

## ELEMENT 12 DEMOLITION AND DECONSTRUCTION – HAZARDS AND RISK CONTROL

### Learning Outcomes

- Identify the main hazards of demolition and deconstruction work
- Outline the control measures for demolition and deconstruction work
- Identify the purpose and scope of a pre-demolition/refurbishment survey
- Outline the main control measures that a demolition/refurbishment method statement should include

### 12.1 Introduction

Demolition is undoubtedly one of the most dangerous activities which will be undertaken on any construction site. Nineteen workers have been killed on demolition sites in the last three years as well as several members of the public including some children.

### 12.2 Legal Requirements

There are a variety of legal requirements which effect construction and demolition work, some apply to all work sites and a small number are specific to the construction activity.

**HASAWA – S2** Duty to ensure the health, safety and welfare of employees so far as is reasonably practicable. This is supported by the requirement to provide safe plant and equipment which may be used in demolition, safe systems of work, normally in the form of method statements and permits to work. Employees must be trained and provided with the necessary training. A safe place of work when they are carrying out this high risk activity must still be provided.

**S3** Sets a duty on the employer and person in charge of the site to ensure the safety of others who may be affected. In demolition this could include sub contractors on site but also neighbours and members of the public nearby.

**Management of Health and Safety at Work Regulations** – Regulation 3 requires the completion of a suitable and sufficient risk assessment and Regulation 4 requires the risks to be prevented or minimised.

### CDM 2015

#### Regulation 19 Stability of structures

*All practicable steps must be taken, where necessary to prevent danger to any person, to ensure that any new or existing structure does not collapse if, due to the carrying out of construction work, it—*

*(a) may become unstable; or*

*(b) is in a temporary state of weakness or instability.*

*Any buttress, temporary support or temporary structure must—*

*(a) be of such design and installed and maintained so as to withstand any foreseeable loads which may be imposed on it; and*

*(b) only be used for the purposes for which it was designed, and installed and is maintained.*

*A structure must not be so loaded as to render it unsafe to any person.*

### **Regulation 20 Demolition or dismantling**

*The demolition or dismantling of a structure must be planned and carried out in such a manner as to prevent danger or, where it is not practicable to prevent it, to reduce danger to as low a level as is reasonably practicable.*

*The arrangements for carrying out such demolition or dismantling must be recorded in writing before the demolition or dismantling work begins.*

**PUWER** – Any equipment used in demolition must be suitable for the task, environment and user; it must be maintained in good condition.

**LOLER** – Some equipment such as cranes and mechanical handlers may be used to carry out demolition work. This must be thoroughly inspected every 12 months. Every lift must be planned and supervised accordingly.

**Work at Height Regulations**– Steps must be taken to minimise the risk of falling and falling objects. Consideration must also be given to dealing with emergency evacuations from height.

**COSHH** – Hazardous substances may be present in the structure of the building and may be associated with the previous of the building. A suitable and sufficient risk assessment must be carried out and controls taken.

**Control of Asbestos at Work Regulations 2012** – The building needs to be surveyed and if asbestos containing materials present it must be removed by a licensed contractor before the main demolition.

**Control of Lead at Work Regulations**– Storage tanks may have contained lead based paints or compound; these need to be identified and control measures taken. Individual workers may need to be monitored.

**Control of Noise at Work Regulations 2005**– Demolition work is by its nature noisy.

**Control of Vibration at Work Regulations 2005** – Whole body vibration can be an issue in mechanical equipment and hand arm vibration is associated with pneumatic diggers, drills and whackers.

**Electricity at Work Regulations 1989** – Underground and building services needs to be isolated to reduce the risk of explosions and electric shock.

**Building Act 1984** – If a building is to be demolished the Local Authority must be notified.

### ***Copy of a press release from April 2015***

*A famous pub in Kilburn which survived the blitz has been demolished by developers without permission from the council. The unauthorised*

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*demolition follows a council rejection to knock down the pub and build flats.*

*Residents were astounded to discover that builders turned up and knocked down the Carlton Tavern, with all the contents, including a flat screen television, darts board and glasses still inside. Patsy Lord, the pub's landlady, rushed to the scene from her home in Maida Vale after she was alerted to the demolition and told she needed to move her son's car.*

*After opening for business on Monday and hosting an Easter quiz, she was told the pub would be closed for an 'inventory.*

*Speaking to a local newspaper, Maida Vale councillor Jan Prendergast told "They do not have permission to do this. I am absolutely furious.*

*"The council will take very strong measures against them. It's not safe and I'm appalled for the residents who live here."*

*A Westminster council spokesperson told Londonist: "Westminster City Council's Planning Enforcement Team received a report that the Carlton Tavern was in the process of being demolished. A planning inspector of the planning enforcement team visited the site immediately following receipt of the report and noted at 2.30pm that the building had indeed been substantially demolished with only one side wall remaining.*

*"The building's demolition required the City Council's prior approval and as no such approval was sought or obtained, the City Council will be seeking legal advice concerning whether any future action is legally possible.*

*"Pubs play an important role in our local community."*

### 12.3 Demolition methods and equipment

There are a wide range of demolition methods which can be used when demolishing or deconstructing a structure. The methods selected will depend on the structure, its size, height, location and the specific methods used to construct it. Common methods used include:-

- Explosive demolition
- Crane & ball
- Excavator push & pull
- Crane-mounted crusher
- Hand demolition
- Wire rope pulling
- Pulveriser
- Pusher arm
- Shears



#### Deconstruction or Demolition

This is the selective dismantlement of building components, where plans have been made for the waste control hierarchy to be implemented. Where components or materials removed and either reused or recycled e.g. removal of staircases or radiators for reuse elsewhere. Demolition is when a structure is removed by the easiest and often quickest means with the site being cleared being the key objective.

The choice of demolition technique will depend on the nature of the building or structure and its environment. Risks to the public, operatives involved in the demolition process and adjacent structures and buildings should be considered.

Demolition techniques may be :-

- Piecemeal demolition, by hand or a variety of machinery and equipment, taking down the building floor by floor, section by section.
- Deliberate controlled collapse of the entire structure in one go.

#### Piecemeal Demolition

Demolition of buildings or structure by hand-held tools such as electric or pneumatic breakers, sometimes as a preliminary to using other methods, should be carried out, where practicable, in the reverse order to the original construction sequence. Lifting appliances may be necessary to hold larger structural members during cutting and for lowering severed structural members and other debris. Chutes may be used to discharge debris into a vehicle or hopper.

Simple roof structures supported on wall plates should normally be demolished to the level of wall plates by hand, but if this may involve unsafe working, then demolition totally by machine may be appropriate.

Where a building that is to be demolished by machine is attached to another structure, the two properties should be separated by the use of hand methods before the main demolition process begins.

When any part of a building is being demolished by a balling machine, pusher arm or similar equipment, only the machine operator and banks man should be allowed close to the working area. The cabs of all machines should be strong enough to protect the operator against the fall of debris. In particular, the windscreen and roof light should be of shatterproof material and guarded by a grille of steel bars or a substantial mesh.

If explosives are to be used for demolition, the planning and execution, include pre-weakening, should be under the control of a person competent in these techniques. For large demolition, the competent person is likely to be an experienced explosive engineer; for smaller work, a shot-firer may be sufficient.

When the use of explosives is contemplated, it is usual to employ a technique that will ensure the total demolition of the whole building by staging a controlled collapse. The explosive charges are set and fired in a sequence that will weaken the structure in such a way that the building collapses in upon itself.

**Wire Rope Pulling** - this method is the application of a horizontal force at a high level by pulling with wire ropes attached to winches or vehicles, and allowing the impact on overturning to demolish the building or structure. An adequate steel cab or cage should protect the winch or the pulling vehicle and the operator. Buildings over 21m high should not normally be demolished by rope pulling.

Impact hammers normally have a track- or wheel- mounted chassis, an articulated boom, and a heavy duty pick, vibrated by hydraulic or pneumatic power to demolish concrete or masonry.

Nibblers use a rotating action to snap brittle materials such as concrete or masonry. In either case, material should be removed from the top of walls or columns in courses not greater than 600mm in depth, steel reinforcement should be cut separately as necessary.

Buildings and structures normally have structural elements designed to carry safely the loading likely to be imposed during their life.

### ***Deliberate Controlled Collapse***

As a preliminary to a deliberate controlled collapse, after loads such as furnishings, plant and machinery have been removed, the demolition contractor may be able to weaken some structural elements and remove those now redundant. This pre-weakening is essentially a planned exercise and must be preceded by an analysis of its possible effects on the structure until it collapses, to ensure that the structural integrity of the building is not jeopardized accidentally. Insufficient information and planning relating to the structure may result in dangerous and unsafe work.

The deliberate collapse of the whole or part of a building or structure requires particularly high standards of planning, supervisions and execution, and careful consideration of its effect on other parts of the structure or on adjacent buildings or structures. A surrounding clear area and exclusion zone are required to protect both personnel and property from the fall of the structure itself and debris which may be thrown up by the impact.

The collapse is usually achieved either by removing key structural elements (e.g. with explosive charges) or by wire rope pulling at a high level to overturn the structure. The possible modes of failure must be studied to ensure that the method selected will produce the required pattern of collapse. If the operation is not successful, the remaining structure may be extremely dangerous for the completion of the demolition.

Demolition by deliberate controlled collapse is not usually appropriate for prestressed concrete except for simple pre-tensioned floor planks or slabs.

## 12.4 Planning & Pre Demolition Surveys

Before any demolition work can commence preparation and planning is essential. The previous use of the building needs to be identified, is it a complete demolition or just part of the structure, is it likely the building was built on contaminated land?

Before any demolition occurs, it is essential that a pre-demolition survey be undertaken, this will allow the individual situation to be examined and for the relevant safe systems of work to be determined before work commences. The survey should aim to identify:

- the method used to construct the building originally
- whether there are any adjacent buildings which may be affected
- location of overhead and underground services
- any hazardous substances present i.e. asbestos
- any items which could affect the building's stability e.g. underground tanks or vaults
- Type of structure
- Identify post tensioned structures
- Condition of structural members
- Shoring requirements
- Cellars/storage tanks
- Services
- Hazardous materials
- Hazards from structure
- Hazards from state of decay
- Presence of other structures
- Access to the site
- Removal of waste
- Certificates from gas/elec suppliers of isolation



The survey would normally include the making of exploratory holes in walls to find out how they are supported and what they are made of, as usually this information is not readily available. Investigations may need to be made to identify key structural

elements including pre-and post-tensioned components. Anyone involved in the pre-demolition surveys must be deemed to be competent.

This information should allow the surveyor to identify how the building can be safely demolished, the nature of the work that will need to be carried out and in what sequence the work must take place. (BS 6187 gives guidance on Demolition) Before demolition takes place, several different bodies need to be informed of the planned project. Namely: HSE, Gas, Water, Electricity companies, Highways Agency and any owners of adjoining properties. Many HSE inspectors will willingly visit a site when the preliminary survey is being carried out. After the survey, decisions will need to be taken on how the task is to be done.

## 12.5 Hazards

“anything with the potential to cause harm”

Typical demolition hazards include:-

- Flying particles
- Explosion
- Moving plant and equipment
- Work at height / falls from height
- Premature collapse
- Pre-stressed concrete
- Flying debris
- Unstable building
- Stored energy
- Damage to adjacent buildings
- Work at height -persons falling
- Material falling
- Confined spaces
- Cellars
- Dust
- Hazardous substances (asbestos/lead/solvents/mercury)
- Sharps / sharp objects
- Noise & vibration
- Pcb's
- Fluorescent tubes
- Un-isolated services
- Debris falling from heights.
- Flying glass
- Plant collapsing or falling into basements etc.
- Health hazards from chemicals, asbestos, lead based coatings, biological contamination.
- Ionising radiation from fire detectors
- Debris, timber with protruding nails etc.
- Unplanned pre-weakening
- Pre-stressed & post-tensioned concrete structural members
- Manual handling during soft strip stage

All services will need to be isolated before work on demolition commences. A competent site supervisor must be appointed to co-ordinate the demolition. He will decide what measures are required to ensure the work can be carried out safely, not only for those involved in the work but also anyone else who may be affected.

## 12.6 Demolition Methods

The actual demolition system used will be determined by the type of building and how it was originally constructed. The main methods which can be used are:-

- Hand demolition
- Mechanical by pusher arm
- Mechanical by deliberate collapse
- Mechanical by ball and chain
- Intentional explosion

Prior to the main demolition stage, the fixtures and fittings will normally be removed from the building during the “soft strip” stage.

- Soft strip carried out prior to structural demolition
- Removal of anything with scrap value
- Involves workers inside structure
- Most hazardous part of demolition:
  - Hazardous materials,
    - lead
    - Asbestos
    - PCBs etc
- Removal of some of the load-bearing components

### **12.7 Management of Demolition Projects**

The application of a typical safety management system can be applied to demolition, it is supported by the key responsibilities of the Principal Contractor and Principal Designer.

The project must be managed with consideration to the following procedures and paperwork:-

- Pre-demolition survey
- Risk assessment
- Statutory inspections
- Formal training & certifications
- Supervision
- PPE standards
- Licensing of plant drivers
- Permits to work for high risk activities
- Method statements for each stage of demolition
- Health surveillance
- Monitoring on site – site inspections and audits

At the end of the project, an H&S file must be prepared to give the land owner details of the site, service locations etc.

### **Key People**

The people in charge of the site, as well as the specific demolition project, must be identified. Their specific responsibilities need to be clarified; these may include the level of competence required to carry out certain specific tasks.

Co-ordination of the task is essential with communication key; there are a number of people who have a key role in ensuring safety standards on site. (See Element one for further details of the CDM requirements).



## 12.8 Controlling the risks

### Access

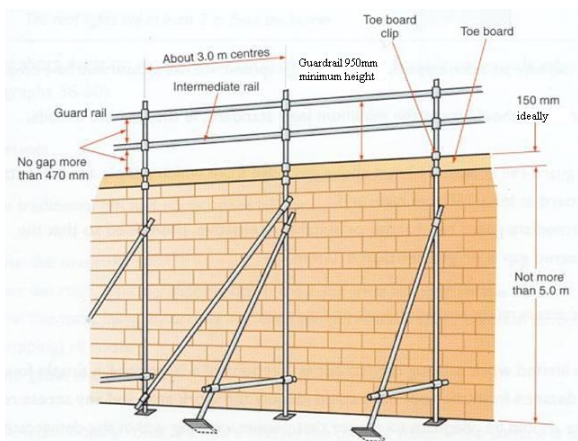
This can be via the existing stairs, independent scaffold, mobile scaffold, mobile access equipment such as mobile elevated platforms and ladders. Holes may be made in the floor to allow access and for items to be pushed or lowered through. The means of escape from a roof in an emergency must also be considered.

This includes how safe access and egress to the whole site and specific structure will be achieved and maintained.



### Protection against falls

The best option is to carry out the demolition work remotely rather than working at height. Netting does not prevent falls but it does reduce the risk of injury. Harness and fall arrest systems may be needed where work at height cannot be avoided.



### Falling objects

- Toe boards & close boarded platform
- Chutes
- Barriers at ground level
- **Plant &**



**Equipment** - What equipment will be used, any special arrangements for delivery erection, dismantling, location and maintenance.

- **Pre-Weakening Arrangements**
  - removal of fixtures and fittings
  - explosives
  - temporary supports
- **Protection of People - Public**
  - Employees
  - Trespassers
  - Neighbours
- **Removal of Services** - Arrangements for temporary services may need to be provided where required. Protection may also be required to prevent mains being fractured by the heavy weight of falling rubble which could cause possible explosions or broken sewers.

- **Noise** – Noise from demolition can be dangerous for employees and a nuisance to neighbours. From the employee perspective, if noise reaches 80dB(A) Lepd, an assessment must be carried out. Machinery will need to be fitted with silencers and barriers may need to be erected. Suitable ear defenders will be needed. To reduce complaints from neighbours, site vehicle car parks away from neighbours.
- **Flammable materials** – Consider how and where they will be used, precautions required storage arrangements etc.
- **Hazardous Substances** – consider:
  - How they will be identified
  - Disposal arrangements
  - Protective measures and PPE
- **Transport** – Consider how it will be organised, traffic routes, clearways, sufficient space from demolition area and the removal of waste will all need to be considered.

#### **Dust and debris control by**

- Light water sprays
- Air movers/fans
- Sheeting
- Netting
- Limit crushing on site
- PPE – respirators

#### ***Environmental Issues***

- Limit crushing concrete on site to avoid dust generation, but it can be good practice to enable reusing to reduce the transportation impact and carbon foot print from moving large heavy bulky materials.
- Trained workers who know their duties in respect to waste management.
- Check waste for contaminants
- Separate – recyclables/hazardous
- Waste license for waste collection/Waste transfer notes/Hazardous waste consignment notices
- Arrange for waste collections on regular basis
- Keep records of waste taken off site
- Limit fires on site
- Wheel washing
- See mechanical handling and work at height section for further details of moving objects and people.

#### **Security Arrangements**

Within the construction industry many deaths occur every year, included in these figures are the some 12 fatal accidents to members of the public, including 2-3 children.

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All employers and self employed have a legal duty under S3 of HASAWA to protect members of the public from the hazards of construction, this also includes contractors and sub contractors who may be working on the project.

Non-employees who may be affected by a construction project:

- visitors
- trespassers
- representatives of the client
- members of the public passing nearby

Visitors should be accompanied where possible, provided with information on the possible hazards they may encounter and be provided with adequate PPE. Those working on site should also be made aware that visitors are to be expected.

Trespassers who are thieves or vandals and members of the public etc. are still owed a common law duty of care. The contractor and client need to ensure both authorised and unauthorised people visiting are safe whilst on site.

### **Signage**

Warning signs alone are not sufficient to prevent many people from either entering a site or going into a danger zone, especially children will ignore such signs. The HSE has produced a guidance note (GS7) which relates to the precautions to prevent children having accidents on construction sites.

### **Perimeter Fencing**

Suitable fencing should be provided, close boarded to a height of 2m. Access gates should be supervised, where the fence has to be taken down to allow access it should be replaced as soon as possible.

### **Barriers & Fencing**

Perimeter fencing will not be appropriate for many instances such as external refurbishment, demolition work or street works. Protective barriers can only be provided at ground level where road works are carried out there are details laid out by the Department of Transport.

Scaffolding should be close boarded and should be provided with brick guards or netting, alternative routes away from the danger area should be signed. Waste skips should be stored in a cordoned off area. Adequate lighting may be needed if member of the public will be passing nearby especially during the night.

### **Site Roads**

Roads should allow good visibility of the site, especially at entrance and exit points. Where possible pedestrians should be kept away from any vehicle movement. Any temporary or permanent road services should be of a suitable construction, dense material, drained and maintained to reduce the possibility of accidents.

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## 12.9 Demolition Method Statements

CDM 2015 requires a method statement to be written for all demolition work. This should ensure that consideration has been given to how all the main hazards and risks will be controlled.

### Sequence of Demolition

- Removal of fixtures and fittings
- Holes are normally knocked through the floors to allow rubble to be dropped through. This can help prevent an uncontrolled collapse caused by the weight of a build up of rubble.
- Exposure of structural steel - This is normally cut to avoid the transmission of vibration into other buildings.
- Removal of walls and concrete floors - these are normally punched by plant
- Supporting girders are normally burnt through
- Removal of waste

Typical other issues covered will include:-

- Scope of the work
- Methods of demolition to be used
- Key people and their competence or training requirements including the named responsible person for the project
- Contact utilities
- Service disconnection
- Provision of temporary services
- Soft strip requirements e.g. removal of fixtures and fittings
- Goal posts – O/H cables
- Asbestos removal
- Plant to be used on site
- Security
- Signage & exclusion zones
- Sheeting/netting
- Machines/crane specific
- Protection from falls
- Access to site
- Shoring adjacent structures
- PPE: hard hats, safety foot wear, harnesses, gloves etc.
- Emergency plans
- Methods for working safely at height.
- Protection of the third parties and the public
- Waste management
- Welfare provision
- Communication