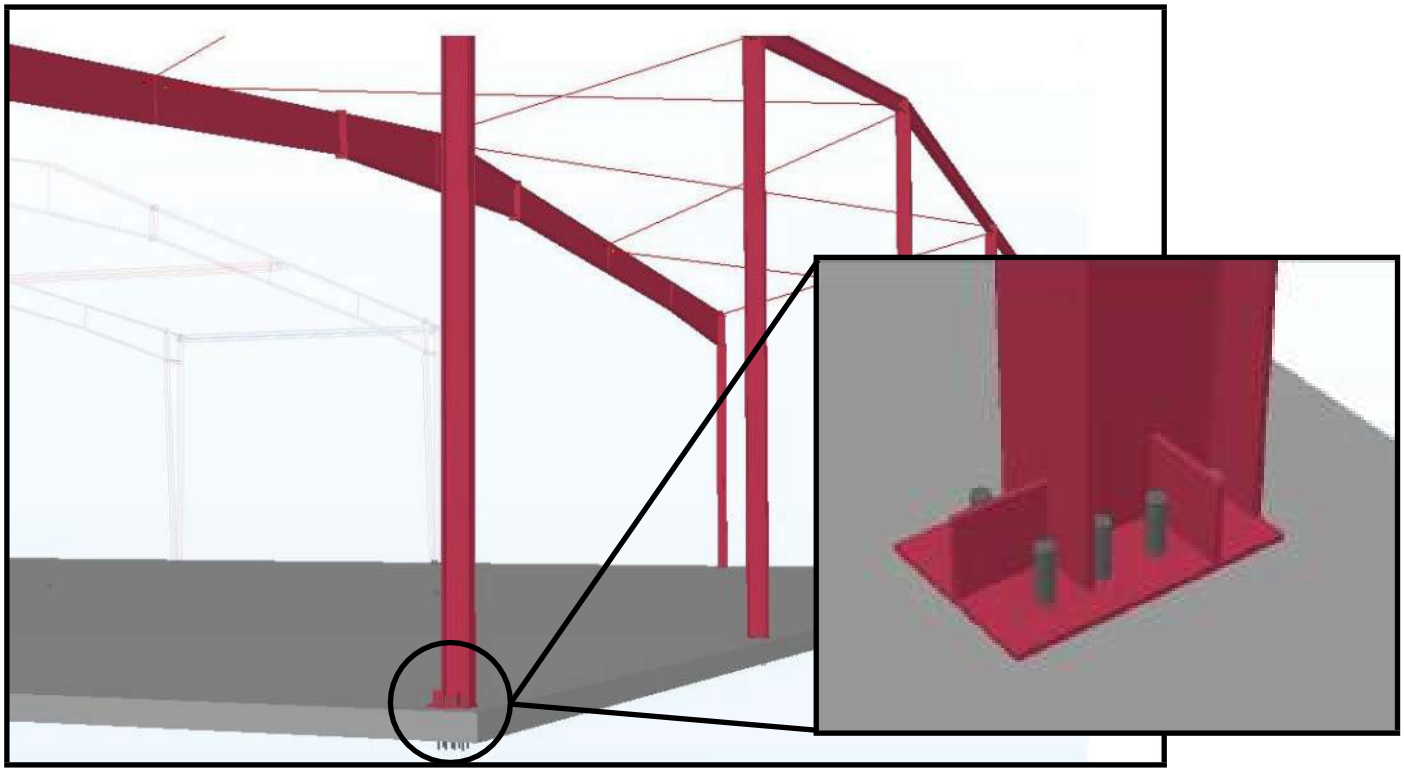


Portal Frames are rigid frames that span in the longitudinal direction between primary rigid frames. Portal Frames are an alternative longitudinal bracing solution that replaces standard X-Bracing in one or both sidewalls with Portal Frames. Portal Frames are options where a desired clear height or clear width must be met in a sidewall bay. Due to their inherent flexibility and greater mass, Portal Frames are a more expensive longitudinal Bracing option than full height X-Bracing.

The below guidelines are intended to provide guidance when utilizing Portal Frames.

1. Provide one bay of bracing for every five bays or 150’-0”, whichever is less.
2. Provide one bay of bracing for every 80’-0” of building width.
3. Building Width ≤ 240’-0”.
4. Low Eave Height ≤ 30’-0”.
5. Use when the required clear height under the bracing is > 10’-0”.
6. Always consider Framed Opening heights when considering Portal Frames, especially vertical lift OVHD.
7. If the required clear height is ≤ 6’-0” from the eave, a full height Portal Frame will be provided.

FIXED BASE CORNER COLUMNS



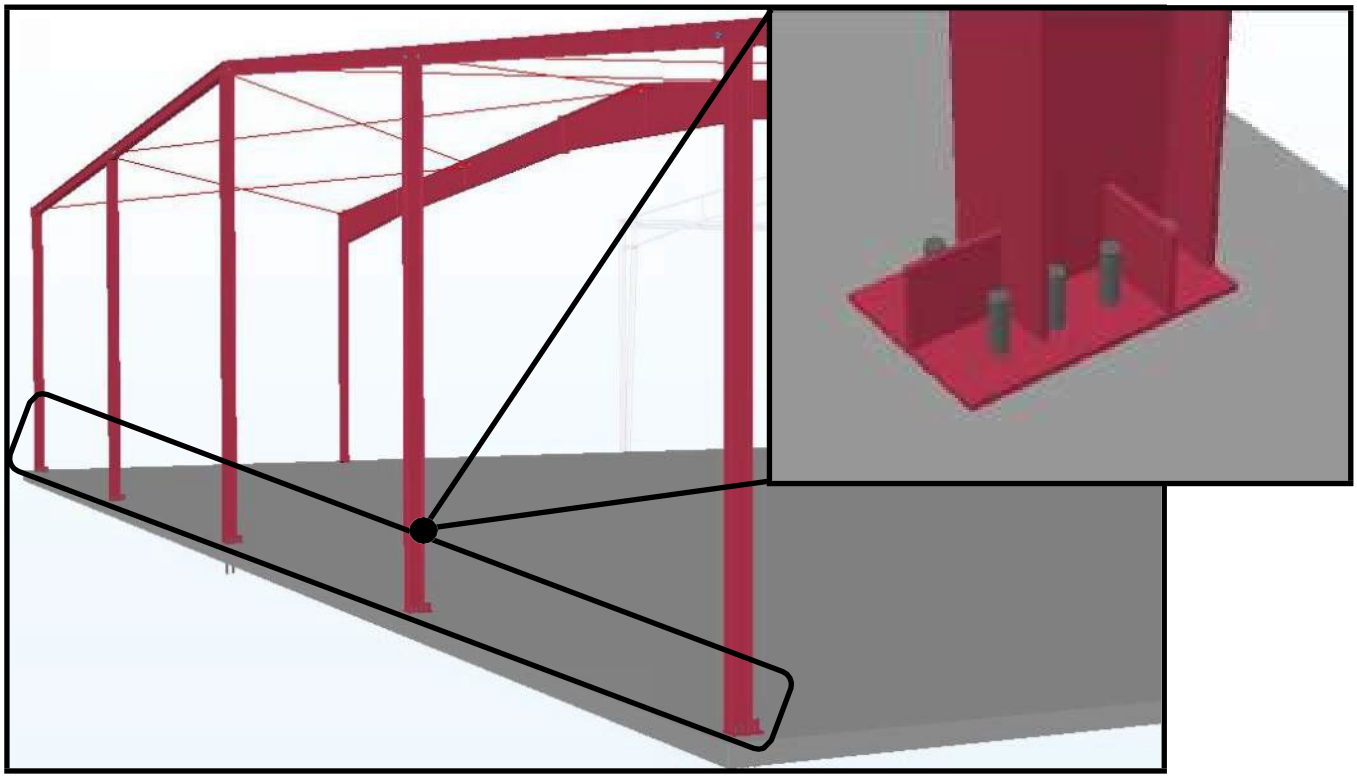
Another option for the longitudinal bracing system is to provide fixity at the Post & Beam Endwall corner column, known as Fixed Base Corner Columns, as shown above. Fixed Base columns act similar to a flag pole and resist longitudinal movement by deflecting and transferring the longitudinal loads to the foundation which resists the resulting axial, shear, and bending moment. Typically, foundations resisting moments are larger and more expensive than foundations supporting axial and shear loads alone.

Due to their inherent flexibility and greater column and foundation mass, Fixed Base Corner Columns are a more expensive longitudinal Bracing option than full height X-Bracing.

The below guidelines are intended to provide guidance when utilizing Fixed Base Corner Columns.

1. Building Width ≤ 100’-0”.
2. Low Eave Height ≤ 18’-0”.
3. Building Roof Slope ≤ 1:12.
4. Requires Post & Beam Endwall Frames at both Left and Right Endwalls.
5. Not recommended for projects with hardwall systems.

FIXED BASE ENDWALL COLUMNS



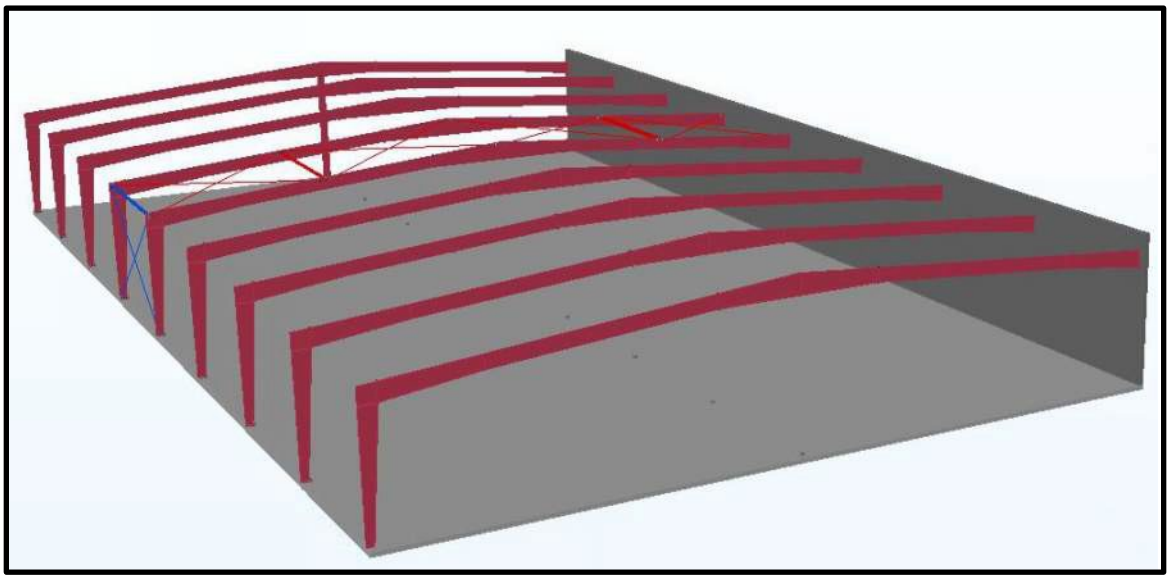
Another extension of Fixed Base Corner Columns, Fixed Base Endwall Columns expand the number of fixed base corner columns from only the Post & Beam corner columns to all endwall Post & Beam columns, as shown above. Fixed Base columns act similar to a flag pole and resist longitudinal movement by deflecting and transferring the longitudinal loads to the foundation which resists the resulting axial, shear, and bending moment. Typically, foundations resisting moments are larger and more expensive than foundations supporting axial and shear loads alone.

Due to their inherent flexibility and greater column and foundation mass, Fixed Base Endwall Columns are a more expensive longitudinal Bracing option than full height X-Bracing.

The below guidelines are intended to provide guidance when utilizing Fixed Base Corner Columns.

1. Building Width ≤ 160’-0”.
2. Low Eave Height ≤ 18’-0”.
3. Building Roof Slope ≤ 1:12.
4. Requires Post & Beam Endwall Frames at both Left and Right Endwalls.
5. Not recommended for projects with hardwall systems.

SHEAR WALLS

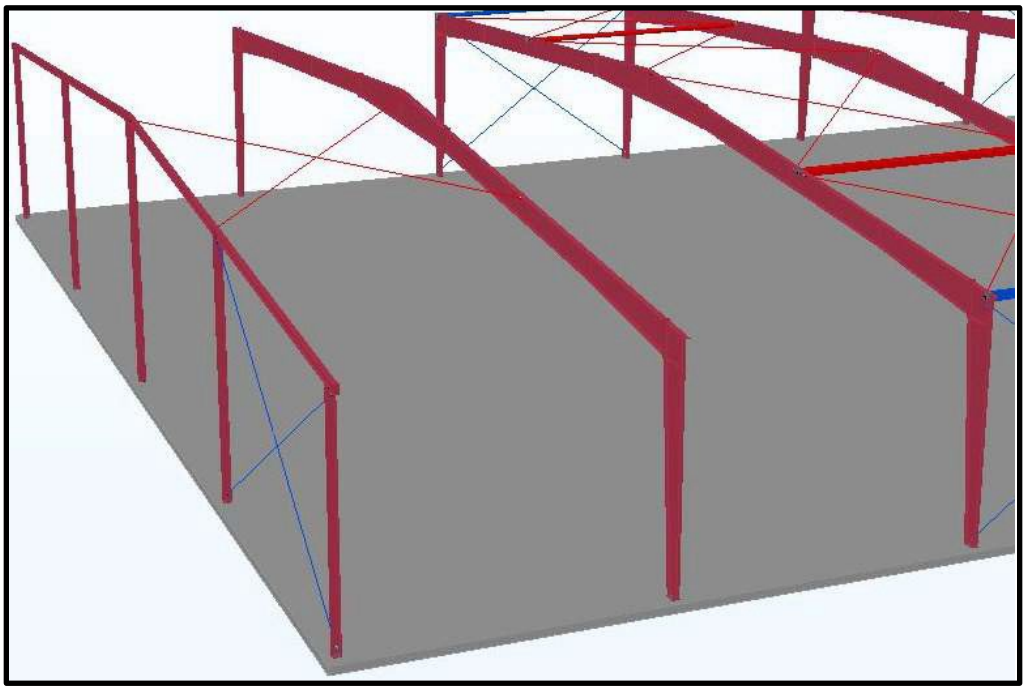


Shear walls are structural members, typically composed of pre-cast or tilt-up concrete wall panels, which are used to resist the building longitudinal forces.

Nucor Building Systems will only assume that full height, load bearing walls will act as shear walls.

STANDARD LATERAL BRACING OPTIONS

Lateral bracing is typically required only at Post & Beam Endwall frames, as Rigid Frames are designed to resist lateral loads.



FULL HEIGHT ENDWALL X-BRACING

Just like full height sidewall X-Bracing is the standard, lowest cost Nucor Building System solution to longitudinal strength and stability, full height endwall X-Bracing serves the same purpose for lateral strength and stability. The below guidelines are intended to provide guidance when utilizing full height endwall X-Bracing.

1. Standard rules of thumb for Full Height Endwall X-Bracing is shown below:
    a. Provide one bay of bracing for every 100’-0” of building width.
2. X-Bracing may be relocated to avoid walk doors by providing partial bay (K-Bracing) based on geometry considerations.

ENDWALL ROOF X-BRACING

When Full Height Endwall X-Bracing is not allowed due to opening or other requirements, the Post & Beam endwall frame can be braced, in the roof plane, back to the first interior Rigid Frame. In this case, the additional loads from the brace members are resisted by the connecting Rigid Frame, which will potentially add to the weight of that frame.

The guidelines for the number of braced bays of Endwall Roof Bracing is the same as for Full Height Endwall X-Bracing shown above.

BRACE DETAIL FOR SIDEWALL WIND COLUMNS

Long bay buildings (bays greater than or equal to 35 feet) typically employ mid-bay Wind Columns in order to reduce the span of sidewall girts. These Wind Columns require additional bracing to brace them back to the adjacent Rigid Frames for stability purposes. Nucor Building Systems uses the following detail in order to transfer the wind or stability forces from the wall to the adjacent main frames.