The design of purlins and girts can have an effect on other structural elements throughout the frame of the structure. For example, if a continuous purlin and girt system is being used then the effect on the first intermediate portal from the gable end wall needs to be considered. Generally the loads on this frame (and reaction loads) will be increased under certain load cases if the portal frame design is being completed as a 2D design, due to the increased first purlin support reaction in a continuous system. If an overall 3D design is completed incorporating purlins and girts then this effect will need to be included in the modelling.

4.4 BRACING SYSTEMS

BRACING PRINCIPLES

Typically steel sheds and garages have a rectangular floor plan and wind loads are effectively resisted in two directions: perpendicular to the ridge line of the building and parallel to it. A portal frame is primarily designed to resist the wall wind loads that are perpendicular to the ridge line along with the majority of roof loads. A bracing system is employed to resist the wall wind loads parallel to the ridge line. This bracing system is just as important as the main portal frame of the structure and must be given appropriate attention by the designer.

Several options are available to the designer when developing an appropriate bracing system, including but not limited to:

- Conventional tension-only cross bracing.
- Moment frames.
- Compression elements.
- Combined compression and tension systems.
- Diaphragm action.

Due to this array of options, a number of general comments regarding bracing system design are outlined as follows. These comments should be considered by the designer during the development of the bracing system employed.

- Justification through calculations (if possible) or testing of the bracing system is required.
- The bracing elements are structural members and need to be checked in accordance with the relevant member checks previously outlined.
- During 3D modelling the designer should be cautious that bracing members do not become overstressed and thus provide greater stiffness to the model than can be justified by the preliminary design.
- If a bracing member is only capable of carrying tensile or compressive loads then it is critical that the modelling of the structure take this restriction on the bracing system's capabilities into account.
- If tensile-only bracing is employed then it is likely that compression struts are being used to carry the force to a connection where this load can then be resisted by tensile members. These struts must be designed to carry these compression loads in combination with any other loads that they are carrying. This is especially important for purlins and girts used in this way.
- If the main portal frame used to resist wall loads perpendicular to the ridge line is incorporated into the bracing system design, it is important that all combined checks be appropriately considered for the main portal frame.
- Adequate connections must be designed for all bracing systems – either through calculations (if possible) or through testing.
- Gable end wall frames are often not designed to resist in-plane wind forces through portal moment action and as such may require a bracing system to be employed. The basis of end wall structural design should be clearly indicated in design documentation.
- Standard additions such as mezzanine floors, lean-tos, open sided walls, etc can all have an impact on the design of an appropriate bracing system. These building features need to be considered where appropriate.
- Similarly to main frame base reactions, bracing base reactions must be transferred appropriately to the foundations which must be designed to resist these loads.

CONTENTS