A

Seminar report

On

DEMOLITION OF BUILDING

Submitted in partial fulfillment of the requirement for the award of degree
Of Civil

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Preface

I have made this report file on the topic **DEMOLITION OF BUILDING;** I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to ……..who assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

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INTRODUCTION

We know every structure is designed for a life period. The existence of the structure after the service life period is very dangerous to its occupants and surrounding buildings .The building act usually contains provisions that enable local authorities to control demolition works for the protection of public safety and to ensure adjoining premises and the site are made good on completion of the demolition. A notice of conditions is issued that require certain works to be undertaken to achieve these aims. Where demolition of a building takes place, the owner must inform the council. Greenhouses, conservatories, prefabricated garages and sheds do not require permission to be demolished. Usually if the building to be demolished has a volume of less than 1750 cubic feet (49.56 cubic meters), then permission is not required to knock it down.

DEMOLITION

Demolition is the process of tearing down or falling down of a building after its life period with the help of some equipments or any other method. When explosives are used for this then the demolition process are called as an implosion. Every civil engineering structure is designed for a life period. After that the existence of a structure is very dangerous. So removal of such structures with proper safety measures has got great importance. There are different steps involved before and during the time of a demolition activity. They are described as follows.

STEPS BEFORE DEMOLITION

The different steps before the execution of a demolition process are:

1. Surveying
2. Removal of hazardous materials
3. Preparation of plan
4. Stability report
5. Safety measures

Surveying

Surveying means study of different parameters of the structure and its surroundings. There are two types of surveying are mainly conducted. They are

A. Building surveying

B. Structural surveying

A. Building surveying

It includes,

(a) Record Drawings

Prior to the Building Survey, the existing record plan, including layout plan showing adjoining properties, pedestrian walkway, roads and street, etc. shall be retrieved.

(b) Survey Items

The Building Survey shall cover the following:

(1) The construction materials;

(2) The existing use and, if possible, the past uses of the building prior to demolition;

(3) The presence of wastewater, hazardous materials, matters arising from toxic chemicals, flammable or explosive and radioactive materials, etc. and possible presence of materials which can contribute to air pollution and soil contamination;

(4) Potential dangerous areas, e.g., abnormal layouts, presence of enclosed voids, and non-ventilated light wells which may trap obnoxious gas at the bottom;

(5) Adjoining properties and site conditions, such as the existence of slope and retaining wall, wall supporting ground, illegal structures, bridges, underground railway and its above ground

structures, including entrances, vent shafts, distribution substations, traction substations, plant rooms, overhead railway structures, surface track sections, overhead cables or guy wires, and other utility Service connections;

(6) Drainage conditions and possible problems on water pollution, flooding and erosion, especially on sloping sites and water receiving bodies;

(7) Shared facilities with adjoining building, including common staircases, party walls, and possible effect on it, such as self-enclosed walls to the adjoining buildings, during demolition;

(8) Hoarding and covered walkway requirements;

(9) Adjoining pedestrian and vehicular traffic conditions;

(10) Available headroom, clear spaces and distance of building from lot boundary which may affect the loading operation and transportation of building debris during demolition;

(11) The sensitivity of neighborhood with respect to noise, dust, vibration and traffic impact.

(12) Available site area to allow on-site sorting of building debris; and

(13) Street furniture such as fire hydrant, parking space/meters, street light, street sign and hawkers' stalls which could be affected by the demolition project.

(c) Hazardous Materials

(1) Unless the Building Survey reviews that no obvious hazardous material is present in the building, the Authorized Person shall cause proper sampling and testing for the hazardous materials;

(2) In the case when hazardous materials e.g., asbestos containing materials, or petroleum, are present, they shall be removed and cleaned/disposed of according to the statutory requirements administered by the Environmental Protection Department, Fire Services Department, Labour Department and any other Government Departments.

(3) In the case when the site has previously been used to store chemicals, and other dangerous goods, soil contamination assessment shall be required at pre-demolition stage and/or post-demolition stage; and

(4) In the case when the site has previously been used to store explosives, special procedures to ensure no explosives remain on site will be required.

B. Structural surveying

(a) Record Drawings

Prior to the Structural Survey, the existing record layout, structural framing plans and structural details shall be studied. The Registered Structural Engineer shall check the presence of unusual detailing that may cause abnormal structural behavior during demolition, e.g., upward anchor of tensile reinforcement in cantilevered structures. If existing record plans are available, these plans shall be used as reference and preferably be brought along with the Structural Survey.

(b) Survey Items

The Structural Survey shall cover the following:

(1) The structural materials used;

(2) The original structural system employed in the design;

(3) The method of construction;

(4) Any dilapidation and degree of deterioration on any structural elements;

(5) The structural conditions of adjoining structures and its shoring which may be affected by the proposed demolition work;

(6) The presence of continuous structures that may be truncated by the demolition;

(7) The structural system and structural conditions of basements, underground tanks or underground vaults;

(8) The presence of exposed bracing or possible presence of covered bracing;

(9) The nature of walls, whether it is block wall, reinforced concrete walls, load bearing walls or partition walls;

(10) Cantilevered structures such as canopies, balconies, or other forms of architectural features; and

(11) Any fixtures to the building such as signboard, sun-shading devices.

(c) Special Structures

The Structural Survey shall review the following:

(1) The correctness of structural information available;

(2) The presence of any unconventional structural elements which may require special attention and well-defined modification procedures;

(3) The possibilities of structural modification to enable efficient demolition traffic during demolition; and

(4) Any limitation on shoring and other temporary supports.

(d) Investigation and Testing

In the case when no structural details are available, the structural survey shall include on site measurement and retrieve any structural framing as much as practicable, performing tests and exposing some key structural elements to facilitate checking on existing structure. This will allow the development of procedures that ensure the stability of the building at all stages during demolition.

Removal of hazardous materials

If hazardous materials, such as asbestos containing materials, petroleum contamination and radioactive contamination, exist in the building, further investigation and removal of such hazardous material or contamination by specialist shall be referenced.

Asbestos Containing Material

Specialists shall be employed to take samples and cause such samples to be tested for asbestos containing material. In the case when asbestos containing material are discovered, specialist contractor shall be employed to remove such asbestos containing material. The asbestos waste should be handled, stored and disposed of as chemical waste in accordance with the Waste Disposal Ordinance and Waste Disposal (Chemical Waste) (General) Regulation.

Soil Contamination Material

In the case when possible soil contamination material is present, specialist shall be employed to prepare soil contamination test proposal and submit such proposal to the Environmental Protection Department for comment. Upon agreement by the Environmental Protection Department, and completion of the tests, a Soil Contamination Assessment shall be submitted to the Environmental Protection Department for acceptance. In the case when remedial works are required, the remedial proposal shall be submitted to the Environmental Protection Department for approval prior to implementation of such remedial works.

Preparation of plan

A Demolition Plan shall include the following:

(1) A plan showing:

(a) The location of the building to be demolished;

(b) A detailed topography of the site and its surrounds together with ground level contours and sections of the slopes and ground supported by the building where appropriate;

(c) Details of ground removal and/or backfilling; and

(d) The distances from the building to be demolished to its adjacent buildings, streets, structures and significant street furniture.

(2) A layout plan of all floors of the building to be demolished, with adequate sections, showing:

(a) The occupancy usage of the floors;

(b) The structural support systems;

(c) Principal materials of construction;

(d) The condition of the building e.g. the degree of deterioration; and

(e) The relationship of the building to be demolished with neighboring properties affected by the demolition, which include all adjoining buildings and unauthorized structures, shared staircases, party walls, truncating continuous frames, slopes, retaining wall, overhead cables, guy wires and underground utility services.

(3) A plan showing the structural arrangement and construction of all unconventional structural elements, such as prestressed concrete structures, precast concrete members, stressed skin structures, steel framed structures, hangers, hanging ties, trusses or Vierendeel girders, deep beams, long span beams (greater than 10m), arches, transfer plates, transfer girders, earth retaining or basement structures, buildings which also act as earth-retaining structures supporting adjacent ground, flat slabs, hollow block ribbed slabs and large cantilevered structures;

(4) A plan showing the procedure for the demolition of the building; detailed sequence of demolishing particular structural members; and the method of demolition to be adopted including the restrictions on the use of any particular type of equipment;

(5) In the case when powered mechanical plants and equipment are used, a plan showing the route of movement of powered mechanical plants and equipment including the method of lifting mechanical plant, where necessary, onto the top floors of the structure; any structural alterations required to

suit the demolition, e.g. temporary strengthening to suit early removal of any ground floor/or cockloft structure to facilitate vehicular movement at ground floor, or strengthening of deteriorated key structural members; and any shoring, temporary supports and/or floor propping required;

(6) A plan showing all precautionary measures for the protection of the public including hoardings, covered walkways, catch platforms, catch fans, scaffolding, protective screens and safety nets;

(7) A plan showing the proposed shoring and precautionary measures for all affected adjacent buildings, slopes, retaining structures and services at each stage of the demolition works;

(8) A plan showing the proposed shoring and temporary support to be provided to the building to be demolished;

(9) A plan or descriptive notes on the proposed methods for handling and disposal of debris including

(a) The permissible temporary accumulation of building debris at upper floors and at ground floor;

(b) Method of handling demolished building debris;

(c) The routing and movement of debris from each floor to on grade holding area prior to leaving the site;

(d) Means of transportation of debris off the site;

(e) Time and frequency of debris disposal off site;

(f) Record scheme on the tonnage of each truck load, truck license plate, driver's name, trip tickets and location of dump site;

(g) The site supervisory personnel responsible for the debris management system; and

(h) A temporary parking layout for mobile machines and trucks, if necessary;

Stability report

According to Building (Administration) Regulation, the Demolition Plan must be accompanied by a Stability Report with supporting calculations. The Stability Report shall include the following parts:

(1) A report on the stability of the building to be demolished during all stages of demolition;

(2) In the case when powered mechanical plants or equipment are used, a report on the stability of the building with supporting calculations to demonstrate that the use of the plants and equipment will not render inadequate the margin of safety of, or cause damage to any building, structure, street, land and services;

(3) In the case when powered mechanical plants or equipment are used, structural calculations for all temporary supports and bracings;
(4) A report on the stability of neighboring buildings, adjoining properties.
(5) In the case when temporary or permanent supports are required to these neighboring buildings, adjoining properties, and party walls, structural calculations for these temporary and permanent supports; and
(6) A report with calculations demonstrating that the demolition work will not render inadequate the margin of safety of, or cause damage to any building, structure, street, land and services.

Safety measures

Training and Communication

Demolition workers, including plant or equipment operators, shall go through proper job safety training and be informed of the potential hazards by attending training sessions as well as on-the-job training. At present, the Construction Industry Training Authority has organized relevant training courses for site supervisors/foremen and plant or equipment operators.

Equipment Maintenance

All equipment shall be tested and examined before use. They shall be properly stored and maintained. The equipment shall be inspected daily and results of the inspection shall be recorded accordingly. A detailed safety instruction shall be provided to cater for specific situations of the project, if necessary.

Electrical Safety

A properly connected power source from a local electric utility supplier or a mobile electricity generator shall be utilized in demolition sites. The safety requirements given in the Factories and Industrial Undertakings (Electricity) Regulations shall be adhered to.

Fire

All flammable goods shall be removed from site unless they are necessary for the works involved. Any remaining flammable goods shall be stored in proper storage facilities. All furniture, timber, doors, etc. shall be removed before any welding work is performed. Fire fighting appliances shall be provided and maintained in working conditions. The Construction Site (Safety) Regulations require the contractor to maintain in good condition and free from defects all fire fighting appliances provided in such construction site.

Occupational Health

The health of workers on site shall be properly protected in accordance with the relevant subsidiary regulations of the Factories and Industrial Undertakings Ordinance and the Occupational Safety and Health Ordinance with particular attention to the following areas:

(A) Exposure to Dust;

(B) Chemical Exposure;

(C) Heat Stress and Ventilation;

(D) Noise Exposure;

(E) Medical and First Aid Facilities;

(F) Sanitation; and

(G) Occupational Diseases.

Emergency Exit Requirements in Demolition Sites

Emergency exits shall be provided during building demolition. In case of any emergency evacuations, the emergency exit will serve as a lifeline for transportation of injured workers. A minimum of one exit route shall be maintained and designated as the emergency exit at all times during the demolition. Adequate lighting and fire extinguishing equipment shall be provided. Emergency exit shall be properly protected, free of obstruction, and properly marked with exit signs or other indications to clearly show the route. All workers shall be informed about the exit route.

Vibration

Demolition work will cause vibration to neighboring buildings or structures to various extents, depending on the method of demolition. The most serious vibration is caused by implosion. The effect of vibration caused by implosion is categorized as follows:-

1. Permanent ground distortion produced by blast-induced gas pressures;
2. Vibratory settlement of foundation materials;
3. Projectile impact (i.e. blast fly rock); and
4. Vibratory cracking from ground vibration or air blast. These effects will have to be dealt with specifically in the method statement for implosion. For other mechanical demolition methods, the vibration effect is usually less than some other construction processes, such as percussive piling and blasting. In some cases, the traffic vibration caused by heavy duty tractors is more significant than that caused by mechanical demolition. In order to identify the actual cause and

effect of vibration, Registered Specialist Contractors (Demolition) are advised to carry out vibration monitoring during demolition. As a general guideline, the peak particle velocities at any adjoining structure shall not exceed 15mm/sec for prolonged vibration caused by mechanical demolition.

Environmental Precautions

The general requirements to minimize environmental impacts from construction sites can also be applied to demolition processes. The following sections contain some of the procedures to be adopted:

(a) Air Pollution

Concrete breaking, handling of debris and hauling process are main sources of dust from building demolition. Dust mitigation measures complying with the Air Pollution Control (Construction Dust). Regulations shall be adopted to minimize dust emissions. Burning of waste shall not be allowed. Diesel fumes generated by mechanical plant or equipment shall be subject to the control of the Air Pollution Control (Smoke) Regulations.

(b) Noise

Noise pollution arising from the demolition works including, but not limited to, the use of specified powered mechanical equipment (SPME), powered mechanical equipment (PME), such as pneumatic breakers, excavators and generators, etc., scaffolding, erection of temporary works, loading and transportation of debris, etc. affects the workers, and the sensitive receivers in the vicinity of the demolition site. Silent type PME shall be used to reduce noise impact as much as practicable. Demolition activity shall not be performed within the restricted hours as established by EPD. Currently under the Noise Control Ordinance, noise from the use of SPME and PME within restricted hours is governed by a Construction Noise Permit (CNP) system.

(c) Water

The discharge of wastewater from demolition sites requires a valid discharge license from the EPD and the application of such a license shall be made under the Water Pollution Control Ordinance (WPCO). Effluent shall be treated to the standards as stipulated in the license before discharge.

(d) Hazardous Materials

If removal of asbestos containing material is needed, an Asbestos Investigation Report (AIR) shall be submitted to EPD. An Asbestos Abatement Plan (AAP) shall be submitted at least

28 days before the asbestos abatement work commences. The asbestos abatement works shall be carried out in accordance with the Air Pollution Control Ordinance (APCO) and the Factories and Industrial Undertakings (Asbestos) Regulations before demolition. Other materials such as LPG cylinders in domestic flats, toxic and corrosive chemicals for industrial undertakings, and any other hazardous materials have to be identified and properly handled and removed prior to the commencement of the demolition of the building. The management of waste must fully comply with the Waste Disposal Ordinance. Additionally, management of waste which is classifiable as a chemical waste must also comply with the Waste Disposal.

METHODS OF DEMOLITION

There are two types of demolition

1. Non explosive demolition
2. Explosive demolition.

Non explosive demolition

It means the demolition of a structure done with some equipment without the use of any explosive. Different equipments used for the demolition activity are

a. Sledge hammer

A sledge hammer, equipment used for removing a stone wall or a single column. It consists of a long stem with a metallic head. It is used to give impacts on the surfaces and that cause the demolition of structure. It cannot be used for removal of large buildings.

Fig 1. Sledge hammer

b. Excavators and Bulldozers

Fig 2. Excavator

Hydraulic excavators may be used to topple one-or two-story buildings by an undermining process. The undermining process means, erode the base or foundation, i.e., dig or excavate beneath the foundation so as to make it collapse. The strategy of excavation is to undermine the building while controlling the manner and direction in which it falls. The demolition project manager will determine where under mining is necessary so that the building is pulled into the desired manner and direction. Safety and cleanup considerations are also taken into account in determining how the building is undermined and ultimately demolished.

Fig 3. Bulldozer

Loaders or bulldozers may also be used to demolish a building. They are typically equipped with “rakes” (thick pieces of steel that could be an I-beam or tube) that are used to ram building wall. Skid loaders and Loaders will also be used to take material out and sort steel.

c. Wrecking balls

Fig 4. Crane with wrecking ball

In case of buildings have greater heights (5 to 6 story) normal excavators and bulldozers are not sufficient. In such cases crane with wrecking balls are used to perform the demolition activity. The wrecking balls are steel balls hanging from a steel rope which is attached to the crane. This method is more effective only for high rise masonry structures because of the uncontrolled backward movement of steel ball after the impact on the wall surface. Now this method not commonly used because of this uncontrolled behavior of wrecking balls.

d. High reach excavators

Fig 5. High reach excavator

High reach demolition excavators are more often used for tall buildings where explosive demolition is not appropriate or not possible. These excavators are used to demolish up to a height of 300 feet. These excavators with some attachments are also provided for some specific purposes. For example excavators with shear attachments are typically used to dismantle steel structural elements. Hydraulic hammers are often used for concrete structures and concrete processing attachments are used to crush concrete to a manageable size, and to removing reinforcing steel.

Explosive demolition

The basic idea of explosive demolition is quite simple. If we remove the support structure of a building at a certain point, the section of the building above the point will fall down on the part of the building below that point. If this upper section is heavy enough, it will collide with the lower part with sufficient force to cause significant damage. The explosives are just trigger for the demolition. It's gravity that brings the building down.

Demolition blasters or blasting expert ("Blasting expert" means a person who is the holder of a valid mine blasting certificate.) load explosives on several different levels of the building so that the building structure falls down on itself at multiple points. When everything is

planned and executed correctly, the total damage of the explosives and falling building material is sufficient to collapse the structure entirely, so cleanup crews are left with only a pile of rubble. The main challenge in bringing a building down is controlling which way if falls. There are mainly two ways to implode a building,

1. felling like a tree
2. falling into its own footprint Felling like a tree

1. Felling like a tree

In this the blasting crew will be able to tumble the building over on one side, into a parking lot other open area. This sort of blast is the easiest to execute, and it is generally the safest way to go. Tipping a building over is something like felling a tree. For example to topple the building to the north, the blasters detonate explosives on the north side of the building first , in the same way you would chop into a tree from the north side if you wanted it to fall in that direction . Blasters may also secure steel cables to support columns in the building, so that they are pulled a certain way as they crumble.

2. Falling into its own footprint

Sometimes, though, a building is surrounded by structures that must be preserved. In this case, the blasters proceed with a true implosion, demolishing the building so that it collapses straight down into its own footprints (that means the total area of building is removed into the base of the building). This feat requires such skill that only a handful of demolition companies in the world will attempt it.

Fig 6. Demolition of a chimney in Germany (falling into footprint)

Blasters approach each project a little differently, but the basic idea is to think of the building as a collection of separate towers. The blasters set the explosives so that each "tower" falls toward the centre of the building, in roughly the same way that they would set the explosives to topple a single structure to the side. When the explosives are detonated in the right order, the toppling towers crash against each other, and all of the rubbles collect at the centre of the building. Another option is to detonate the columns at the centre of the building before the other columns so that the building's sides fall inward.

According to Brent Blanchard, an implosion expert with the demolition consulting firm Protec Documentation Services, virtually every building in the world is unique. And for any given building, there are any number of ways a blasting crew might bring it down. Blanchard notes the demolition of the Hayes Homes, a 10-building housing project in Newark, New Jersey, which was demolished in three separate phases over the course of three years . "A different blasting firm performed each phase," Blanchard says, "and although all of the buildings were identical, each blaster chose a slightly different type of explosive and loaded varying numbers of support columns. They even brought the buildings down in different mathematical sequences, with varying amounts of time factored in between each building's collapse."

Explosives used

Blasters use different explosives for different materials, and determine the amount of explosives needed based on the thickness of materials. For concrete column, blasters use traditional Dynamite or similar explosive materials. Dynamite is just absorbent stuffing soaked in a highly combustible chemical or mixture of chemicals. When the chemical is ignited, it burns quickly, producing a large volume of hot gas in a short amount of time. This gas expands rapidly, applying immense outward pressure (up to 600 tons per square inch) on whatever is around it. Blasters cram this explosive material into narrow boreholes drilled in the concrete columns. When the explosives are ignited, the sudden outward pressure sends a powerful shock wave busting through the column at supersonic speed, shattering the concrete into tiny chunks.

Demolition of steel column is a bit more difficult, as the dense material is much stronger. For buildings with a steel support structure, blasters typically used the specialized explosive material Cyclotrimethylenetrinitramine, called RDX for short. RDX – based explosive compounds expand at a very high rate of speed, up to 27,000 feet per second (8,230 meters per second) . Instead of disintegrating entire column, the concentrated, high velocity pressure slices

right through the steel, splitting it in half. Additionally blasters may ignite dynamite on one side of the column to push it over in a particular direction.

CONCLUSION

Type of demolition method depends upon various factors such as site condition, type of structures, age of building, height of building and economy. Anyway controlled demolition of building is necessary to ensure safety. Explosive demolition is the preferred method for safely and efficiently demolishing the larger structures. Almost all major building implosions in the world are handled by 20 well-established companies, blasting is passed on from generation to generation.

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