

## DEMOLITION CONSTRUCTION SAFETY PROGRAM

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### PURPOSE/SCOPE

Demolition work involves many of the hazards associated with construction. However, demolition incurs additional hazards due to unknown factors such as: deviations from the structure's design introduced during construction, approved or unapproved modifications that altered the original design, materials hidden within structural members, and unknown strengths or weaknesses of construction materials. To counter these unknowns, all personnel involved in a demolition project must be fully aware of these types of hazards and the safety precautions to take to control the hazards.

Although a contractor may be concerned about employee safety, there should also be heightened awareness for the safety of the general public and the property of others. All company employees, contractors and subcontractors must follow the requirements of this program during all demolition projects. This program outlines control measures contractors must implement as part of their existing program to plan for a successful and safe demolition project. Those supervising demolition activities should be familiar with the OSHA 29CFR1926, Subpart T, and all federal, state and local requirements that apply to demolition work.



Demolition is the dismantling, razing, destroying or wrecking of any building or structure or any part thereof. Demolition work involves many of the hazards associated with construction. However, demolition involves additional hazards due to unknown factors which makes demolition work particularly dangerous. These may include:

- Changes from the structure's design introduced during construction;
- Approved or unapproved modifications that altered the original design;
- Materials hidden within structural members, such as lead, asbestos, silica, and other chemicals or heavy metals requiring special material handling;
- Unknown strengths or weaknesses of construction materials, such as post-tensioned concrete;
- Hazards created by the demolition methods used.

To combat these, everyone at a demolition worksite must be fully aware of the hazards they may encounter and the safety precautions they must take to protect themselves and their employees.

### BUILDING DEMOLITION



Building demolition is achieved by a variety of means and methods, using many kinds of equipment and tools. Demolition experts can recommend which methods are appropriate for particular projects. For simplicity, demolition methods can be grouped under the categories of mechanical, implosion, and special.

#### MECHANICAL DEMOLITION

The most widely used method of building demolition today involves the use of various specialized mechanized equipment and tools. While the crane and wrecking ball have long been the symbol of large, high-rise demolition projects,

demolition contractors employ a variety of high-reach excavators equipped with tools for crushing concrete and shearing steel at heights up to 120 feet. These machines can operate in confined work areas and can separate the building materials as they “chew” the building apart. In the last twenty years, effective remote-controlled machines have been developed that can be used in hazardous environments, confined spaces, areas that have been damaged or are structurally weakened, and areas that are sensitive to noise or vibration. These machines are also being used for selective demolition in radioactive environments.

### **IMPLOSION**

Implosion methods are very effective for bringing down high structures that would be difficult to reach with equipment or too expensive to demolish one floor at a time. These methods use highly specialized explosives to undermine the supports of a structure so it collapses either within its own footprint or in a predetermined path. The implosion process is especially suited for high-rise buildings (usually more than twelve stories) and a variety of special structures (e.g., cooling towers, nuclear reactor containments, space launch towers, smokestacks, boilers, steel mill furnaces, and so on). Common explosives—usually various forms of dynamite and ammonium nitrate—are frequently used to blast heavy concrete such as that in bridge piers and machinery foundations. Only a handful of companies are qualified in this demolition method, and they almost always work as a subcontractor to a conventional demolition contractor.

### **SPECIAL DEMOLITION**

Certain types of demolition require specialized handheld tools for cutting, chipping, drilling, and breaking small amounts of materials (e.g., removing concrete for a new door in an active hospital, cutting and removing a specified pipe in a rack containing piping that is in use, removing a terra-cotta arch for reinstallation, etc.). The tools for these tasks are mostly powered by hydraulic or pneumatic systems and can usually be moved by two men. Special demolition projects are various. A typical project might require the contractor to remove partitions and suspended ceilings in a building area that is partially occupied, or cut new openings in concrete walls and floors for mechanical chases and doorways. Another special demolition type is careful removal of significant historic fabric in existing buildings. Often this is required when building systems are upgraded but the historic fabric (e.g., terra-cotta, windows, carved moldings, etc.) must appear to have been undisturbed afterwards. This process requires documentation prior to demolition and proper removal, cataloging, and storage of the historic building fabric.

### **HAZARDS**

Employers must plan ahead to get the job done safely. Proper planning is essential to ensure a demolition operation is conducted with no accidents or injuries. This includes, but is not limited to:

- An engineering survey completed by a competent person before any demolition work takes place. This should include the condition of the structure and the possibility of an unplanned collapse.
- Locating, securing, and/or relocating any nearby utilities.
- Fire prevention and evacuation plan.
- First Aid and Emergency Medical Services.
- An assessment of health hazards completed before any demolition work takes place.

Employers must provide the right protection and equipment. The employer must determine what Personal Protective Equipment (PPE) will be required. In demolition operations, PPE may include:

- Eye, face, head, hand, foot protection
- Respiratory protection
- Hearing protection
- Personal Fall Arrest Systems (PFAS)
- Other protective clothing (for example, cutting or welding operations)

It is not enough to provide PPE. Employees must be trained on the selection, use, fitting, inspection, maintenance, and storage of PPE.

Employers must train all employees about hazards and how to use the equipment safely. Under the Occupational Safety and Health Act (OSH Act), Public Law 91-596, employers have a responsibility to provide a safe workplace for employees. Employers must instruct employees how to recognize and avoid or remove hazards that may cause an injury or illness based on their assigned duties. Certain OSHA construction standards require that employees receive training in specific topics. *Employers must provide this safety training in a language and vocabulary their workers can understand.*

## OSHA STANDARDS

Demolition work involves many of the hazards associated with construction; therefore, all of 29 CFR Part 1926 – Construction Standards apply at a demolition site. However, demolition involves additional hazards due to unknown hazards, which makes demolition work particularly dangerous. For this reason, OSHA created the Subpart T – Demolition standards specifically for these operations.

### WHICH DEMOLITION STANDARD IS THE MOST FREQUENTLY CITED?

1926.850(a) – Preparatory operations. This standard accounts for up to three-fourths of the citations on a demolition worksite. 1926.850(a)(1), which requires an "engineering survey" to be completed prior to starting demolition, accounts for more than half these preparatory operations citations.

#### Primary Demolition Standards (29 CFR 1926)

- 1926 Subpart T, Demolition.
- 1926.850, Preparatory operations.
- 1926.851, Stairs, passageways, and ladders.
- 1926.852, Chutes.
- 1926.853, Removal of materials through floor openings.
- 1926.854, Removal of walls, masonry sections, and chimneys.
- 1926.855, Manual removal of floors.
- 1926.856, Removal of walls, floors, and material with equipment.
- 1926.857, Storage.
- 1926.858, Removal of steel construction.
- 1926.859, Mechanical demolition.
- 1926.860, Selective demolition by explosives.

## ENGINEERING SURVEY REPORT

Winger, or the client shall prepare specific documentation that records the Engineering Survey results. The Engineering Survey Report shall be signed and dated by the person conducting the survey. At a minimum, the Engineering Survey Report must include:

- Building characteristics.
  - Construction type & structure size
  - Number of stories or height
  - Structural hazards
  - Basements & confined spaces
  - Party wall locations

- Wall tie requirements & number
- Shoring requirements for adjacent structures
- Type of shoring & location
- Protection requirements for adjacent structures.
- Demolition methods that will be used.
- Public protection required.
  - Pedestrian walkways or roadways that may need to be relocated.
  - Walkways or roadways should be well lit & kept clear of equipment & debris.
  - Sidewalk sheds may be necessary to protect pedestrians from overhead hazards.
  - Special controls or procedures may be necessary if a portion of the structure is occupied.
  - If the project is entirely protected with security fencing, the gates should be kept closed at all times throughout the demolition work.
- Overhead & underground utility protection is required.
  - The location of all electric, gas, water, sewer & communications lines should be identified & the lines shut off before work is started.
  - The National Association of Demolition Contractors recommends that utility lines be color-coded: Red, if the lines are to stay. Green, if the lines are to be removed.
  - The local one-call system should be notified.
- Above & Below-ground tanks should be protected.
  - Purging & testing of these tanks should be completed.
  - Locations of pits or open holes should be identified and barricaded.
  - EPA requirements must be identified & complied with.
- If hazardous materials are found, responsibilities should be assigned to the appropriate contractor(s) for removal & disposal of the materials.
  - Asbestos & other materials may be in furnaces, reactors, boilers, insulation, other fire protection materials, certain types of floors and ceiling tiles.
  - Lead may be in pipe systems & with lead-based paints.
  - Polychlorinated biphenyls may be in electrical systems such as transformers & capacitors.
- Existing damage to nearby structures.
  - This damage should be documented. Photographs and/or videotape can be taken to supplement documentation.
  - The documentation should be dated & retained with the Engineering Survey Report.
- Blasting. If the use of explosives is required for the demolition project, the Competent Person must be familiar with the OSHA standard 29CFR1926, Subpart U, blasting safety requirements.

## **SAFE WORK PLAN**

The Safe Work Plan identifies and plans specific safe work procedures and practices and safety equipment that should be in place when demolition activities begin. The Safe Work Plan should be tailored to the specific demolition job tasks being undertaken.

### **ITEMS THAT MUST BE COVERED IN THE SAFE WORK PLAN INCLUDE:**

- Confirmation that the Engineering Survey Report is read by jobsite supervisory personnel and reviewed by craft personnel.
- Notification of medical personnel, fire department, utility companies & local authorities that their services are required for the demolition.
- Posting of emergency telephone numbers for all these services at all telephone locations.
- A comprehensive plan for confined space work and other identified hazards & exposures.
- Appropriate personal protective equipment (PPE) is available on-site.

- Securing the project site perimeter & posting of warning signs.
- Fire prevention & protection:
  - Fire can be a serious threat at demolition sites, potential sources of ignition should be identified.
  - The Fire Department must be able to gain access to any part of the jobsite, as well as fire hydrants.
  - Ample supplies of portable fire extinguishers must be available.
  - Restrict smoking, open flames and spark producing operations to specific, safe areas.
  - A fire warning system must be in place so that personnel can be quickly notified and evacuated in the event of a fire.

## DEMOLITION AND CLEANUP

Before commencing demolition work:

- Ensure approval has been granted from the owner to proceed and the owner has provided a report of any asbestos containing materials.
- Barricade area to prevent unauthorized persons to enter the work area. Barricades should be placed a minimum of 6 feet away from the work area.
- Review existing plans (if available) to identify structural systems. If plans are not available consult a structural engineer.
- Identify the plant and equipment to be used, safe means of access and egress to the site and adjoining buildings and any possible environmental impacts from the demolition process.
- Locating and disconnecting utilities such as gas, water, electrical, steam, and sewer is a vital step of demolition.
- When applicable, proper lockout/tagout must be performed before the start of any demolition.

Before doing demolition work also inspect available personal protective equipment (PPE), and select, wear and use the PPE appropriate for the task. Demolition work involves many of the same hazards associated with construction work. However, demolition also poses additional hazards due to unknown factors such as:

- Deviations from the structure's original design;
- Approved or unapproved modifications that altered the original design;
- Materials hidden within structural members; and
- Unknown strengths or weaknesses of damaged materials.

To counter these unknowns, all personnel involved in a demolition project need to be fully aware of these types of hazards and the safety precautions available to control these hazards.

### OTHER PRELIMINARY TASKS

- A written engineering survey must be performed on each structure being considered for demolition to determine the condition of the framing, floors and walls, and to assess the possibility of an unplanned collapse of any portion of the structure.
- Brace or shore the walls and floors of structures which have been damaged and which employees must enter.
- Inspect and maintain all stairs, passageways and ladders.
- Properly illuminate all stairways.
- Shut off or cap all electric, gas, water, steam, sewer and other service lines outside the building line. Notify appropriate utility companies.
- Temporarily relocate and/or protect any essential power, water, or other utilities.
- Determine the types of hazardous chemicals, gases, explosives, and flammable materials which have been used in any pipes, tanks, or other equipment on the property.
- Test and purge the hazardous chemicals, gases, explosives, or flammable materials.

- Survey for asbestos or other hazardous materials.
- For areas where engineering controls are not provided, such as open holes, guardrails uninstalled or removed, etc., 100% fall protection must be utilized at all times.
- Guard wall openings to a height of 42 inches.
- Cover and secure floor openings with material able to withstand the loads likely to be imposed.
- Debris dropped through holes in the floor without the use of chutes must be completely enclosed with barricades not less than 42 inches high and not less than 6 feet back from the projected edge of the opening above.
- Floor openings used for material disposal must not be more than 25% of the total floor area.
- When not being utilized, floor or wall openings must be hard barricaded.
- Use enclosed chutes with gates on the discharge end to drop material to the ground.
- Design and construct chutes that will withstand the loads likely to be imposed without failing.
- Post signs at each level of structures, warning of the hazard of falling materials.
- Protect entrances to multi-story structures with sidewalk sheds or canopies for a minimum of 8 feet.
- Canopies must be at least 2 feet wider than the structure entrance and be able to hold a load of 150 lbs./sq. ft.
- Storage of material and debris must not exceed the allowable floor load.

### **WORK PROGRESSION**

- Except for cutting holes in the floors for chutes, holes to drop materials through, preparation of storage space & similar preparatory work, the demolition of floors and exterior walls shall begin at the top of the structure and proceed downward.
- Each story of exterior wall & floor construction shall be removed & dropped into the storage space before commencing the removal of exterior walls & floors in the next story below.
- Hazards to anyone from the fragmentation of glass shall be controlled.
- Mechanical equipment shall not be used on floors on working surfaces unless such floors or surfaces are of sufficient strength to support the imposed load.
- Employee entrances to multistory structures being demolished shall be protected by sidewalk sheds, canopies or both.
- Protection shall be provided from the face of the building for a minimum of eight (8) feet.
- All such canopies shall be at least two (2) feet wider than the building entrances or openings and shall be capable of sustaining a load of 150 psi.
- Only those stairways, passageways & ladders designated as means of access to the structure shall be used.
- The designated means of access shall be indicated on the demolition plan.
- Other access ways shall be indicated as Not Safe for Access & closed at ALL times.
- The stairwell shall be covered at a point no less than two (2) floors below the floor on which work is being performed.
- Access to a floor where work is in progress shall be through a separate lighted, protected passageway.
- During demolition, continuing documented inspections by a competent person shall detect hazards resulting from weakened or deteriorated floors, walls, or loosened material.
- NO employee shall be permitted to work where such hazards exist until they are corrected by shoring, bracing or other means.

### **DEBRIS REMOVAL**

- When the debris is dropped through openings in the floors without chutes, the openings and the area onto which the material is dropped shall be enclosed with barricades not less than 42 inches high and not less than six (6) feet back from the projected edge of the opening above.

- Signs warning of the hazard of falling materials shall be posted at EACH SIDE of the debris opening at each floor level.
- Debris removal shall not be permitted in lower areas until debris handling ceases on the floors above.
- The openings shall not exceed 48 inches in height measured along the wall of the chute.
- Such openings, when not in use, shall be kept closed at all floors below the top floor.
- A competent employee shall be assigned to control the operation of the gate, and the backing & loading of trucks.
- The storage of waste & debris on any floor shall not exceed the allowable floor load.
- In buildings having wood floor construction, the floor joists may be removed from not more than one floor above grade to provide storage space for debris, provided falling material is not permitted to endanger the stability of the structure.
- When wood floor beams serve to brace interior walls or free-standing exterior walls, such beams can be left in place until other support can be installed to replace them.
- Floor arches, to an elevation of not more than 25 feet above grade, may be removed to provide storage area for debris provided such removal does not endanger the stability of the structure.
- Storage space to which material is dumped shall be blocked off, except for openings for the removal of materials, and such openings shall be kept closed when material is not being removed.
- Floor openings shall have curbs or stop-logs to prevent equipment from running over the edge.
- Any opening cut in the floor for the disposal of materials shall be no longer than in size than 25% of the aggregate total floor area, unless lateral supports of the removed flooring remain in place.
- Floors weakened or otherwise made unsafe by demolition shall be shored to carry safely the intended imposed load for demolition.

#### **DISPOSAL CHUTES**

Disposal chutes are inclined channels or passages for disposing of scrap material from upper levels of buildings that are under construction, renovation or demolition. The bottom of the chute is usually positioned directly above a waste dumpster.

- Use a disposal chute any time you are dropping materials more than 20 feet to a point outside a building.
- Barricade the area underneath floor openings that are not equipped with chutes whenever you have to drop materials through the openings to a lower level.
- Barricades should be at least 6 feet from the edges of the opening above and at least 42 inches high.
- Post signs on all sides of access to warn others about the overhead falling materials.
- All material chutes, and sections that are at an angle of more than 45 degrees from the horizontal shall be enclosed, except for openings equipped with closures at or about floor level for the insertion of materials.
- Any chute opening into which debris is dumped shall be protected by a guardrail 42 inches above the floor or other surface on which personnel stand to dump the material. This also applies to any space between the chute & the edge of openings in the floors through which the debris will pass.
- A substantial gate shall be installed in each chute at or near the discharge end.
- When operations are not in progress, the area surrounding the discharge end of a chute shall be closed.
- Where material is dumped from mechanical equipment or wheelbarrows, a toeboard or bumper, not less than 4 inches thick and 6 inches high, shall be attached at each chute opening.
- Chutes shall be designed & constructed of such strength as to eliminate failure due to impact of materials & debris loaded therein.

#### **REMOVING WALLS AND MASONRY SECTIONS**

- Demolition of exterior walls and floors must begin at the top of the structure and proceed downward.
- Masonry walls must not be permitted to fall on the floors of a building in masses that would exceed the safe carrying capacities of the floors.

- No wall section, one story in height or higher, shall be permitted to stand alone without lateral bracing, unless such a wall was originally designed and constructed to stand without such lateral support, and is safe enough to be self-supporting.
- All walls must be left in a stable condition at the end of each work shift.
- Employees shall not work on the top of a wall when weather conditions create a hazard.
- Structural or load-supporting members on any floor must not be cut or removed until all stories above such a floor have been removed.
- In buildings of “skeleton-steel” construction, the steel framing may be left in place during the demolition of masonry.
- Walkways or ladders must be provided to enable workers to safely reach or leave any scaffold or wall.
- Walls, which serve as retaining walls to support earth or adjoining structures, must not be demolished until the supporting earth has been properly braced or until adjoining structures have been properly underpinned.
- Walls, which will serve as retaining walls against which debris will be piled, must not be used unless they are capable of supporting the imposed load.
- Dismantle steel construction column length by column length, and tier by tier.

### MECHANICAL DEMOLITION (MOST COMMON)



- No workers shall be permitted in any area when using a crane’s headache ball or clamshell to remove debris.
- Only those workers necessary to perform such operations must be permitted in this work area at any time.
- The weight of the demolition ball must not exceed 50 percent of the crane’s rated load.
- Company policy requires any Winger Companies, herein referred to as Winger, employee performing a lift with a crane to use the Winger Crane Pre-Lift Permit.
- The crane boom and loadline must be as short as possible.
- The ball must be attached to the loadline with a swivel-type connection to prevent twisting of the loadline, and it must be attached by positive means in such a manner that the weight cannot become accidentally disconnected.
- When pulling over walls or portions thereof, all steel members affected must have previously been cut free.
- All roof cornices or other such ornamental stonework must be removed prior to pulling walls over.
- During demolition, continuing inspections by a competent person shall be made as the work progresses to detect hazards resulting from weakened or deteriorated floors, or walls, or loosened material.
- No employee shall be permitted to work where such hazards exist until they are corrected by shoring, bracing, or other effective means.

### DEMOLITION SAFETY REQUIREMENTS

All contractors adhere to safe work practices. Before beginning any demolition work, an Engineering Survey Report is required. Once demolition work has started, there will be additional safety requirements for various activities. A Competent Person is required to conduct the Engineering Survey prior to beginning any demolition work. The purpose of the Engineering Survey is to thoroughly evaluate the project to identify potential hazards and develop controls to prevent accidents. Potential hazards include:

- Occupational Health Hazards.
- Cave-ins.
- Explosions.
- Premature Collapse.
- Fire.

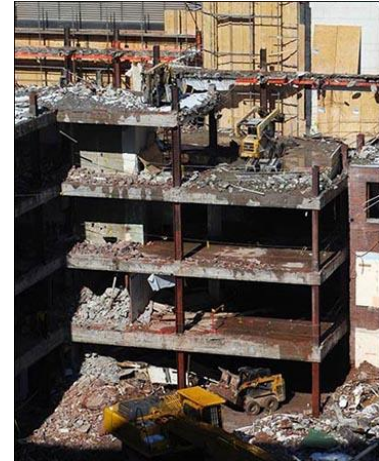


Contractors must have **written evidence** that an Engineering Survey was conducted and retain that report on-site. For contractors that perform demolition work on an infrequent basis, it is recommended that a Safety Consultant's services be contracted for the demolition work. All personnel involved in demolition work should be briefed on the ANSI A10.6. Safety Requirements for Demolition.

### DEMOLITION SAFETY TIPS

Demolition work involves many of the same hazards that arise during other construction activities. However, demolition also involves additional hazards due to a variety of other factors. Some of these include: lead-based paint, sharp or protruding objects and asbestos-containing material.

- Brace or shore up the walls and floors of structures which have been damaged and which employees must enter.
- Inspect personal protective equipment (PPE) before use.
- Select, wear and use appropriate PPE for the task.
- Inspect all stairs, passageways, and ladders; illuminate all stairways.
- Shut off or cap all electric, gas, water, steam, sewer, and other service lines; notify appropriate utility companies.
- Guard wall openings to a height of 42 inches; cover and secure floor openings with material able to withstand the loads likely to be imposed.
- Floor openings used for material disposal must not be more than 25% of the total floor area.
- Use enclosed chutes with gates on the discharge end to drop demolition material to the ground or into debris containers.
- Demolition of exterior walls and floors must begin at the top of the structure and proceed downward.
- Structural or load-supporting members on any floor must not be cut or removed until all stories above that floor have been removed.
- All roof cornices or other ornamental stonework must be removed prior to pulling walls down.
- Employees must not be permitted to work where structural collapse hazards exist until they are corrected by shoring, bracing, or other effective means.



### ADDITIONAL RESOURCES

- **Environmental Protection Agency (EPA):**
  - Construction & Demolition Materials
  - RCRA in Focus - Construction, Demolition, and Renovation (PDF).
  - The Asbestos Hazard Emergency Response Act (AHERA)
  - Asbestos National Emission Standard for Hazardous Air Pollutants (NESHAP) Regulations (40 CFR Part 61, Subpart M)
  - On the Road to Reuse: Residential Demolition Bid Specification Development Tool 40 CFR 61.145 - Standard for demolition and renovation (PDF).
- **Federal Emergency Management Agency (FEMA):**
  - 9523.4 - Demolition of Private Structures
  - Health and Human Services - National Institute for Occupational Safety and Health (NIOSH): Lead Poisoning in the Demolition of bridges and other steel structures. Publication Number 91-116a.
  - NIOSH Guide to the Selection and Use of Particulate Respirators
- **United States Army Corps of Engineers (USACE):**
  - Safety and Health Requirements Manual. EM 385-1-1, 15 September 2008.

- Chapter 23 - Demolition.
- Appendix A - Minimum Basic Outline for Accident Prevention Plans. Example Checklist (PDF) from USACE Galveston District.
- **Industry Links**
  - *NDA - National Demolition Association (United States).*
  - *Construction and Demolition Recycling.*
  - *NFDC - National Federation of Demolition Contractors (United Kingdom).*
  - *IDC - Institute of Demolition Engineers (United Kingdom).*
- **Miscellaneous**
  - *Demolition Planning (PDF). Excerpt from *The Architect's Handbook of Professional Practice*, (2006).*

## **SOURCE CREDITS**

U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), CFR §1926 Subpart T, [www.osha.gov](http://www.osha.gov)

Safety Info, An OSHA Compliance Resource, <https://www.safetyinfo.com/guest-library/materials/written-safety-programs/demolition-construction-safety-program>

Demolition Planning (PDF). Excerpt from *The Architect's Handbook of Professional Practice*, (2006).

## **DOCUMENT CONTROL:**

Initial Program September 1, 2015

Revised October 19, 2016

Revised September 13, 2017

Revised April 3, 2018