

Bearing Wall Removal

One way of obtaining an open concept living space in a home is to remove interior walls. This is one of the most common interior renovation projects currently undertaken by homeowners.

There is quite a bit of confusion about the role of these interior walls and it is important to carefully consider the implications of removing walls, even when your Contractor assures you that it's ok. The following information will help to educate you about this type of renovation so that you can protect yourself and make wise decisions.

Types of Load Bearing Walls:

- Wood frame stud walls: Typically made up from 2x4 or 2x6 wood studs spaced at 16" on centre. These walls are commonly used in both interior and exterior walls in houses. (Note that most homes built after 1960 are wood frame construction with either exterior siding or brick veneer.)
- Concrete block (often called Cinderblock) masonry walls: Most commonly used as foundation walls in houses. Still commonly used today.
- Brick masonry walls: Most commonly used as exterior walls in older homes (above grade, double brick), but also commonly used for foundation walls in older homes (below grade, triple brick).
- Cast-in-place concrete walls: Most commonly used as foundation walls in houses.

Interior walls may be load-bearing, meaning that these walls carry vertical loads from above and are required to provide proper support for the floor structure above.

Interior walls may be simple partition walls, meaning that they don't provide support for loads from above but rather, simply serve as a separation wall between rooms.

Interior walls may also be shear-walls, meaning that they act as a diaphragm to provide lateral support for the building structure as a whole, to prevent the building from swaying sideways. Imagine a rectangular house which has windows across the entire front and rear walls and has no interior partitions with provide bracing for the side walls; in this case, the side walls of the house are flat plates with no perpendicular walls to provide rigidity, in which case the house can easily sway sideways under even moderate winds.

How do you identify whether or not a wall is a load bearing wall or a shear-wall?

If a wall directly supports the ends of floor joists sitting on top of a wall, then the wall is clearly a load-bearing wall. However in some cases, the joists are continuous above a wall, and this makes the situation a bit more complicated.

The only way to confirm whether or not the floor joists are discontinuous above the wall and directly supported on top of the wall is to cut a hole in the ceiling and take a look. Your contractor can cut a hole in the ceiling and look inside the ceiling, in order to determine whether the joists are continuous or not.

You will need the services of a structural engineer to determine whether or not a wall is a shear-wall, however in most cases, interior walls in houses are not acting as shear-walls, unless your house is located in an earthquake prone area.

The joists above the wall are continuous...does this mean that the wall is not load-bearing?

Sometimes floor joists are observed to span continuously over top of a wall; in this case, the wall still may be load bearing. The only way to know for sure is to check to see if the overall span of the floor joists is less than or equal to the

maximum allowable floor joists span provided for in the local Building Code. For example, the Ontario Building Code provide that the maximum allowable clear span of a 2"x8" SPF No.1 or No. 2 Grade floor joist @ 16" on centre with mid-span bridging is only 11'-9", so if the span is greater than 11'-9", then the joists are deemed to be over-spanned.

In many older homes which are long and narrow, the main floor (1st floor) joists span the full width of the house but still provide support for a wood stud wall above (often located between a hallway and a living/dining room) and this wall also provides support for the second floor joists which are continuous above the wood stud wall, but over-spanned such that they rely upon the additional support provided by the wood stud wall. We have coined the term "load sharing walls" for this type of wall, since these walls have the effect of tying the continuous main floor joists to the continuous second floor joists above. When one of these walls is removed, the main floor joists receive less load than before, however the 2nd floor joists suffer from the loss of the support wall from below, rendering these joists both overloaded and overly flexible (bouncy).

How can a floor be strengthened to compensate for the removal of a load bearing wall?

If the wall that you want to remove is load bearing, then you will need to do one of the following in order to provide support for the floor above:

1. **Introduce Beams:** A beam (wood or steel) can be designed and installed to replace a load-bearing wall. The new beam should be properly sized by a structural engineer or other competent home designer, and also must be properly supported at each end on properly designed posts and footings, or, on load-bearing support walls.

The new beam can be either "flush" mounted (embedded into the floor cavity above) or "dropped" below the ceiling, leaving a bulkhead.

When the beam needs to be small and compact, then steel is the preferred choice of material. A steel beam will need to have a depth approximately equal to the length of the beam, divided by 24, whereas a wood beam will need to have a depth approximately equal to the length of the beam, divided by 17. These sizes should only be used as a general guideline; the type and grade of lumber, number of plies, and steel flange thicknesses will vary depending upon the actual loads which need to be carried and detailed design of these beams and supporting posts is always needed.

In some situations, a completely open concept is required where even new posts cannot be accommodated within the desired layout. In this situation, it is sometimes possible to support the ends of new beams on transfer beams oriented perpendicular to the new beam so that loads can be transferred to the exterior walls of the home at the level of the beam, and no new posts are required. Note that this sort of arrangement adds extra beams (and therefore extra cost) to the project.

2. **Strengthen Floor Joists:** If floor joists are over-spanned due to the removal of a load-bearing wall, then the joists can be strengthened by doubling or tripling the floor joists to permit them to span the full span distance. Usually this is only done when the original floor joists are continuous and in good condition. One of the difficulties in strengthening floor joists is that, in order to do so, electrical wiring and heating system ducts or pipes often need to be removed and/or relocated, and this can add significant additional cost the project. Where the existing floor joists are continuous and in good condition, it is sometimes also possible to make the existing joists effectively deeper by fastening small strips of wood the bottom of the existing joists so as to make the joists deeper while not having to remove wiring and heating ducts. The new wood strips need to be fastened with a suitable construction adhesive and screws spaced and installed in accordance with the recommendation of a structural engineer. Note, however, that this type of strengthening is not always possible and proper advice from a structural engineer is needed to determine whether or not this type of strengthening is possible.

How is my structure supported?

All building structures must be supported on footings or foundation walls which are designed to carry the weight of the structures above. The basement foundation wall of a house must resist soil pressure from the outside, and also must be

able to support loads from walls, beams, and posts from above. Interior walls of houses are, therefore, sometimes structural insofar as they provide support for floor joists, roof joists, and ceiling joists from above.

How much does it cost to remove a wall and install a new beam?

The cost of removing and disposing of a wall and supplying and installing a new beam will vary tremendously depending upon the size and length of the beam and the ease with which electrical and heating system can be relocated. The only way to fully determine a total cost is to have design drawings prepared by a structural engineer so that you can obtain apples-to-apples quotes from several contractors. Ideally, you should also budget certain fees for electrical, heating, dry walling, painting, and floor repairs. It is also important to remember that new support posts need to be installed and these posts sometimes need to extend all the way to a basement floor where new concrete footings need to be installed; alternatively, new posts can be supported on existing floor beams which may or may not need strengthening to carry the new concentrated point load from the new posts.

Without having any detailed information about your project, we recommend that you budget \$4,000 to \$8,000 per wall which is to be removed.

I want to create an entirely open concept with a full wall of doors and windows at the back of my home...is this possible?

It is possible to create an entire wall of windows and doors, however remember that door and windows are not like walls...they can't be used to support vertical or horizontal loads (horizontal loads are from wind forces and earthquake forces). For this reason, it is often necessary to introduce not only steel beams (to carry vertical loads) but also steel columns which are rigidly connected to steel beams below and above the window and door openings.

Are these steel beams and posts what my engineer called a shear frame?

Yes, a shear frame is designed to frame around an opening but be extremely rigid so as to prevent inter-storey drift between two floor levels. The steel frame is made of steel since it must be very rigid and it is almost impossible to achieve the required rigidity with wood or engineered wood products. The steel shear frame must be fastened very thoroughly to the floor framing both above and below the opening where it is to be provided to be effective.

Is a shear frame expensive?

Sometimes a shear frame can add quite a bit of cost, as much as \$5,000 to \$10,000 to the cost of the house framing, depending upon the size of the opening. Make sure that you have this kind of frame designed by a professional structural engineer and installed by a contractor who is familiar with this sort of construction since the detailing of this frame is important. We also recommend that you have the installation inspected carefully at the time of construction since improper installation will defeat the whole purpose of the frame itself!

Please call us!

If you would like for us to help you with your renovation project, please call us and we can provide a quotation for the preparation of detailed design drawings that you will need to apply for and obtain a building permit from your municipality.



Ken Davis, P. Eng.
Consulting Structural Engineer
President
KH Davis Engineering Consultants Ltd.
KH Davis Construction Ltd.



1468 Danforth Avenue
Toronto, Ontario M4J 1N4
Phone: 416-489-1228
Fax: 416-429-3991
e-mail: mail@khdavis.com
Website: www.khdavis.com