

DEMOLISHING OF CONCRETE STRUCTURES

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INTRODUCTION

- ❑ Demolition is the *dismantling*, razing, destroying or wrecking any building or structure or any part of building by pre-planned and *controlled methods*.
- ❑ Demolition is bringing down the building and other structures safely
- ❑ Demolition is one of the most dangerous activities in the construction sector
- ❑ Demolition Can be total or partial
- ❑ Total demolition is aimed at the recovery of the area for subsequent re-use, while partial demolition is aimed at the recovery of the building for refurbishing or rebuilding.



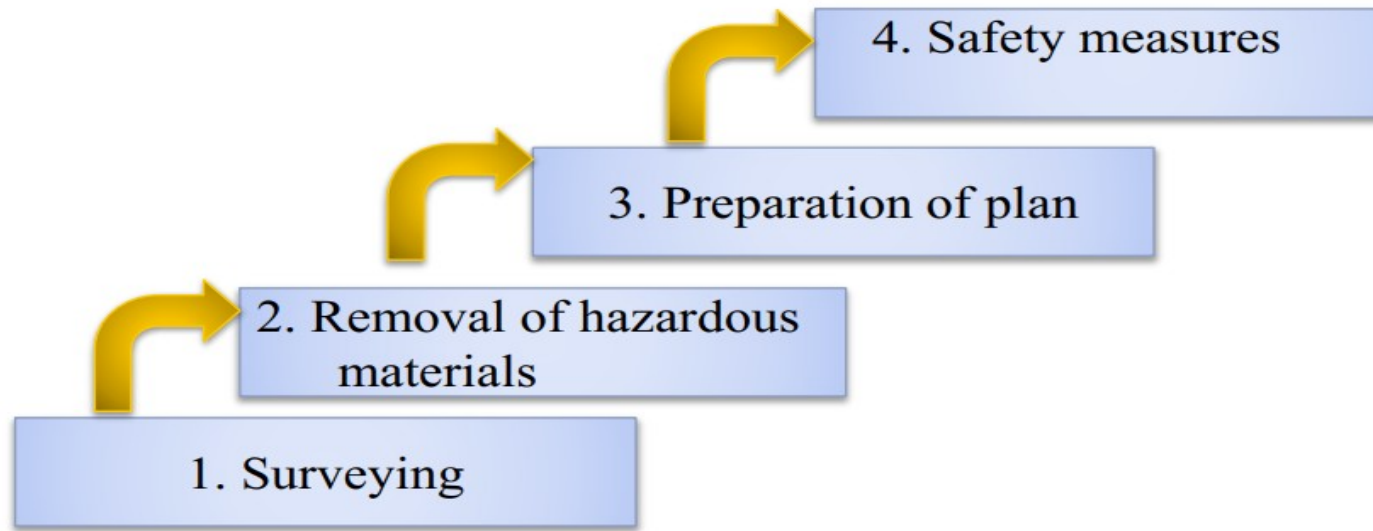
WHY DEMOLISHING?

- ❑ The structures which have already passed their **design life** need to be reconstructed, for safety and operational requirements.
- ❑ The **old structures** need to be demolished for **replacement by new structures**
- ❑ **Small structures** can be demolished by manual methods but machinery and advanced techniques are required for demolition of **bigger structures**
- ❑ **Advanced techniques** are also required for faster demolition and demolition in confined areas.



STEPS BEFORE DEMOLITION

- Demolition work is to be performed safely and with number of different steps involved before and during the execution of a demolition process.



1. SURVEY FOR DEMOLITION

- ❑ For demolition of a building ,detailed survey and assessment of a building is necessary. It includes

A. Building survey

- ❑ Drawing records
- ❑ Material survey
- ❑ Hazardous materials
- ❑ Photographs of a building to be demolished
- ❑ Surrounding buildings
- ❑ Building height, distance from nearby buildings
- ❑ Type of building



1. SURVEY FOR DEMOLITION

B. Structural survey

- ❑ Drawing records
- ❑ Special structure
- ❑ Behavior of structure
- ❑ Structural support system
- ❑ Degree of deterioration



2. REMOVAL OF HAZARDOUS MATERIALS

a. 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 Regulation



Asbestos Material

2. REMOVAL OF HAZARDOUS MATERIALS

b. 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.



Soil contamination

3. PREPARATION OF PLAN

- Based on demolition surveys, a demolition plan is prepared This plan is produced with the application for approval to the local authority. ***This plan includes***
- Plan showing the location of a building to be demolished.
 - ❖ Building height, structural system
 - ❖ Extent of damage to the building
 - ❖ Existing structures and facilities in the vicinity
 - ❖ Layout plan
 - ❖ Proposed method of demolition
 - ❖ Safety measures
 - ❖ Proposed sequence of demolition steps
 - ❖ Details of equipment's used.
 - ❖ plan for handling and disposal of debris
 - ❖ Proposed arrangements for site supervision



4. 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
- ***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.



4. SAFETY MEASURES

Electrical Safety

A properly connected power source from a local electric utility supplier or a mobile electricity generator shall be utilized in demolition sites

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.



DEMOLISHING SEQUENCE

Demolition sequence shall be determined based on Actual site conditions, Restraints, The building layout, The Structural layout and its construction. In general, the following sequence shall apply:

- ❑ *Utilities* disconnection. Electricity, plumbing water lines, drainage connections etc..
- ❑ All *cantilevered* structures, canopies, verandahs and features attached to the external walls shall first be demolished prior to demolition of main building and its internal structures on each floor



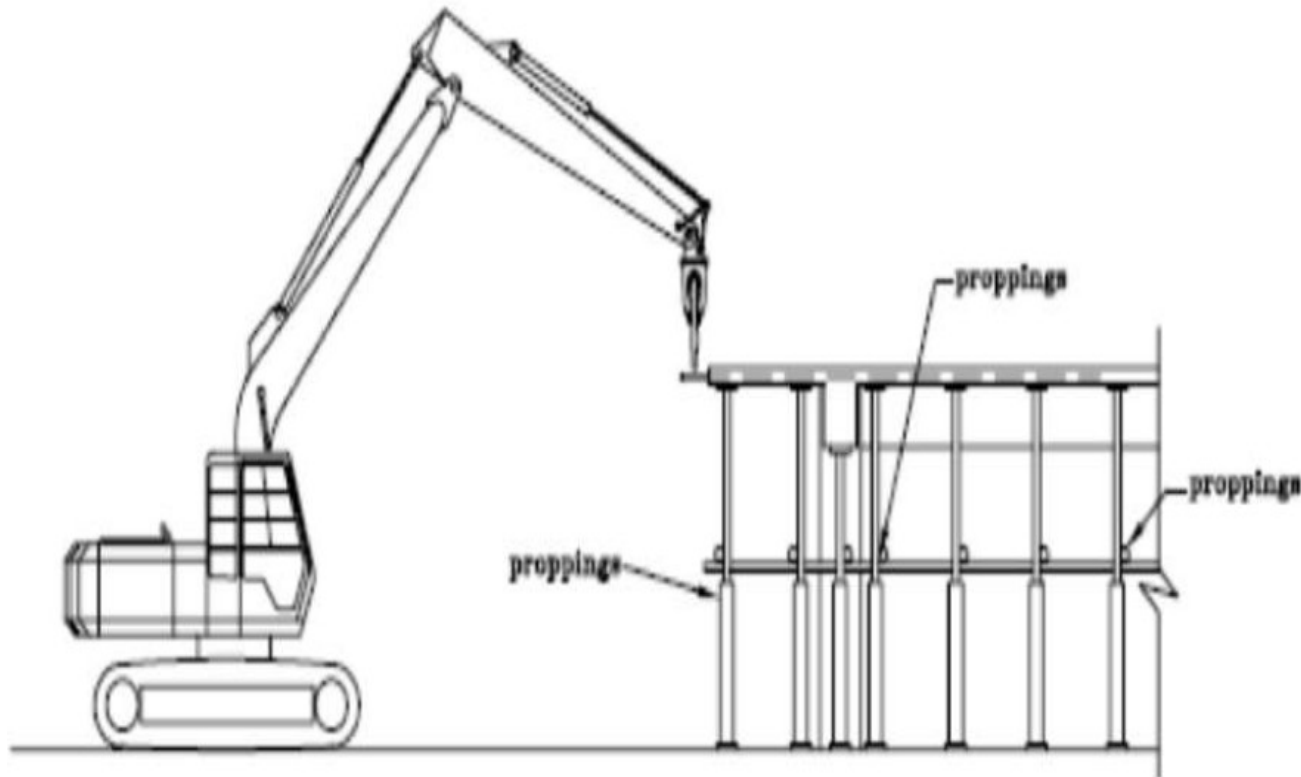
DEMOLISHING SEQUENCE

- ❑ When demolishing the roof structure, all lift machine rooms and water tanks at high level shall be demolished in *“top down”* sequence to the main roof level
- ❑ Demolition of the floor slabs shall begin at **mid span** and work **towards the supporting beams**.
- ❑ Floor beams shall be demolished in the order of *cantilevered beams, secondary beams and then main beams*.
- ❑ *Non-load bearing* walls shall be removed **prior to** demolition *of load bearing* walls.



DEMOLISHING SEQUENCE

If site conditions permit, the first floor slab directly above the ground floor may be demolished by machine standing on ground.



FACTORS AFFECTING DEMOLISHING METHODS

- According to Kasai et al/1988/ are demolition methods classified into principles and mechanisms of breaking.
- The selection of a specific process should be based on the experience learned from the conventional demolition industry, and applicable experience from actual decommissioning programs.

□ *Some of the factors to affecting selection of demolishing methods are;*

a) Type of structure

Different types of structure like load bearing masonry structure , RCC framed structure, steel structure , etc.



FACTORS AFFECTING DEMOLISHING METHODS

b. Size of structure

If the size of structure is small, hand demolition can be sufficient. For large structures and multi storied buildings special like wrecking ball method, deliberate collapse, implosion technique etc are necessary.

c. Available time period

d. Location of structure

e. Limitation of noise, dust and vibrations

f. Skill of workers

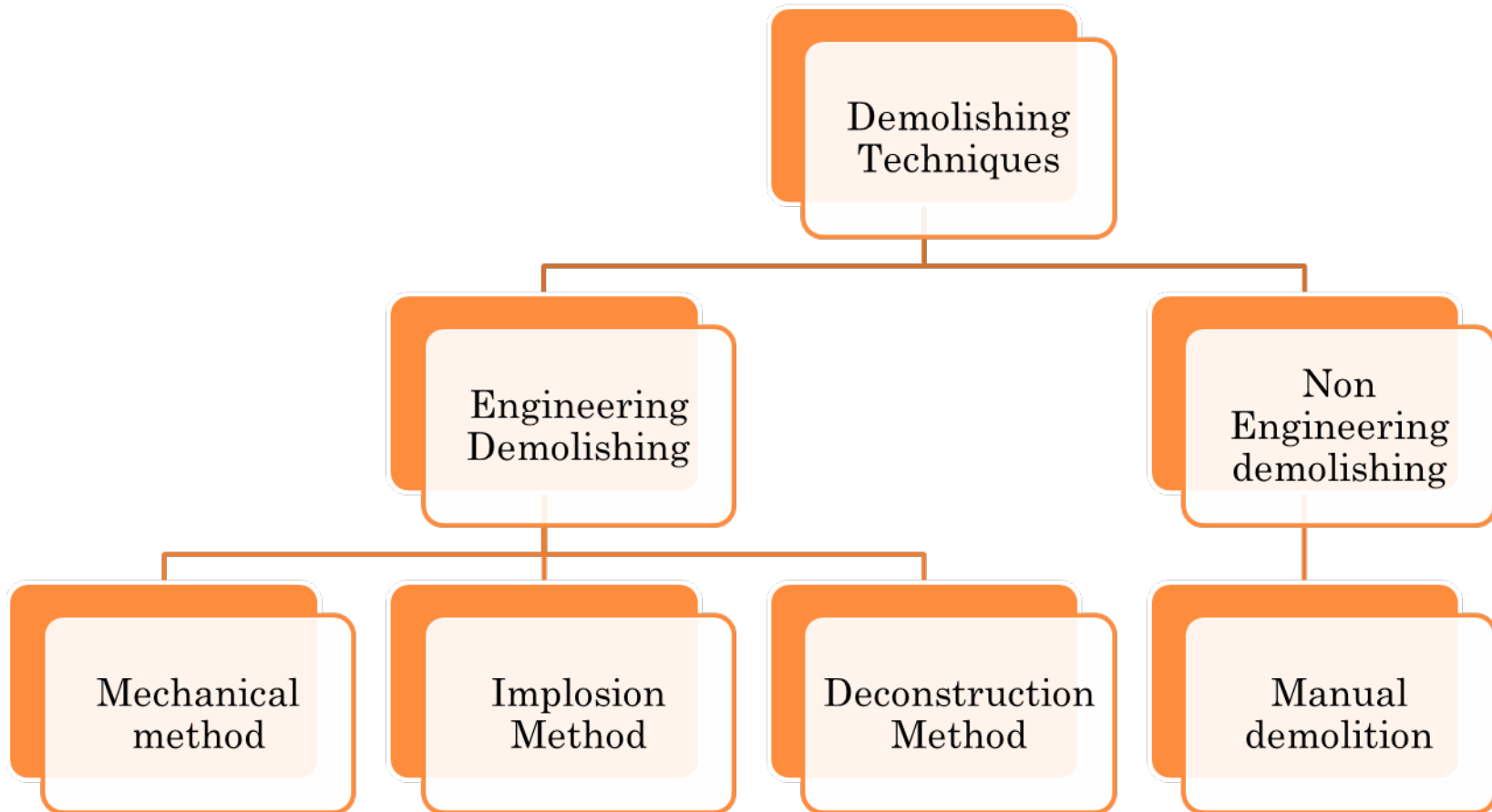
g. Safety

h. Availability of equipment

i. Adjacent structures



FACTORS AFFECTING DEMOLISHING METHODS



CONTINUED...

Manual Methods

- ❑ This is demolishing by **human operatives**/hand held operations.
- ❑ Suitable for use in smaller site with congested space where larger machine cannot be employed.
- ❑ using simple electrically or pneumatically powered tools such as picks, hammers, wire cutters or hand driven hydraulic jacks etc. to carry out the demolition of individual elements.
- ❑ Tools required for manual demolition;
 - Hammers
 - Picks
 - Wire cutters
 - Welding cutters
 - Hand driven hydraulic jacks etc.



CONTINUED...

Mechanical Methods

- ❑ Wrecking method
- ❑ Pusher arm technique
- ❑ Thermic lance technique
- ❑ Non explosive demolition
- ❑ Concrete sawing method
- ❑ Deliberate collapse method
- ❑ Pressure jetting method
- ❑ bursting

Implosion Methods

- ❑ demolition of structure with the help of explosives is called as implosion



1. MANUAL METHODS

- Manual methods are carried out top down, proceeding, in general, from the roof to ground. The sequence of demolition may vary, depending on
 - Site conditions and
 - Structural element to be demolished



1. MANUAL METHODS

1. ***Hand held hammering;*** Repeated hammering is often used to fracture and break concrete mainly due to occurring tensile and shear stress.

i. **Rotary-hammer** ;boring holes by Rotary hammering; in concrete. They are versatile and also work well in the hammer-only mode.

ii. **Chipping hammer;** Lightweight and hand-held, chipping hammers are perfect for breaking vertical and overhead concrete surfaces.



1. MANUAL METHODS

iii. Demolition hammer;

Demolition hammers deliver hammering action only, unlike rotary hammers, which are used to bore holes.



2. Hydraulic concrete crusher

Hydraulic concrete crushers are used to reduce concrete into smaller, more manageable pieces. They also separate steel reinforcement from concrete.



1. MANUAL METHODS

3. Pavement breaker

Pavement breakers are used in heavy concrete demolition projects because they can demolish pavements, roads, and extremely thick concrete



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3. Hydraulic splitter

Hydraulic splitters use lateral forces against the insides of concrete holes to break up the concrete without creating lots of noise and debris.



2. MECHANICAL METHODS

- The sequence of demolition by machine is typically the same as the top down manual method, except that most of the *demolition is done by mechanical plant*

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1. Excavator and attachments



ATTACHMENTS



Grapples



Hammer



Shear



Multiprocessor



Pulverizers



Buckets

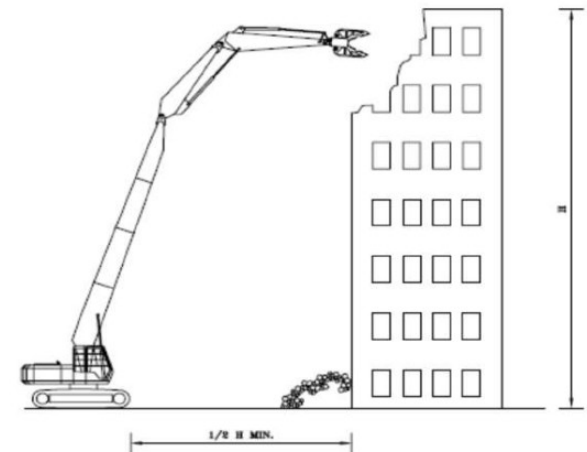
2. MECHANICAL METHODS

1.1 Excavator mounted with hydraulic crusher

- The **crusher attachment** breaks the concrete and the reinforcement by the hydraulic thrust through the long boom arm system
- The hydraulic crusher can be operated from the ground outside the building. This method is also suitable for dangerous buildings, silos and other industrial facilities.
- The excavator shall operate on firm ground that can support the machine during the crusher operation.
- Each section of the structure shall be demolished in a **top down sequence**



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2. MECHANICAL METHODS

1.2. Excavator mounted with A hydraulic jackhammer;

- Typically much larger than portable ones, may be fitted to mechanical excavators or backhoes and is widely used for roadwork, quarrying and general demolition or construction groundwork.

- Pneumatic breakers are simpler tools with fewer moving parts, requiring less maintenance.

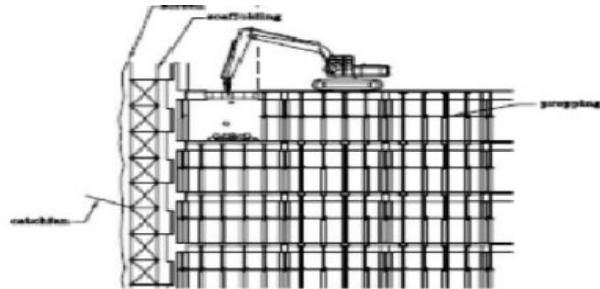


2. MECHANICAL METHODS

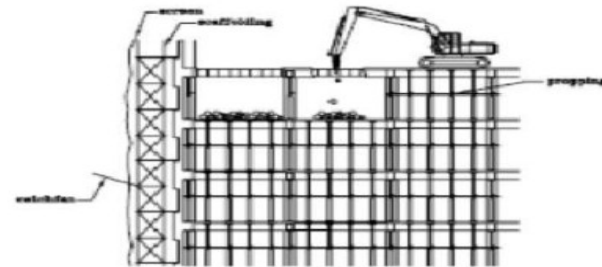
- ❑ The demolition begins with the **lifting of the mechanical plant** on to the building top floor.
- ❑ **Adequate propping** shall be installed at floor levels below the working floor to safely support the operation of the mechanical plant.
- ❑ The **movement** of the mechanical plant shall only be within **the propped area**. The propped areas shall be suitably marked.
- ❑ The mechanical plant shall be lifted onto the roof of the building by the use **of mobile crane** or other appropriate means as approved.
- ❑ The machine shall descend down to the next floor by means of a ramp. The ramp may be a temporary structure or other appropriate design.



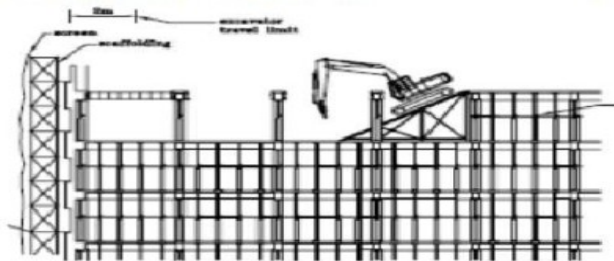
2. MECHANICAL METHODS



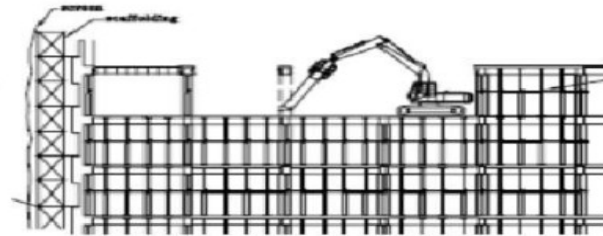
1. Demolish slab & beam



2. Continue demolishing slab & beam

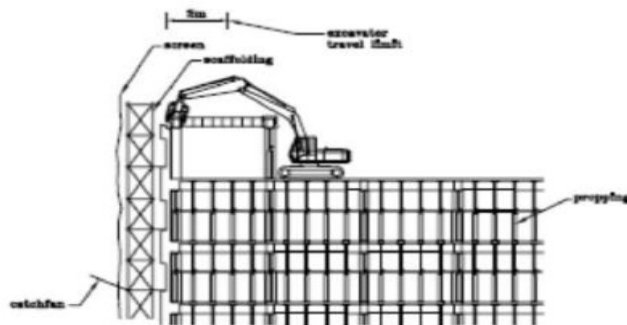


3. Access ramp to lower floor

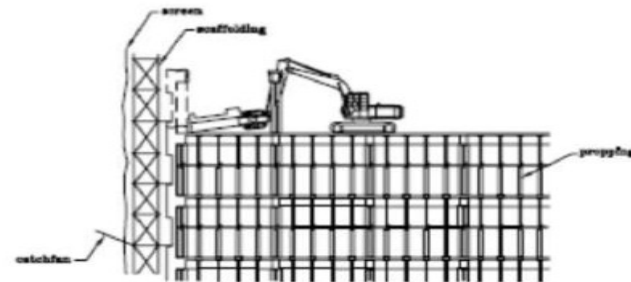


4. Demolition of interior column

Active
Go to S



5. Cut external wall & column



6. Pull down wall section

Typical sequence of demolition by top down method with Machines

2. MECHANICAL METHODS

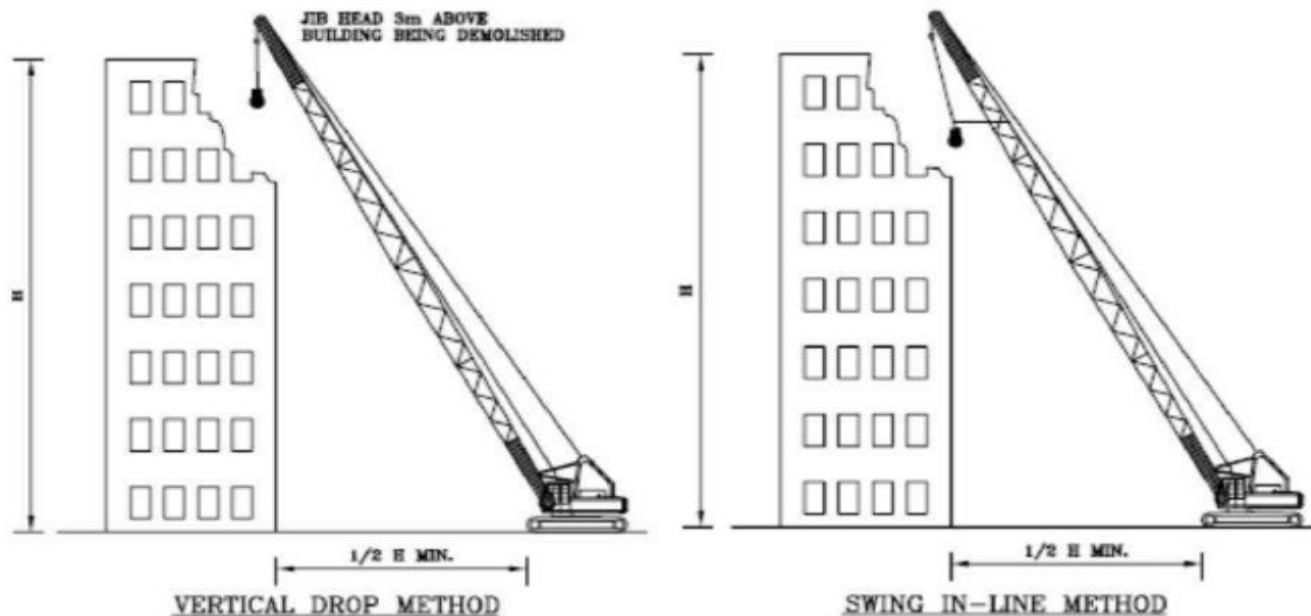
2. Ball and crane

- This is one of the oldest and most commonly used methods for demolition.
- The wrecking ball application consists of a crane equipped with a steel ball.
- A crane uses a wrecking ball, weighing up to 6120kg, which is either dropped onto or swung into the element to be demolished.
- Concrete members can be broken into small pieces, but secondary cutting of reinforcing may be necessary.



2. MECHANICAL METHODS

- The destruction of the building is by the impact energy of the steel ball suspended from the crawler crane. The wrecking ball operates outside the building.
- However, the operation requires substantial clear space. The application also demands high level skill operators and well maintained equipment



2. MECHANICAL METHODS

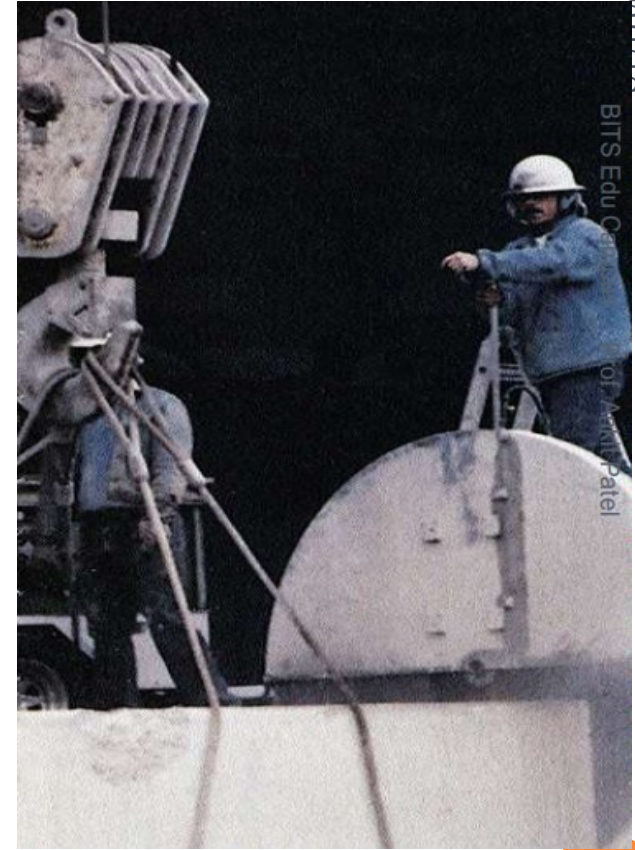
- ❑ Recommended techniques for the wrecking ball operations include (1) Vertical Drop -free falling of the wrecking ball onto the structure and (2) Swing in line - swinging of the ball in-line with the jib.
- ❑ A second dragline will normally connect to the ball horizontally to control the ball motion
- ❑ The operation shall not be performed adjacent to **overhead power lines**. The site shall be entirely fenced off to forbid public access.
- ❑ One of the disadvantage of this method is the breakup process can cause considerable dust, vibration and noise which may be objectionable.



2. MECHANICAL METHODS

3. Dismantling

- Selective or complete demolition of concrete structures is possible by cutting elements and then removing them with a crane.
- The cutting process may be by sawing, water jetting or thermal lance.
- Because the surface of the cut concrete is smooth and relatively regular, these methods have particular application when the objective is partial demolition, for instance in the creation of openings in walls and slabs.



Dismantling a beam

2. MECHANICAL METHODS

Continued...

- Hydro demolition uses a high pressure supersonic water jet, that penetrates the pores and cracks of the concrete and builds up an internal pressure. When this pressure exceeds the tensile strength of the concrete, the concrete breaks.
- The water jet can be used not only for cutting straight lines but also contours, a useful feature for cutting access manholes.
- A thermal lance is created by packing a seamless mild steel tube with low carbon rods and passing oxygen through the tube.



Water jet cutting

2. MECHANICAL METHODS

Continued...

- While this method eliminates vibration and dust problems, it creates other hazards associated with smoke and fire danger.
- Whether sawing, jetting or lancing is used to dismantle the structure or its components, each element must be safely lowered to the ground.
- The amount of **time** and **cost of labor** are the main drawbacks.
- Toxic waste such as asbestos sheets and lead paint have no resale value so they are discarded.



Thermal Lance

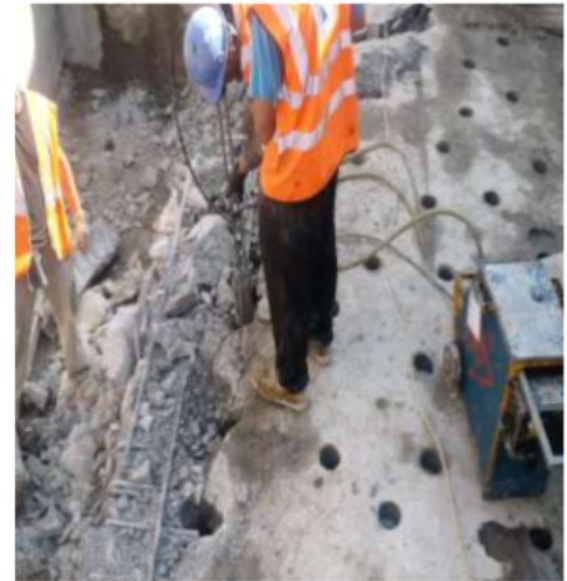


Sawing method

2. MECHANICAL METHODS

4. Pressure bursting

- can be used in cases where relatively quiet, dust-free, controlled demolition is preferred. The cutting process may be by sawing, water jetting or thermal lance.
- Both mechanical and chemical pressure bursting split the concrete, either with a splitting machine operating on hydraulic pressure provided by a motor in the case of mechanical bursting, or through the insertion of an expansive slurry into a pre-determined pattern of boreholes in the case of chemical bursting



Pressure bursting

- Both methods work by applying lateral forces against the inside of holes drilled into the concrete.



5. EXPLOSIVES

- ❑ **Implosion** is the **strategic placing of explosive material** and timing of its detonation so that a structure collapses on itself in **a matter of seconds**, minimizing the physical damage to its immediate surroundings
- ❑ The technique **weakens or removes critical supports** so that the building can no longer withstand the force of gravity and **falls under its own weight**.
- ❑ Numerous small explosives, strategically placed within the structure, are used to catalyze the collapse. Nitroglycerine, dynamite, or other explosives are used to shatter **reinforced concrete supports**.
- ❑ For the demolition of concrete structures it is usual to drill holes at a pre determined angle into the concrete to be removed

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5. EXPLOSIVES

- ❑ The holes are then charged with an explosive which is electrically detonated
- ❑ Despite its terminology, building implosion also includes the controlled demolition of other structures, such as bridges, smokestacks, towers, and tunnels
- ❑ Empirical judgment based on the skill and experience of the operator is the basis for blasting design.
- ❑ A simpler but far less effective method of blasting is to lay the explosive charge on the element to be demolished and cover it with sand bags.
- ❑ Precautions should be taken to stop flying debris and in all circumstances strict site control must be maintained to ensure the safety of workers and the general public.

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CONTINUED...

Pre blast considerations

- ❑ The design may include pre-weakening of the structure, the strategy in placement of the explosives and time delay so that the building will collapse in a safe manner.
- ❑ Pre-weakening of the structure may include cutting out a portion of the shear walls and other structural elements
- ❑ A test blast may be conducted to verify the strength of the structural member and to fine tune the explosive design.
- ❑ Protection of the adjacent properties and habitats is also an important consideration.

Concrete columns fully loaded with explosives



CONTINUED...

Test blast

Before carrying out the actual blasting, a test blast, in order to ascertain the efficiency of explosive & detonators.

The wrap



Before

re debris does n



After

charges.



CONTINUED...

5. Explosives

General things

- High Risk Factor
- Time Taken
- Produce Distortion
- Expensive
- Chances of error
- Need of experts
- Error may leads to
 - No demolition
 - Loss of life's



DEMOLITION OF PRESTRESSED CONCRETE

- ❑ Demolishing pre stressed concrete structures can be more difficult than demolishing reinforced concrete because of the energy stored in the pre stressing tendons.
- ❑ Pre stressing tendons are likes stretched rubber bands, with energy stored in the stretching process.
- ❑ The release of the stored energy in a rubber band causes it to sail through the air.
- ❑ The total demolition of a pre stressed pre-tensioned structure is no more difficult than the demolition of a cast-in-place reinforce concrete structure.



DEMOLITION OF PRESTRESSED CONCRETE

- ❑ Pre stressed pre-tensioned members are usually designed to resist applied loading in only one direction.
 - ❑ Because of this, the members will fail rather easily if a force can be applied in an opposite or lateral direction
 - ❑ The partial demolition of pre tensioned pre stressed structure requires more care than similar operations on a cast in place structure.
-
- ❑ Pre-tensioned slabs and beams, or smaller dismantled portions, may be lifted and lowered to the ground as complete units (As shown in the photo). Generally, any necessary shoring and subsequent lifting should be from points near the ends of the units



Photo A. Sections of this precast, prestressed double tee unit were shored, sawed and lifted out.

DEMOLITION OF PRESTRESSED CONCRETE

- Safe, uneventful demolition of relatively low structures using a crane and a ball has been accomplished where there is adequate surrounding work space.
- Disassembly or from - the - top -down demolition requires a large amount of shoring which must be installed along the entire length of the members, unless intermediate tendon anchors were installed during construction.
- Once shored, the slab and beams can be de tensioned—in reverse order in which they were tensioned. Then the slabs and beams can be demolished using those methods previously described, with the exception of the ball-and-crane method.
- The partial demolition of an unbonded post-tensioned structure can be very complicated and hazardous. If “as - built” drawings are not available, this operation can be even more complex.



DEMOLITION OF PRESTRESSED CONCRETE

- ❑ After the shoring is in place, the tendon and reinforcing bars are located using magnetic detection devices.
- ❑ Once this is done, careful drilling, chipping or sawing may be used to expose the prestressing tendons (Photo B).
- ❑ The concrete can then be broken with either hand-held or machine-mounted breakers, or once completely severed, reduced to a size which may be lifted and lowered.
- ❑ Careful planning by competent persons experienced in post tensioning is essential before attempting partial demolition of post-tensioned structures



Photo B. Detensioning the tendon releases its force and allows safe removal of post-tensioned concrete sections. Here a laborer is chipping grout out of an anchorage pocket to allow access for a hydraulic

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THANK YOU

