6.4 Mechanical, Electrical, and Plumbing Components

6.4.11 Conveyors

6.4.11.1 Conveyors

Material handling conveyors come in all shapes and sizes from the conveyor belt at the grocery store checkout line, the clothing conveyor at the dry cleaner's, assembly line conveyors in clean rooms, airport baggage handling conveyors, to large industrial conveyors. They are used for many purposes, such as shipping, packaging, assembling, and manufacturing. The conveyors may be horizontal, inclined, hinged, straight, curved, spiral, screw, fixed or on wheels. Tall, inclined, or overhead systems may be a falling hazard; systems critical to facility operations may be important for post-earthquake functionality.

Provisions

BUILDING CODE PROVISIONS

Conveyors are subject to the requirements of ASCE/SEI 7-10, *Minimum Design Loads for Buildings and Other Structures,* (ASCE, 2010), Chapter 13, Nonstructural Components

- Conveyors in Seismic Design Categories D, E, and F that weigh 5 pounds or less per linear foot do not required seismic bracing if the component Importance Factor is $I_p = 1.0$.
- Conveyors that are exempt from the anchorage requirements noted above are still required to be positively anchored to the structure. The anchorage need not be designed or detailed on the construction documents. Flexible connections must be provided between the conveyor and associated pipes or conduits or alternate means for protecting the connection must be implemented.

RETROFIT STANDARD PROVISIONS

ASCE/SEI 41-06, *Seismic Rehabilitation of Existing Buildings* (ASCE, 2007) requires compliance with the anchorage provisions of the standard when the performance level is Immediate Occupancy. Conveyors are classified as both force and displacement controlled. The principal objectives are to prevent the component from sliding or overturning. In addition, depending on the configuration, the conveyor must accommodate building displacements if it is connected to multiple levels in the same structure, or is supported by adjacent structures.

Typical Causes of Damage

- Unanchored conveyors may slide and impact other items, tall or inclined conveyors may overturn, overhead conveyors or components may become dislodged and fall. Conveyors not designed for seismic forces may have damage to the component parts and connectors. Unrestrained conveyor motors and related equipment may be damaged and fall.
- Properly anchored conveyors may remain in place but the contents may fall. For tall or overhead conveyors, this could be a falling hazard resulting in injury and damage to materials or merchandise.
- The conveyor may shift and exceed the alignment tolerances and not be functional until repaired or realigned.

DAMAGE EXAMPLES

Figure 6.4.11.1-1 Misalignment between rice storage hopper and conveyor following the 2010 magnitude-8.8 Chile Earthquake (Photo courtesy of Rodrigo Retamales, Rubén Boroschek & Associates). Where various system components interface with a conveyor, the seismic restraints for the various parts should be coordinated to maintain alignment following an earthquake.

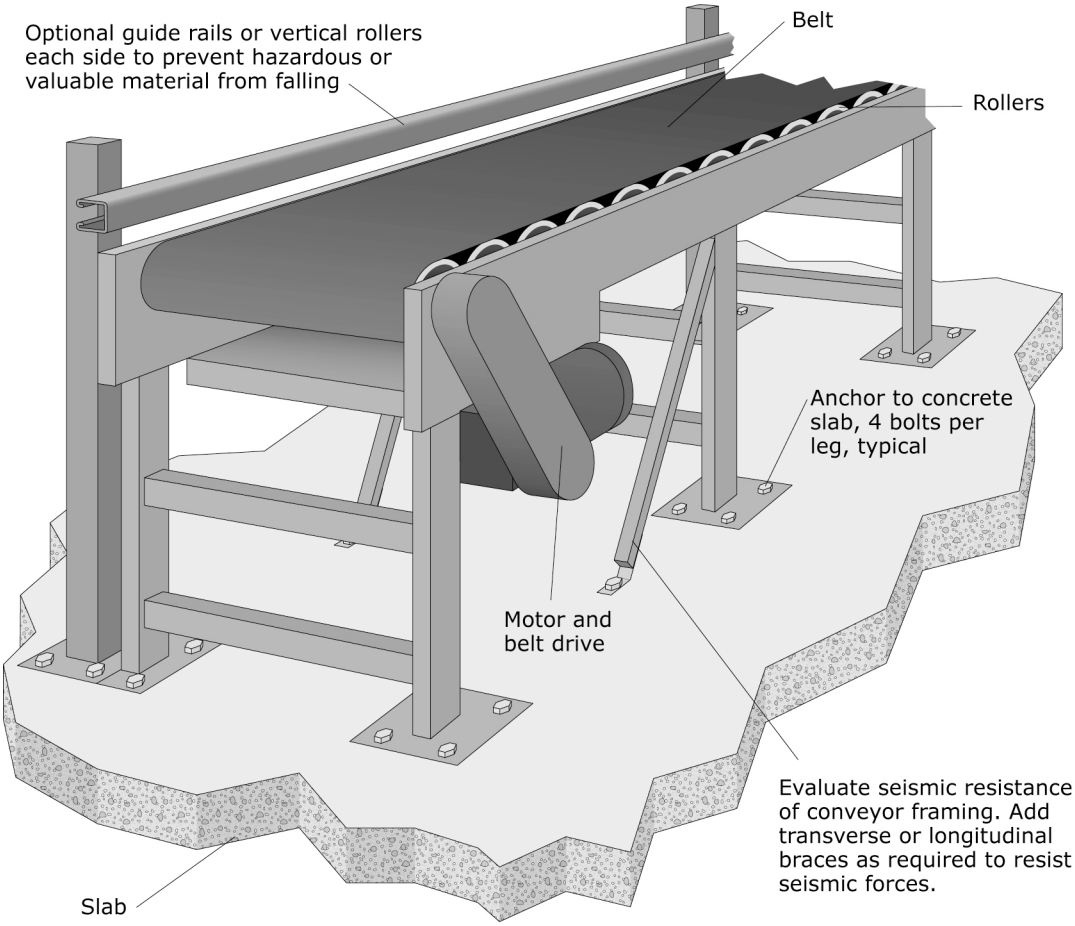
Figure 6.4.11.1-2 Damage to industrial conveyor used to feed grain silos in the 2010 Chile Earthquake (Photo courtesy of Eduardo Fierro, BFP Engineers).

Figure 6.4.11.1-3 Damage to industrial coal conveyor on jetty in southern Peru in the 2001 magnitude-8.4 Peru Earthquake (Photos courtesy of Eduardo Fierro, BFP Engineers). Conveyor was well anchored along entire length but detailing at the seismic joint between the jetty and platform did not allow sufficient movement, resulting in misalignment at end of conveyor and damage to the supports as shown at lower left. Approximately 10% of the rollers fell; these were held in place with friction fittings and did not have positive connections.

Seismic Mitigation Considerations

- Conveyor systems and the associated motors, control systems, and control panels should be restrained or anchored to prevent earthquake damage. If life safety is the primary concern, tall or overhead components should be restrained to reduce falling hazards. If the conveyor is critical to continued operations, or the conveyed materials hazardous or particularly valuable, the system should be engineered to assure continued operations and the safety of the materials. In this case, the anchorage or restraints for interconnecting parts should be coordinated to maintain alignment tolerances following an earthquake.
- There are various conveyor mechanisms including belt driven, chain driven, gravity rollers, chain driven rollers, and flex link conveyors. Conveyors may be supplied with leveling feet which may not be sufficiently robust unless they have been designed for seismic loading. Floor to floor conveyors must be detailed the same as for stairs or escalators and be able to accommodate the anticipated inter-story drift. Where long conveyors are variously suspended, wall-mounted, or floor-mounted, the layout of the supports and restraints should consider the relative motion of the various attachment points. Special detailing is required where conveyors cross building separations or seismic joints.
- Some conveyors come supplied with predrilled base plates at each leg; these should be anchored to the floor slab. Existing conveyor platforms could be strengthened with transverse or longitudinal bracing if they have not been designed for seismic loading; clip angles could be used to anchor the legs to the floor. Check with the manufacturer prior to modifying existing equipment as equipment warranties may be affected.
- Where conveyed materials are hazardous or valuable, it may be prudent to devise guiderails or side restraints of some type to prevent the materials from falling off the conveyor in the event of an earthquake. Such restraints would have to be designed so that they do not to interfere with normal operations.

MITIGATION DETAILS



Note: Seismic restraints should not interfere with normal operations of the conveyor. Check with manufacturer before modifying with additional restraints.

Figure 6.4.11.1-4 Anchorage details for small material handling conveyor (ER).