Considerations in Specifying a Connection for Horizontal Movement

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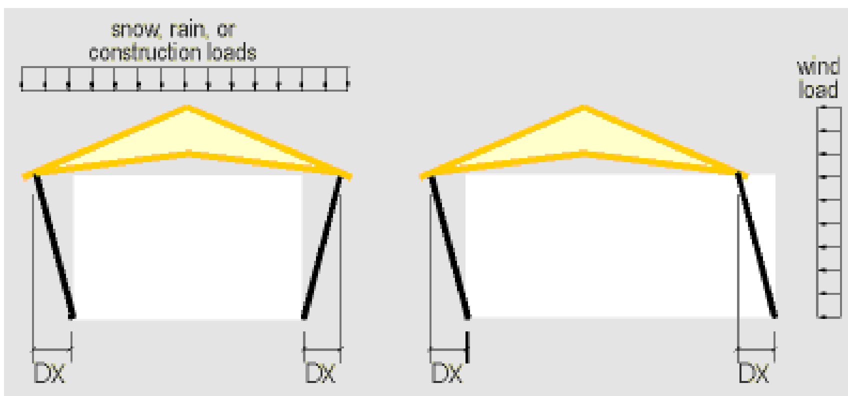
Introduction

There is always the possibility that a solution to a perceived problem brings with it the roots of another problem. The scissors truss clip is one of these solutions. In this short article, the intent is to review the factors relating to the horizontal movement of a structural element, and to review considerations in the design of the overall building for this movement.



Assumptions of Truss Design

Trusses are typically designed for a bearing condition that has a pin type bearing on one end, and a roller bearing on the opposite end. This means that the truss is able to move laterally in response to the load it is supporting. This movement is due to the flexibility of the structure's construction and is a normal response in most residential and light commercial construction.

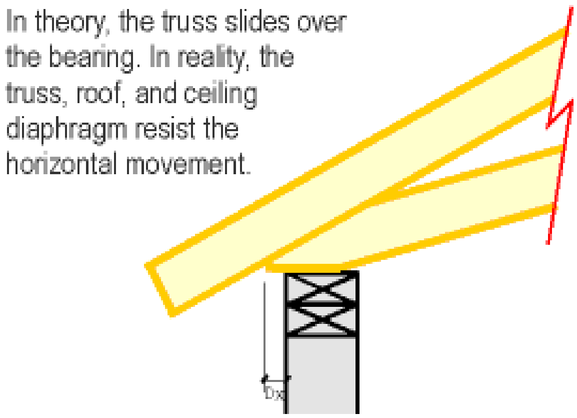
All trusses exhibit horizontal movement at bearings. Scissors trusses produce horizontal movements that vary with span, pitch and loading. Most scissors truss designs include an advisory note about the horizontal movement of the truss. This information is intended to assist the building designer in the evaluation of the overall structure.

Assumptions of Wall Design and Construction

The wall supporting the roof or floor system is designed to resist several loading conditions.

- The side wall supporting the truss is designed to resist lateral load applied to the end wall from wind or earthquakes.
- The wall is designed to resist downward loads from material, construction, or snow.
- The wall is designed to resist uplift loads such as wind loads.
- The wall is designed to resist the lateral loads from such sources as snow drifting or wind.

For lateral loads, the wall is designed on the assumption that it functions as a simply supported beam, with a bearing at each end of the wall. The bottom of the wall is supported by the foundation (or floor diaphragm if the building is a multi-



story) and the top of the wall is supported by the roof diaphragm.

The reaction at the bottom of the wall is transferred to the foundation through mechanical connections such as anchor bolts or light gauge steel connectors. The reaction from the top of the wall is transferred through the truss to the roof diaphragm.

Conflict of Design Assumptions in the Use of a Slotted Truss to Wall Connector

Several proprietary products have been developed and promoted to provide for the horizontal movement of scissors trusses on walls. The horizontal movement is provided by slots in the connector, into which a nail is placed. The nail is intended to be capable of resisting uplift loads, and free to move in the slot of the connector when lateral movement of the truss occurs. The slot in the connector is intended to allow the truss to move, while the wall remains in it's original position.

The conflict of the movement provided by the slot occurs when the building is subjected to wind load. In this load condition, the truss may be in uplift, and the wall is loaded laterally. During this condition, the reaction of the top of the wall would not be transferred to the truss until the wall moved, and the nail in the slot of the connector contacted the metal at the end of the slot. The amount of this movement would depend on the nail location, and the length of the slot. Also, it would be an abrupt, rather than a gradual movement.

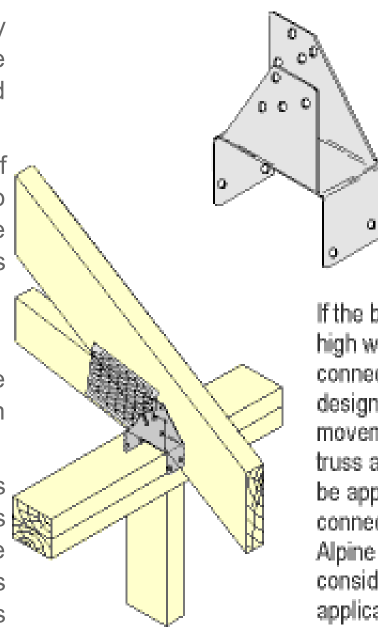
The amount of horizontal movement of the wall under this wind load condition may be unacceptable to the building designer or building owner.

Realities of the Building Design and the Structure's Response to Loads

There is nothing that we can do to escape the fact that trusses (or any other structural element) will move horizontally under load, nor that the wind blows and will place lateral loads onto the wall.

Almost all wall construction is based on the wall being supported by the foundation and a roof or floor diaphragm. In order for the wall to be supported by either means, a solid connection must be provided between the wall and the supporting element.

Based on the building designers' experience with the performance of the completed structure, they may prefer to allow the wall and truss to be positively connected. This is in recognition of the flexibility of the construction of the building, and that a certain amount of movement is acceptable.



If the building is sited in a high wind region, a connector that is designed to allow lateral movement between the truss and wall would not be appropriate. Instead, a connector such as the Alpine HA9 might be considered (above and in application at left).

Historical Performance of Walls and Scissors Trusses

Design considerations that engineers and building designers use are based on the actual performance of materials and connections in response to imposed loads.

The performance of the walls of buildings supporting scissors trusses has been excellent. In most cases, little if any special considerations for connections between wall and truss have been provided for the lateral movement of the wall due to the movement of the truss. This performance is probably due to a combination of factors: Design loads may be higher than the actual loads imposed on the trusses; the roof and ceiling diaphragms provide considerable resistance to lateral deflection; the resistance of the diaphragm is not considered in the deflection calculations of the truss; and the assumption in the truss design that the one end is a roller bearing predicts more movement than will actually occur.

Recommendation

The overall movement of the truss and the wall must be a consideration in the design of the building. If the building is sited in a high wind region, the load from the wall must be transferred into the truss and then into the roof diaphragm. A connector that is designed to allow lateral movement between the truss and the wall would not be appropriate in this application.