

# Demolition Hazards

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Demolition is a complex activity that involves a variety of serious hazards during the scope of the project. Health and safety precautions are listed in EM-385-1-1 and OSHA 29 CFR 1926 Subpart T. Only qualified workers may perform demolition work. Additional training is required before people may be on the site or perform demolition work.

## Preparing for Demolition

Before starting any demolition or renovation work, a **registered professional engineer (PE)** must perform an engineering survey, develop a demolition/renovation plan and assess how to safely work on previously damaged structures. Demolition contracts, insurance brokers and property owners all require the documented demolition/renovation plan.

A registered PE performs a **structural survey** to assess the structural integrity of the building and its components. If load-bearing structures will be removed or demolished, they must complete an **engineering survey**. The PE will determine the type and condition of the framing, floors and walls to decide how to prevent the premature collapse. The PE may also check adjacent structures for demolition hazards.

The registered PE will create a **demolition or renovation plan** and submit it to the project owner for approval. The plan must include controls or corrective actions for listed hazards. At a minimum, the plan will include:

- Project schedule
- Scope of work
- Work methods
- Equipment
- Key personnel
- Site preparation methods
- Waste management plan, including asbestos-containing materials (ACM) and other regulated materials (ORM)
- Site restoration plan
- Specific requirements, as directed by the project owner

Managers will instruct all workers involved in the demolition/renovation activities about the details of the plan.

If the structure was damaged before demolition begins, the PE will advise the team about shoring or bracing structure components to prevent premature collapse. The PE may decide to perform additional engineering surveys for structural damage caused by fires, floods, explosions or other significant events.

## Preparing: Utility Control

Utility service lines may contain electricity, water, gas, sewage or steam. Engineered drawings (site/utility plans) must show the location of all service lines along with their controls. Shut off, cap or properly control the lines inside and outside the building before demolition begins. If utilities are necessary during demolition, temporarily relocate the lines and isolate them.

Notify controlling utility companies in advance if you plan to shut off, control or reroute their lines. An authorized member of the utility company may be required to shut off or cease service to the building for certain utilities.

The project owner must identify and verify disconnection points and de-energize electric connections and service lines. Workers, including contractors, must confirm proper utility control or de-energization prior to starting their work. Lock out de-energized electric lines. Contractors must follow energy isolation procedures and verify all lockout.

Confirm that chemical fire suppression systems are deactivated and depressurized and that all of the chemical mixture is removed from the system before demolition begins. Submit confirmation to the project owner.

### **Preparing: Hazardous Materials**

Hazardous materials may include:

- Chemicals, including PCBs
- Building materials, such as asbestos
- Gas
- Explosives
- Flammable materials
- Dangerous substances, such as lead-based paint, mercury-containing devices and biological hazards

A qualified person must identify any hazardous materials that are in the structure or stored in any pipes, tanks or other equipment within the structure.

Eliminate or control hazards by following any required local standards and regulations before the work begins. Properly dispose of hazardous materials following regulatory and project owner requirements. Stop the work and notify the project owner if anyone discovers hazardous materials during demolition.

### **Protecting the Site and People**

Protect the demolition site from unauthorized people. Close, relocate or properly protect public areas close enough to be affected by the work. Post warning and restricted access signs where people could attempt to enter the work area.

Protect worker entrances and the area at least 8 feet (2.4 meters) out from the building from falling materials, debris or other hazards by using sidewalk sheds, canopies or both. Sidewalk shed roofs require a minimum of 2-inch-thick planking. Canopies must be at least 2 feet (0.6 meter) wider than the entrance to the building. Both sidewalk sheds and canopies must be able to support loads of at least 150 pounds per square inch (PSI).

Workers may only use dedicated stairs, passages and ladders to access the work area. Cover stairwells at least two floors below the work to protect people from falling debris. Make sure passages are well-lit, clear of obstacles and protected from hazards. Inspect ladders regularly and before each use to make sure they are in good condition.

Each site that has demolition work must have a fire and evacuation plan before any work that involves fire hazards begins. Hot work (such as welding, cutting, brazing, grinding and thawing) requires additional permits and planning. Fire and evacuation plans should include duties, procedures and instructions for fire protection and control. Appropriate fire extinguishers should be fully charged and easy to access throughout the work area and in mobile equipment. Everyone must know what to do during fires or evacuations.

All workers who will be exposed to hazards during demolition must be protected with appropriate controls, including PPE. Workers should perform a hazard analysis to identify the necessary PPE before anyone begins to work. The type of PPE that workers need varies depending on the hazards that may be present. It may include protection for heads, eyes, hearing, hands, feet and breathing. Workers may choose to wear dust masks, even if they are not required. See 29 CFR 1910.134, appendix D for more information. The employer must develop a respiratory protection program if workers must wear respiratory protection. Workers who work at heights may require fall protection in addition to engineering and other controls.

## **During Demolition**

Demolition of floors and exterior walls happens in phases and according to the demolition/renovation plan and risk assessment. The phases often begin at the top of the structure and proceed downward from there. Exceptions include cutting holes in floors for trash and materials and creating storage space.

Control and contain glass breakage and fragmentation hazards in and out of the demolition zone, especially if the structure is near a public area. Protect or remove glazed openings.

Floors and working surfaces must be strong enough to support loaded mechanical equipment. Load handling equipment (LHE) must have a certificate of compliance, inspection documentation, operational load testing information and lift plans. Only use mechanical equipment and LHE as intended by the manufacturer. Operators must be trained and, in some cases, certified to use the equipment. Make sure training records and certifications are up to date.

A competent person must identify hazards during demolition that are caused by removing material, removing support structures or general demolition activities. The demolition and renovation plan identifies competent persons and the frequency of inspections. If the competent person identifies a hazard, work should stop until it is corrected, such as with shoring, bracing and support. Do not return to the area until the competent person verifies that the hazards are controlled.

## **Debris**

Safely removing debris is important to protect workers and the public. Remove debris promptly to prevent trips and falls. To prevent harmful airborne dust, use controls like water misting, temporary screenings, curtains and flame-retardant barriers. Be aware that water misting may increase slip, fall and electrical hazards.

Use **chutes** to quickly remove debris from elevated floors. Chutes must be able to withstand the impact of materials or debris. Ask your supervisor before using chutes if you have questions about their capacity.

Chutes must have guardrails at least 42 in (1.1 m) above the floor or area where workers will stand to dump debris. Secure a toe board or bumper at least 4 in (10 cm) high to the chute opening if people will use equipment to dump materials into a chute. Enclose chutes with angles greater than 45° from horizontal surfaces. Chute opening walls should not be higher than 48 in (1.2 m). Keep chute openings securely closed when no one is using them.

Install a substantial gate at the discharge end of the chute. A trained and designated worker must be at the end of the chute to operate the gate and control backing and loading trucks. Close and secure the area around the discharge end of the chute when no one is using it.

You may remove floor joists from wood floors to create debris storage space only if the joist is no more than one floor above grade and removing the joist and dropping debris will not compromise the stability of the structure. When you are removing floorboards to create chutes, leave wooden floor beams and other support structures that are bracing walls in place until you can replace them with another adequate means of support.

Use bumpers or curbs, also called stop-logs, to prevent equipment, tools and other items from falling over the edge of **floor openings**. Disposal floor openings cannot be longer than 25% of the total floor area unless the lateral supports of the removed flooring remain in place. Shore any floor weakened or damaged by work activities to safely carry its intended loads. Solidly plank floor openings within 10 feet of any wall that people are demolishing. The only exception is if workers are kept out of the area below the opening.

Debris may contain regulated waste, asbestos-containing materials (ACM) or other regulated materials (ORM), depending on the age and use of the building. The project owner must approve of the disposal site. Be prepared to provide documentation that confirms proper disposal, including waste types and quantities.

### **Structural Demolition**

Structural demolition involves physically dismantling a structure by removing structural components. Remove or abate ACM or ORM. Ensure that only the workers tasked with removing ACM and ORM are in the area. Their work must be complete before structural demolition begins. Before a structural demolition, workers may need to remove universal waste, complete a partial demolition to frames and/or do a soft demolition. Structures can be removed whole in some cases.

Removing **walls** can affect the structural integrity of the building. The floor must be able to sustain the weight of collapsed walls. Break large walls into smaller sections and remove debris from the area as you go. Do not work on top of the walls unless you control associated hazards, such as falls, traction and safe access and egress. Do not store debris or other materials in walls.

Support any walls that are higher than 6 ft (1.8 m) with lateral bracing unless they are in good condition and designed to stand without support. Keep the time that walls stand without lateral bracing as short as possible. Remove the stories above load-supporting or structural walls before demolishing them. Leave steel framing in place during the demolition of masonry support. Clear each steel component of masonry debris before proceeding. Remove or brace the earth or structures supported by retaining walls before demolishing them.

Barricade the area below **floors** that workers are removing to prevent access. Place warning signs around the perimeter. Use a plank at least 2 in (5 cm) thick and 10 in (25.4 cm) wide for standing support while breaking down floor sections between beams or joists. The planks must provide safe support if the joists between the beam collapse. The straddle space between planks must be less than 16 in (40.7 cm).

People should not walk on exposed beams. Create walkways made of wood planks that are at least 18 in (45.7 cm) wide and 2 in (5 cm) thick and that overlap by at least 1 ft (0.3 m). Stringers must support the flooring planks, and their ends must be supported by floor beams or girders.

Provide safe planking for workers to stand on if floors or portions of them are gone while they are dismantling the **steel components**. Safely lower structural steel. Do not drop it unless it will fall into a barricaded or fully protected dump zone. Secondary debris can be created from dropping large and heavy structures. Install proper support, such as shoring, on floors before erecting derricks, cranes or other lifting devices. Hook steel components to the center of gravity to prevent swinging during movements, and use tag or guide lines for additional control.

**Other structures** that may be part of demolition work include fences, parking lots, lighting, road access, sidewalks, stairs, utilities, storage tanks and equipment. Determine what chemicals or materials were stored inside tanks and vessels before you remove them. If the contents were hazardous, use appropriate control measures. Dispose of hazardous materials according to state and local jurisdictions, which prohibit using general landfills. Clean, purge and verify that previous feed and discharge lines are disconnected and isolated before any work begins. If workers must enter tanks and vessels, use a permit-required confined space entry program specific to each space that workers must enter.

### **Mechanical Demolition**

Mechanical demolition involves knocking structures down using equipment. Only authorized, necessary workers are allowed in mechanical demolition areas. Mechanical demolition is only allowed when the distance to publicly accessible areas is greater than 1/4 of the height of the structure or when appropriate perimeter protection is in place.

Workers must operate **mechanical equipment** using the manufacturer's instructions. Equipment operators must wear respiratory protection. Equipment booms must be able to extend at least 5 ft (1.5 m) above the structures they are demolishing. Ensure that equipment outriggers are properly leveled on ground that will provide adequate support.

The project owner must approve the use of **swinging demolition balls**. They may be required to obtain additional permits and insurance before use. A competent person must inspect the equipment, including rigging, at least once every shift.

### **Blasting**

Blasting involves strategically placing and detonating explosives to make a structure collapse into itself rather than out. Explosives will vary, depending on a structure's size and age and the blast configuration.

Only a qualified, authorized and licensed person may handle explosives and use them for blasting. Some locations call this person the **certified blaster**. Being a certified blaster on blasting operations requires special training.

Some of the hazards from blasting operations include fragmentation; dust, smoke and fumes; vibrations/shock waves; secondary fires; and loud noise.

Certified blasters must consider where **debris** is projected to fall and land in every direction. Structures must have vacant land in all directions that is equal to at least 75% of their height, unless the certified blaster can demonstrate or prove consistent performance with tighter constraints.

The certified blaster must develop a **plan** that is approved by authorities that have jurisdiction, such as fire marshals or government designated authorities (GDAs).

Demolished smokestacks, silos or similar structures must fall at a 90° angle onto a vacant space that is at least 150% of the height of the structure.

A **blasting mat** is usually made of sliced-up rubber tires that are bound together with ropes, cables or chains. Blast mats help to contain the blast, prevent flying rocks and suppress dust when demolishing bases, foundations, piers, abutments or similar structures.

Every demolition can teach us about safe operations for future projects. Conduct an **after-action review** following the use of explosives to document lessons learned.