

## 5.6 ENGINEERED DEMOLITION METHODS

### Mechanical method by

- \* Hydraulic crusher with Long Boom arm
- \* Non Explosive Demolition Agent
- \* Saw cutting
- \* Water jet
- \* Pusher Arm
- \* Other Methods like
- \* Explosive Demolition
- \* Cutting and Lifting
- \* Wrecking Ball
- \* Wire Rope Pulling
- \* Clam Shell

### Piecemeal Demolition (Demolition by Hand):

For demolitions of reinforced concrete buildings by hand, tools such as electric, pneumatic breakers, jack hammers etc are commonly being used.

Oxy-acetylene torch could be used to cut the reinforcements.

The reinforcements shall remain until all the concrete connecting to or supported by the reinforcement is broken away or when its supports are no longer required.

Cantilever canopies, balconies and exterior walls are critical elements in building demolition. In congested areas, these features could critically impact on the safety of the public.

Demolition of these features shall be performed with extreme caution.

If rope or tie wires are used to pull down the structural elements, the pulling wire must be at least 4 times stronger than the anticipated pulling force.

In addition, workers shall be shielded from the rope or tie wires. The rope or tie wire shall be checked at least twice per day.

Lifting appliances may be necessary to hold larger structural members during cutting and for lowering severed structural members and other debris.

#### a) **Mechanical Demolition**

Mechanical demolition generally involves the use of large machinery with attachment to dismantle the building from outside.

The common mechanical methods include the use of a **Hydraulic crusher with long Boom arm, Wrecking Ball, pusher arm, wire rope, clam shell etc...**

These methods shall only be applied to isolated buildings on relatively flat ground.

If it is attached to another structure, the two properties should be separated by the use of hand methods before the main demolition process begins.

The concerns and good practices of the mechanical demolition generally included the following;

- 1) The machine shall be operated on smooth and firm ground;
- 2) It shall also have adequate counter-weight to prevent overturning during the operation;
- 3) The equipment and accessories such as attachments and rope shall be inspected frequently and shall be repaired or whenever necessary;
- 4) The impact of the collapsed structural sections on the floor or ground shall be checked to prevent the potential overloading of the suspended floor, vibration and disturbance to adjacent properties and damage to underground utilities.
- 5) The site shall have full time security to prevent unauthorized personnel entering the site. No person shall stay within the working area of the machine and the building while the machine is operating.
- 6) Sufficient water spray or other anti-dust precautions shall be provided to minimize air pollution by dust;
- 7) The cab of the machine shall be equipped with impact proofed glass and its

construction shall be robust enough to protect the operator from flying debris;

8) A spot person shall be on site full time to provide guidance and assistance to the operator in the demolition process.

### **Demolition Sequence**

In general, the following sequence shall apply:

- a) Prior to demolition of internal floors, all cantilevered slabs and beams, canopies, and verandahs shall first be demolished
- b) The structural elements, in general, shall be demolished in the following sequence:
  - Slabs;
  - Secondary beams; then
  - Main beams
- c) Mechanical plant shall descend from the floor with temporary access ramp, or be lowered to the next day floor by lifting machinery or by other appropriate means;
- d) When a mechanical plant has just descended from the floor above, the slabs and beams, in two consecutive floors may be demolished by the mechanical plant simultaneously. The mechanical plant may work on structural elements on the same floor and breaking up the slabs on the floor above;
- e) The wall panel, including beams and columns shall be demolished by gradually breaking down the concrete or by pulling them down in a controlled manner;

### **A. Hydraulic crusher with Long Boom arm**

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. For environmental reason, it should be used wherever practicable because of its quietness.

### **Application Criteria**

The operation shall have a minimum clear space of 1/2 the building height as a

safety zone for the falling debris; The equipment shall be inspected and maintained periodically to make sure the equipment is in good and safe condition.

The excavator shall operate on firm ground that can support the machine during the crusher operation; Except for special applications, each section of the structure shall be demolished in a top down sequence to ensure stability of the structure;

Debris may be used to build up a platform for the excavator to extend the range of reach. It is important that the debris is densely compacted to support the operation of the excavator. The platform must be flat and the slope must be stable. The height of the build up platform shall be limited to 3 m. The side slope of the temporary platform shall not be steeper than 1:1 (horizontal to vertical) unless the condition allows a steeper slope. The slope of access ramp for the machine shall be in accordance with the manufacturer's recommendation. The width in both directions of the platform shall be at least one and one-half the length of the machine to allow safe maneuver during the demolition operation;

To minimize the dust impact, the structure shall be pre-soaked with water before demolition. Water shall be continuously sprayed during the crushing operation;

Debris may fall out of the building during the demolition. The site shall be completely fenced off. There shall be 24-hour guarded security to allow only authorized personnel for site access. During the operation of the crusher there shall be no worker within the machine operating area or inside the building;

The crusher operator shall possess the essential skills and significant experience in the crusher operation. There shall be a spot person to assist in the operation and alert the operator of any potential problem during the operation.

## **B. Wrecking Ball:**

The wrecking ball application consists of a crane equipped with a steel ball. 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. This method is suitable

for dilapidated buildings, silos and other industrial facilities. However, the operation requires substantial clear space. The application also demands high level skill operators and well- maintained equipment.

### **Application Criteria**

The recommended criteria for the use of wrecking ball are presented in the following: Except for special application, the balling of each section of the structure shall proceed from top to bottom. Care shall be taken to maintain the stability of the structure; Recommended techniques for the wrecking ball operations include:

- 1) Vertical Drop – free falling of the wrecking ball onto the structure;
- 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 ball shall be swung into the building. The ball shall strike at the top of the member so as to avoid the member from falling outside the building.

Slewing the jib is not recommended. The motion of the ball by slewing the jib is difficult to control. It demands expert knowledge of the machine and structure as well as operating skills to safely perform the task. Slewing can potentially induce a tremendous amount of stress on the jib, as such, its use shall be avoided;

The jib or boom shall be operated with not less than 3 m above the portion of the structure being demolished;

Clear space for operation between the crane and the structure being demolished shall be 50% of the height of structure, the clear distance between the site boundary and the building to be demolished shall not be less than 50% of the building height plus an additional 6 m for the crane to maneuver, this criteria shall apply to all sides of the building to be demolished by wrecking ball;

The demolition ball shall be connected with swivel type anti-spin device to prevent twisting and tangling of the wire during operation;

The wire and boom of the machine used for balling shall have a rated capacity, at the working radius, of at least 5 times the weight of the ball;

The strength of the wire shall be at least twice the tensile strength of the nominal steel reinforcement of the floor slab and beams. The high strength wire allows the pullout of the wrecking ball from potential traps;

To ensure that the crane is in good condition, the wire connecting to the ball, the boom components and connecting pins shall be inspected twice daily.

A sufficient length of the wire shall be provided to allow the ball to drop to the lowest working level plus an addition of 10% of the wire length and no less than 3 drums. For swing in-line method, there shall be sufficient length of the dragline wire to allow the ball to fall in the event that the ball is entangled with the falling debris;

The operation shall not be performed adjacent to overhead power lines;

The site shall be entirely fenced off to forbid public access. A 24-hour security guard shall be assigned to the site to enforce the access restriction; depending on the relative location between the fence and the building, and fence shall be designed to withstand accidental impact by the wrecking ball;

During the use of the demolition ball, expect for the crane operator and the spot person, all other workers shall be kept away from the demolition ball's working radius. Nobody shall stay inside the building;

To minimize the dust impact on the surrounding area, the structure to be demolished shall be pre-soaked with water before demolition. Water spraying shall continue on the structure during demolition;

Since the safety and success of the project depend highly on the operator and site personnel, the operator must have proven experience and skill for operating the wrecking ball to the satisfaction of the approval authority; and

A spot person shall be on site during the operation to assist the operator and to ensure site safety. The spot person shall have extensive knowledge and experience in the use of wrecking ball. The qualification and experience of the spot person shall be equivalent to those of the wrecking ball operator.

### C. Hydraulic Pusher Arm:

Articulated, hydraulically-powered pusher-arm machines are normally mounted on a tracked or wheeled chassis, and have a toothed plate or hook for applying a horizontal force to a wall.

The machine should stand on a firm level base and apply force by a controlled movement of the pusher arm.

Special conditions for pusher arm demolition are listed below:

- 1) The pusher arm shall be constructed of steel or equivalent material and shall have adequate strength to operate on the building; a crane boom shall not be used;
- 2) Minimum safety distance of 0.5 times the height of the building element being demolished shall be maintained between the machine and the building for pushing into the building.
- 3) Minimum safety distance of 1.5 times the height of the building element being demolished shall be maintained if structural elements are pulling out of the building;
- 4) The point of application of pushing shall not be less than  $\frac{2}{3}$  of the height and not more than 600 mm below the top of the wall; and
- 5) The pusher arm method shall be limited to buildings less than 15 m high.

Chutes may be used to discharge debris into a vehicle or hopper.

Foundations would normally be grubbed up by excavation machines.