

# Demolition Practices – an Review of Recent Local Project Cases (Demolition within Urban Environment)

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Is this the way to  
demolish a building?

Demolition work is one of the most dangerous operations in construction.

### Reasons/causes:

- Easy to cause injury to human workers due to the difficulty of accessing into or working inside a building which is under demolition.
- Falling of smaller objects or debris from the demolishing building.
- Falling of partially demolished structure.
- Collapse of unstable structure due to original structure being disturbed.
- Employing inappropriate methods to demolish

## Reasons/causes (continued):

- Collapse of heavy demolition equipment due to inadequate support of the partially demolished structure.
- Collapse of the partially demolished structure due to the accommodation of large amount of uncleared debris.
- Congested site environment that easily cause damages to human workers, or to the third parties and their properties that are situated nearby the demolition site.





Difficult  
access for  
workers  
entering into  
a building  
under  
demolition





Further examples  
of difficult access  
in demolition jobs







Partially demolished structure is hazardous and may easily collapse and create accident





Heavy machinery used in demolition may have risk of collapse due to insufficient support.







Accommodation of too much debris during demolition can impose intolerable loading to the disturbed structure







Typical congesting neighbourhood condition for demolishing small buildings within urban environment

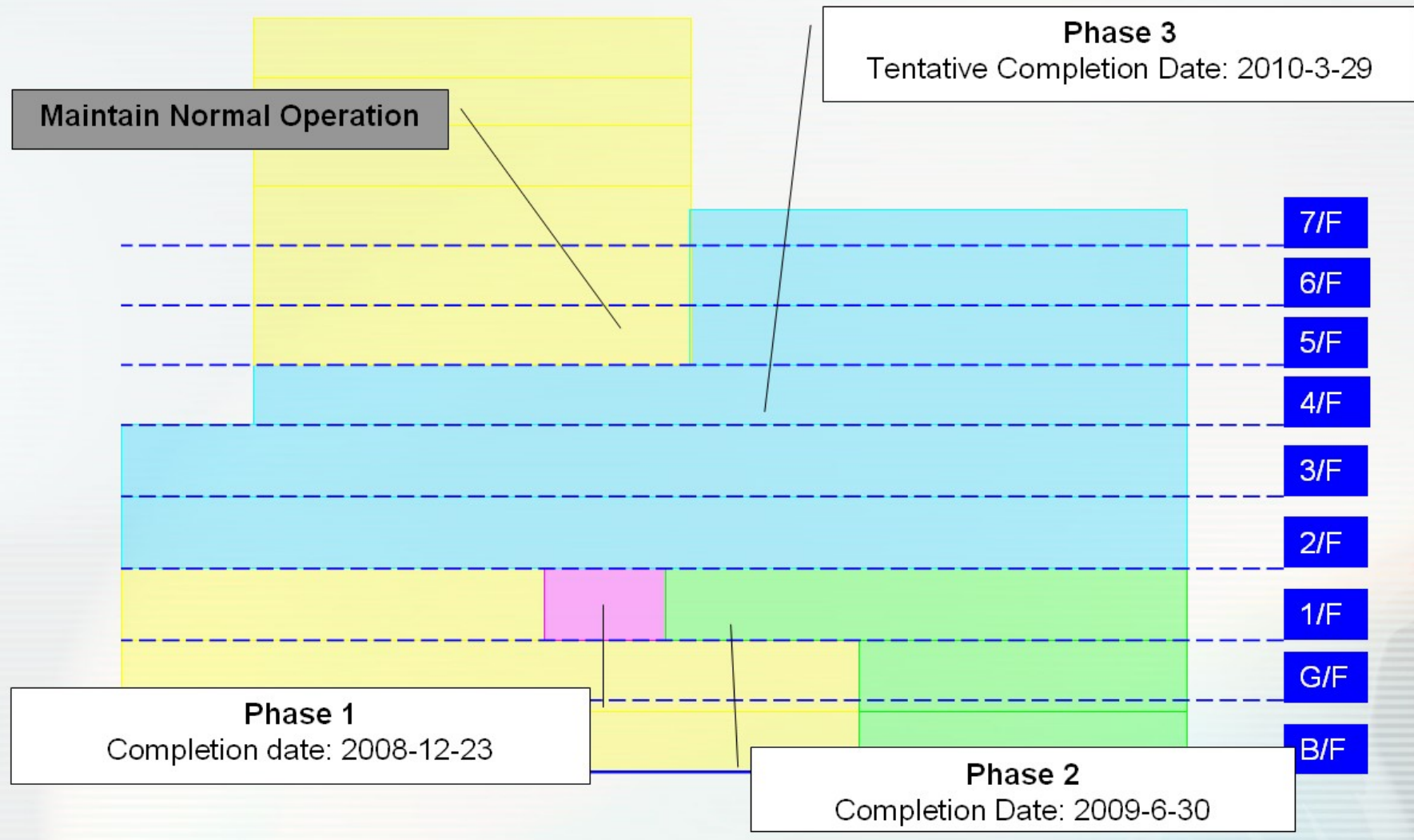


Why demolition is needed?

What kind of projects need demolition?

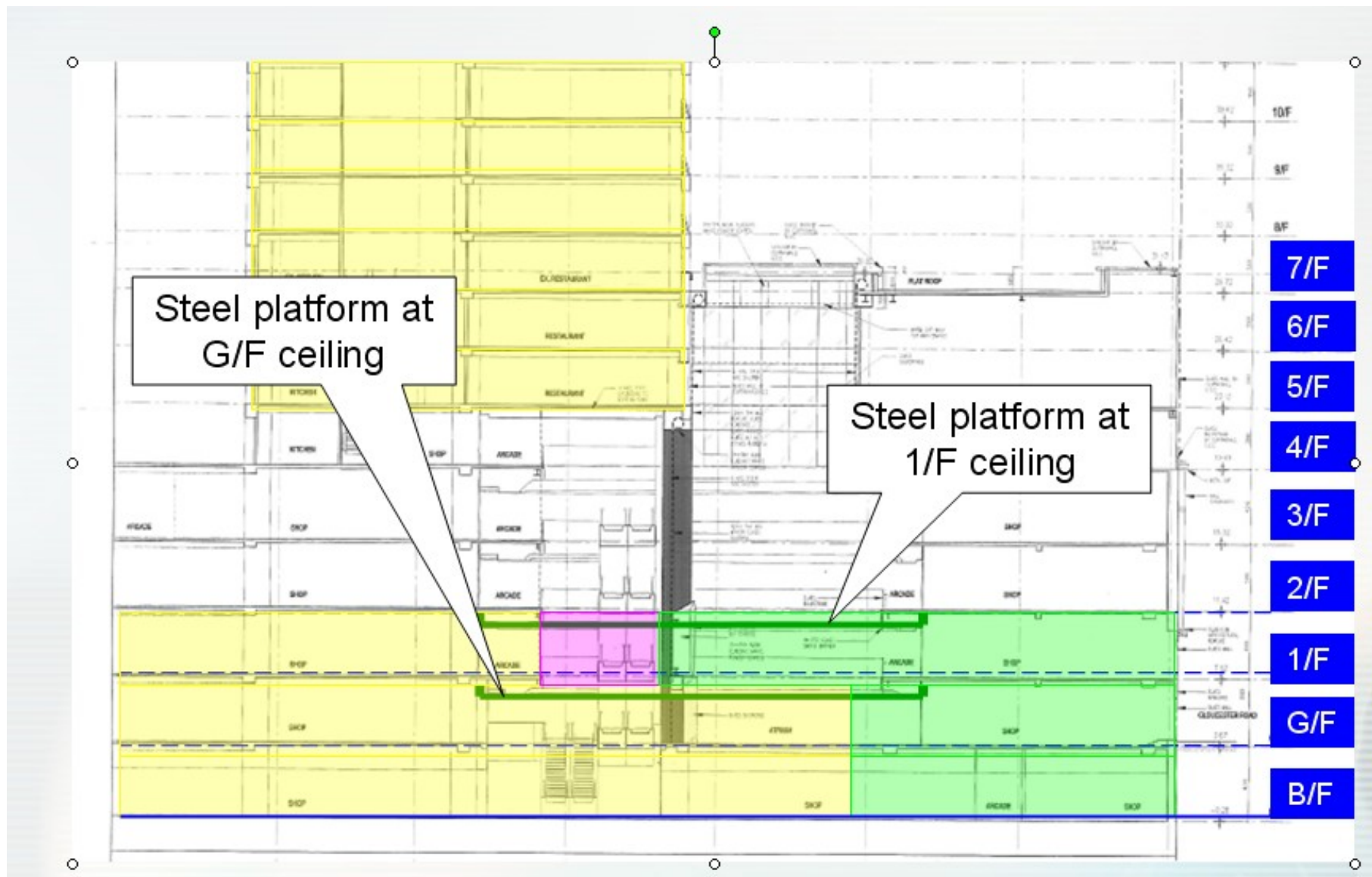
1. Building redevelopment where existing buildings need to be removed.
2. Building alteration projects in which a number of the existing elements need to be removed, altered or re-layout. (esp. for large scale work like a shopping mall)
3. Building works in which new and old facilities needed to be broken through for temporary or permanent access. (e.g. a new pedestrian subway cutting into a basement)
4. Other civil engineering works

# Construction Area



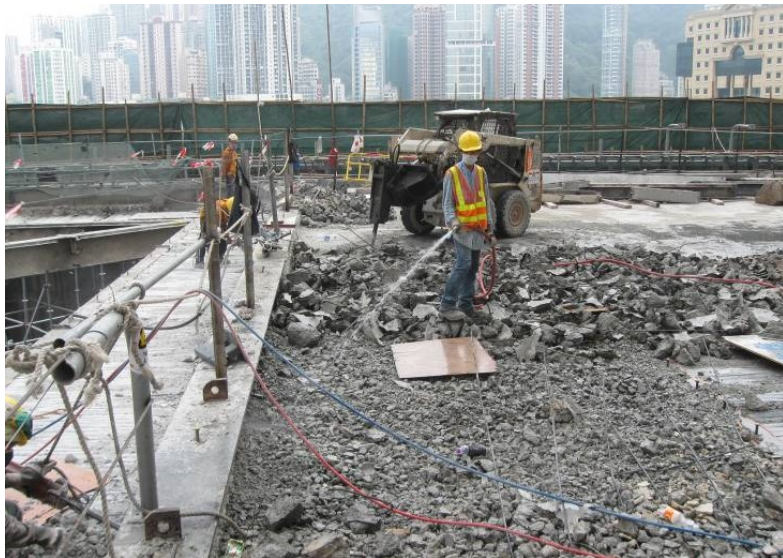
Example for large scale building alteration project inside servicing facilities (the Windsor House A & A project)





Special safety and user provisions during demolition and other A & A works









Building Department has imposed very strict control to any form of demolition works by the use of approval & consent procedure

1. Authorized person (AP) should be appointed to submit application for approval of the demolition, which includes an appraisal report with a method statement proposed for the demolition.
2. Building Department will approve the work subject to the satisfying of all precautionary measures pursuant to the Building (Demolition works) Regulations, as well as the provision of hoarding and covered walkways or any other safety arrangement to satisfy the on-site conditions as required.



3. After approval is obtained, another 2-stage consent procedure are still required before starting the actual demolition.
4. Stage 1 is to obtain the consent for carrying out all precautionary/temporary works which include the installation of the hoardings, covered walkways, scaffolding, catch fans, dust screens and shoring etc.
5. In case the provisions in Stage 1 is completed and to the satisfaction of the Building Department, Stage 2 of consent for the actual demolition can be applied. Demolition can be started only with the successful obtaining of the consent.

Appraisal report as part of the submission documentations. In the report, the following information should be included:

1. Structural survey of the building to be demolished
2. Photographic record of the site and its adjacent buildings, slopes and retaining structures.
3. The overall height of the structure above ground level and the proximity to adjoining buildings.
4. Information on the type of building, its structural support system, the principal materials of its construction, the degree of deterioration and the effect of demolition etc.

Detail structural survey in particular to the following special structures:

- a) Cantilever
- b) prestressed concrete or precast concrete structures
- c) structures supported by ties
- d) special floor structures - waffle floor, flat slab
- e) transfer plate and deep beams
- f) major arches, trusses or girders
- g) earth retaining and basement structures
- h) chemical works, gas works, dangerous good storage
- i) other special structure, such as structural steel, super long span or high headroom

- a) Proposed shoring and precautionary measures for adjacent buildings
- b) Proposed methods of demolition.
- c) Proposed methods of handling and disposing of the demolished materials
- d) Proposed sequence of carrying out work.
- e) Detail of equipments used, with methods of raising, lowering or supporting the equipments.
- f) Proposed arrangements for site supervision



# Demolition Plan

Another required documentation to be submitted to BD for approval is the Demolition Plan, which include the following information:

- a) A set of drawings showing :
  - the location of the building to be demolished
  - other existing structures and facilities in vicinity
- b) Proposed methods of demolition.
- c) Proposed shoring and precautionary measures for adjacent buildings
- d) Proposed shoring and protection for the building to be demolished

# Demolition Plan

- e) Proposed methods of handling and disposing of the demolished materials
- f) Proposed sequence of carrying out work.
- g) Detail of equipment used, with methods of raising, lowering or supporting the equipment.
- h) Structural calculation to justify the proposal
- i) Proposed arrangements for site supervision



Typical dust screen and fans provision to protect building and minimize disturbance to public during demolition







Provision of Hoarding as a protection to public

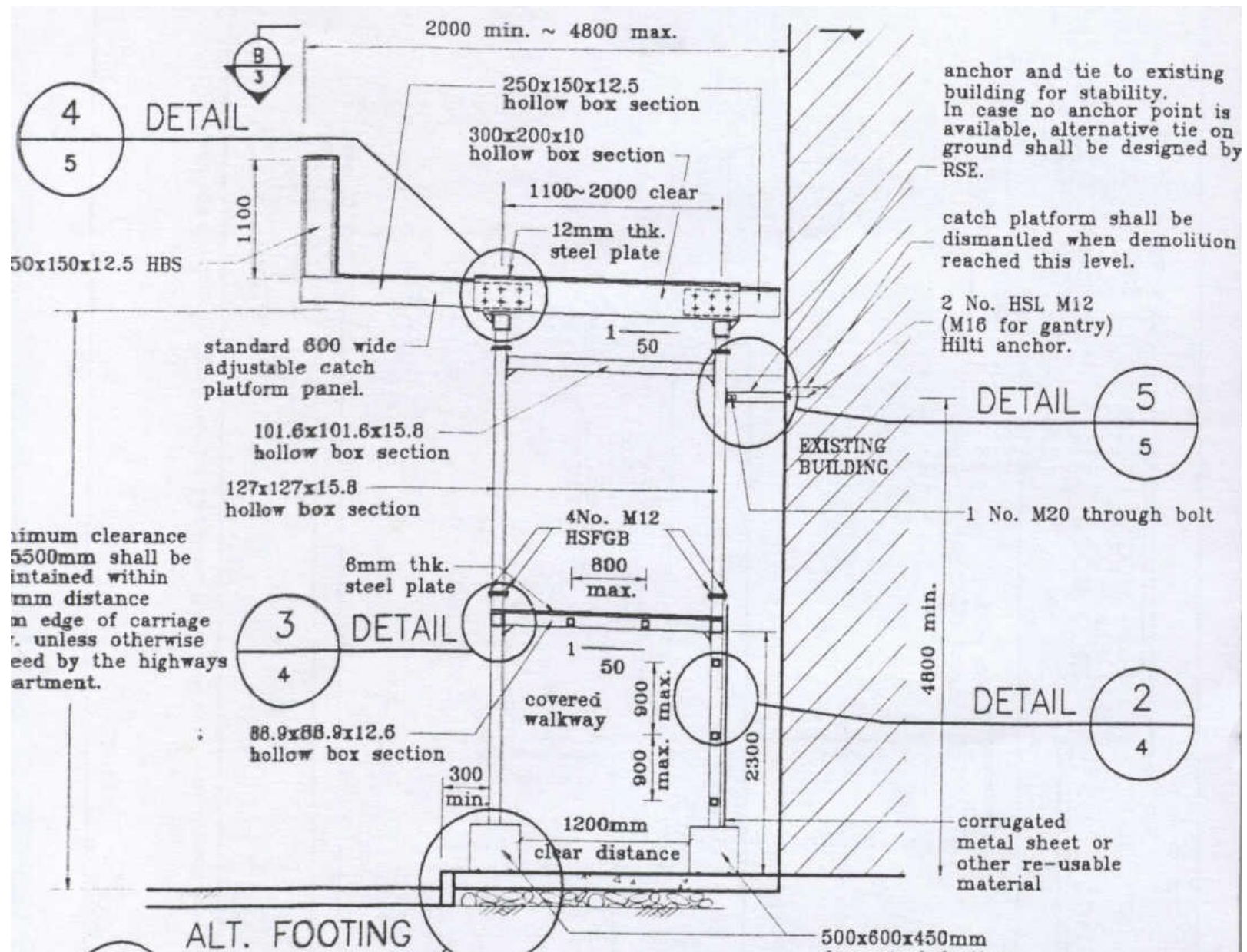






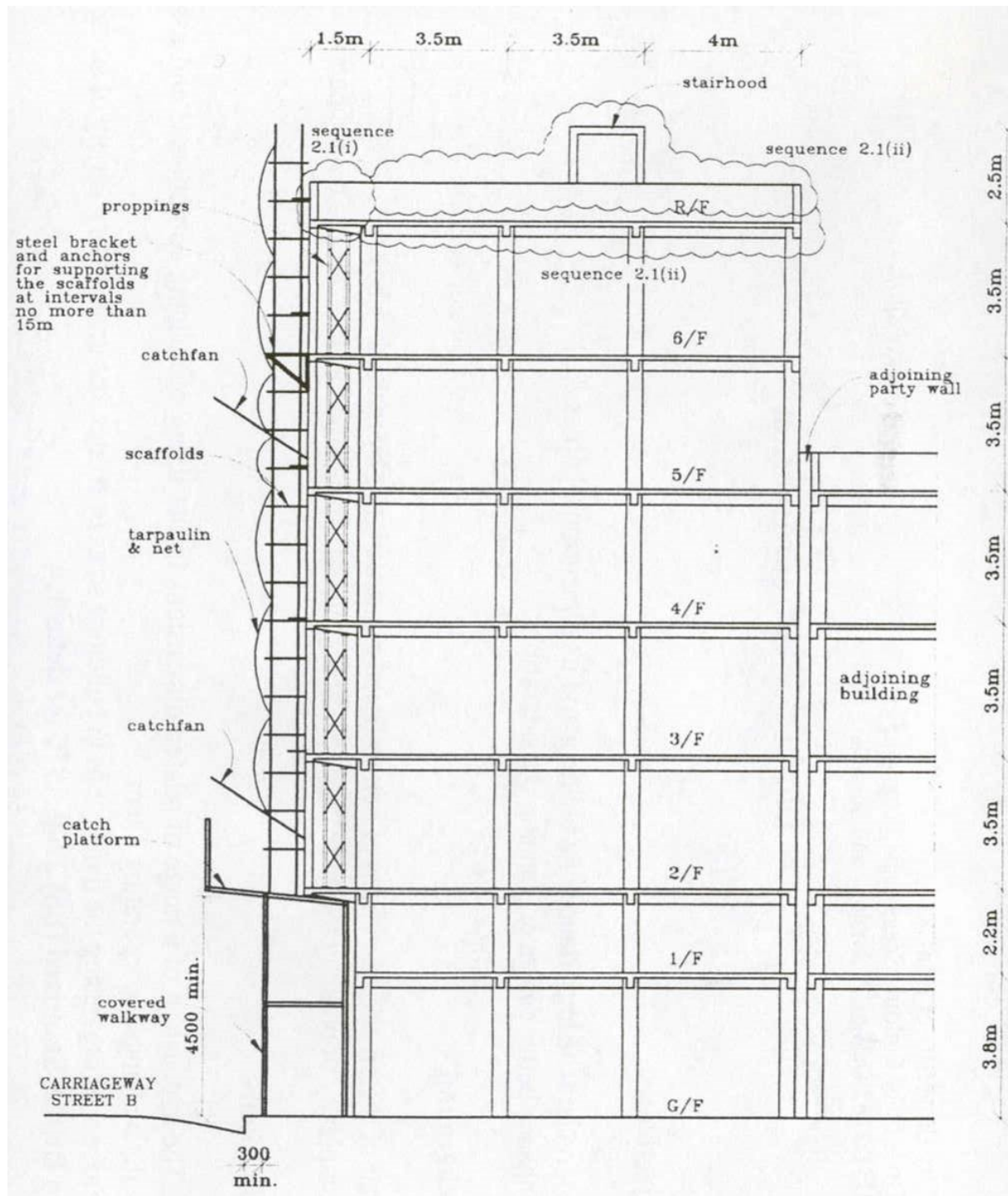






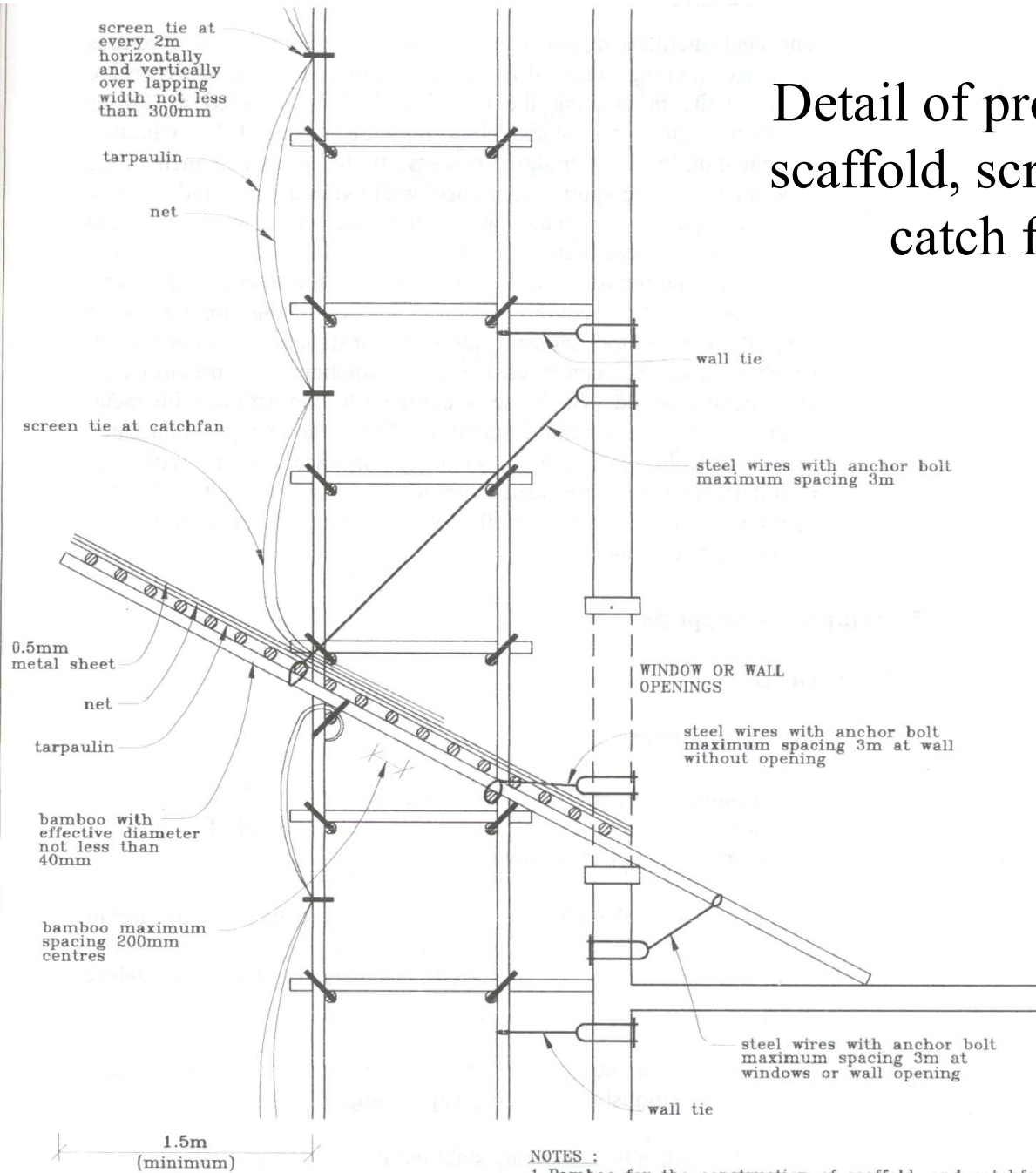
Provision of Hoarding as a protection to public





Provision of Fence and screen to prevent falling of debris and getting out of dust

# Detail of protection scaffold, screen and catch fan



## NOTES :

1. Bamboo for the construction of scaffold, and catchfan shall have an effective diameter not less than 40mm.
2. Metal sheet, net and tarpaulin shall be fastened to the bamboo deck at 4 corners of the sheet or at spacing no less than 1.5m apart whichever is less.





Shaft for falling  
of debris

Common ways to get rid of the demolished debris – to control the falling of the debris into a pre-determined vertical shaft formed on the floor slabs





Debris shaft formed by opening temporarily cut on floor slab



Debris collection area at ground floor under the debris shaft





Temporary props erected to support heavy equipment







Erection of shoring to support  
affected structure

- a) Basement demolition (left)
- b) A nearby retaining wall (right)



Typical sectioning/  
sequencing arrangement of  
work during demolition –  
demolish from exterior  
inward







Typical sectioning/  
sequencing arrangement of  
work during demolition –  
demolish from one side to  
the other side of building







Typical layout  
arrangement in small and  
medium sized building  
under demolition









Typical layout  
arrangement in  
small and medium  
sized building  
under demolition



The following concerns related to the protection and safety of general public or their properties should be provided in the demolition process

1. Overall structure of the adjacent buildings (stability).
2. Party walls and external walls of adjacent buildings (sealing and waterproofing)
3. Foundations of other buildings which may be affected.
4. Public roadway and traffic.

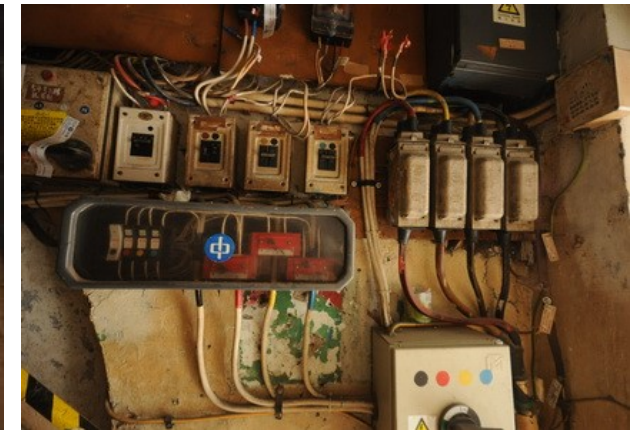
1. Terminate, disconnect or cut off all existing services (gas, water, electricity, drainage etc.)
2. Remove all other building elements or fixtures that are not appropriate to be done by usual demolition equipments. (sometimes also for recycling or regulation requirement for C&D waste reasons)
3. Carry out all required precautionary measures before demolition.
4. Carry out temporary propping and support to facilitate the demolition process.
5. Form access for workers and equipments to carry out the demolition.





Site needs to be prepared/set-up before demolition can be carried out



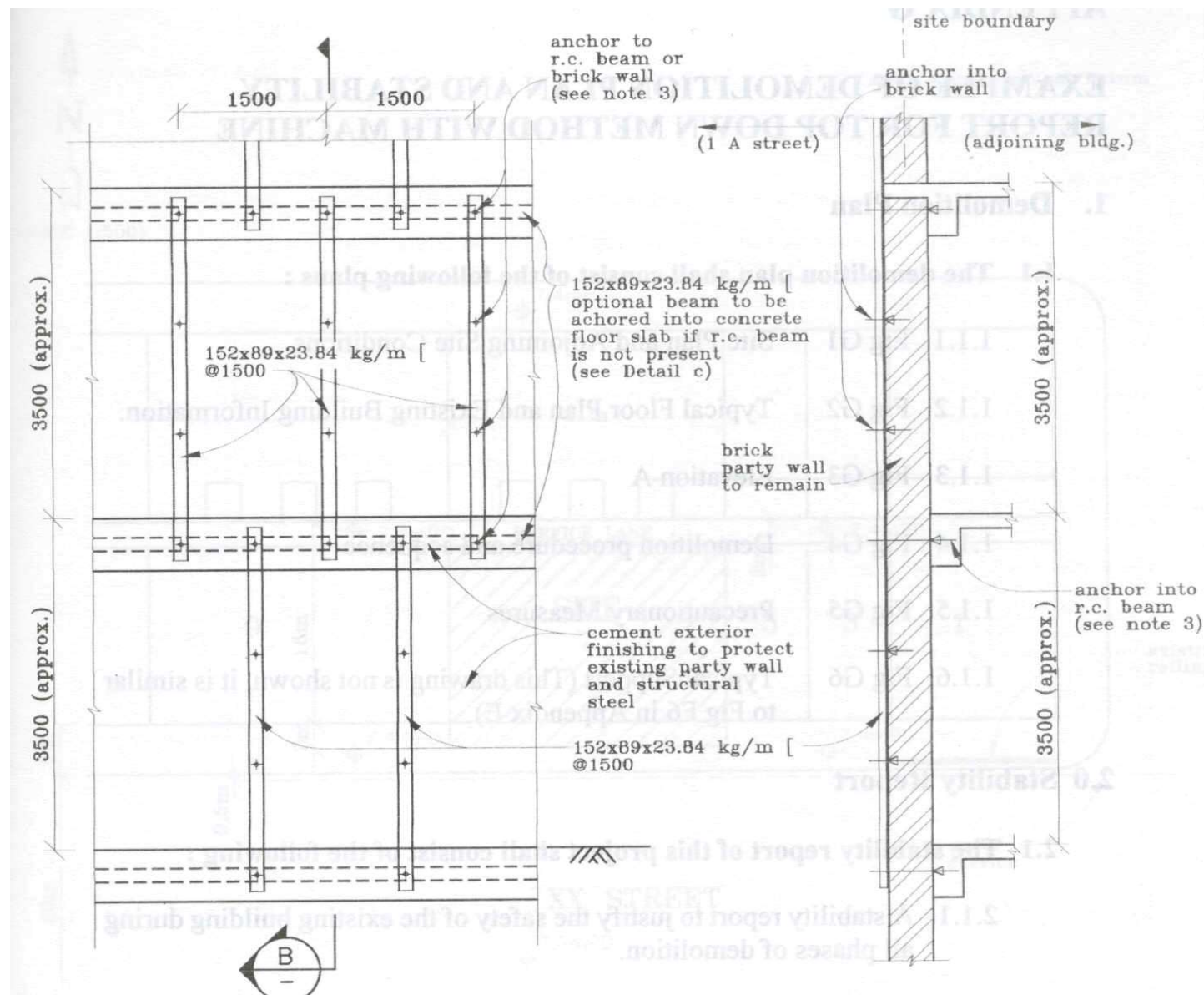


Site needs to be prepared/set-up before demolition can be carried out





Site needs to be prepared/set-up before demolition can be carried out



Strengthening of party wall of adjoining building after demolition  
(by the use of stiffening frame)





**Timber raking shore as a temporary support to adjacent building**

**Shoring support to adjoining building after demolition**





Stiffening frame to strengthen an exposed party wall



Strengthening of party wall of adjoining building after demolition













# Method of demolition

## General Concerns

The choice of choosing a demolition method depends on a number of factors such as the project conditions, site constraints, sensitivity of the neighbourhood and availability of equipment etc.

In general, top-down methods are applicable for most sites, particularly for those situated in busy urban areas. Other mechanical methods applied from the outside of a building may be suitable for projects that have sufficient clear spaces.



# Method of demolition

## General Concerns (continue)

For structural projections such as balconies, canopies and verandahs extending beyond the building lines, demolition by hand held tools or the cut and lift process may be a safe solution.

Each site has its specific features and conditions. The method, including detail procedures, shall be designed to accommodate the specific project requirements. In general, demolition should be done in the reverse order of construction.

# Method of demolition

## Demolition by human operatives –

This method particularly suitable for use in smaller site with congested space where larger machine cannot be employed.

In this case, human operatives are used in the demolition process using simple electrically or pneumatically powered tools such as picks, hammers, wire cutters, welding cutters or hand driven hydraulic jacks etc. to carry out the demolition of individual elements.





Typical demolition arrangement done by human operatives





Typical demolition  
arrangement done by  
human operatives

Slab with the sides  
disconnected ready  
for dismantle





Worker breaking  
down larger piece of  
structure which was  
demolished by  
pulling/pushing  
method.



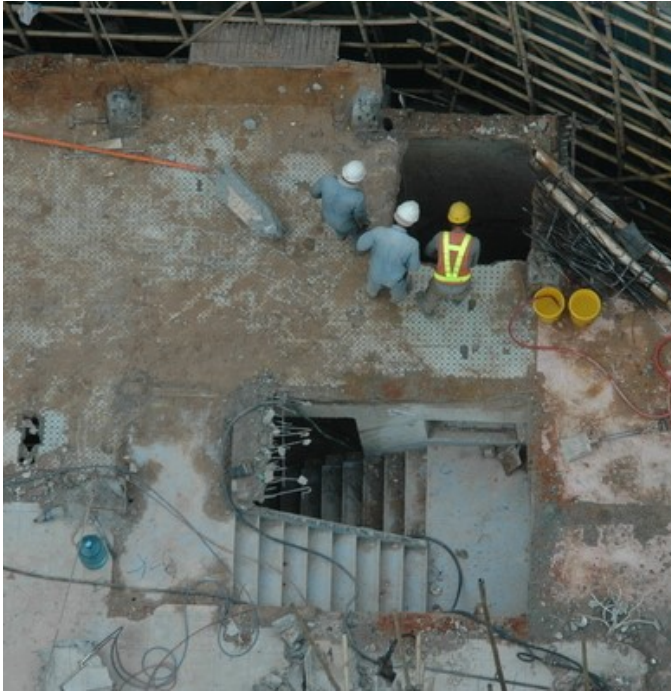




A number of  
works where  
human  
operative is  
unavoidable







A number of works inside demolition site where human operative is unavoidable





Working condition  
and behaviour of  
human operatives









# Method of demolition

Deliberate collapse method –

Demolition by deliberate collapse consists of systematic removal, or weakening of the key structural elements to induce the collapse of the structure.

However, when applying this method, several precautions should be observed, such as:

- Sufficient distance of collapse should be provided
- Collapse procedure should be carefully designed so that there is no pre-mature collapse or collapse out of the anticipated area.
- Control height of building structure to be collapsed



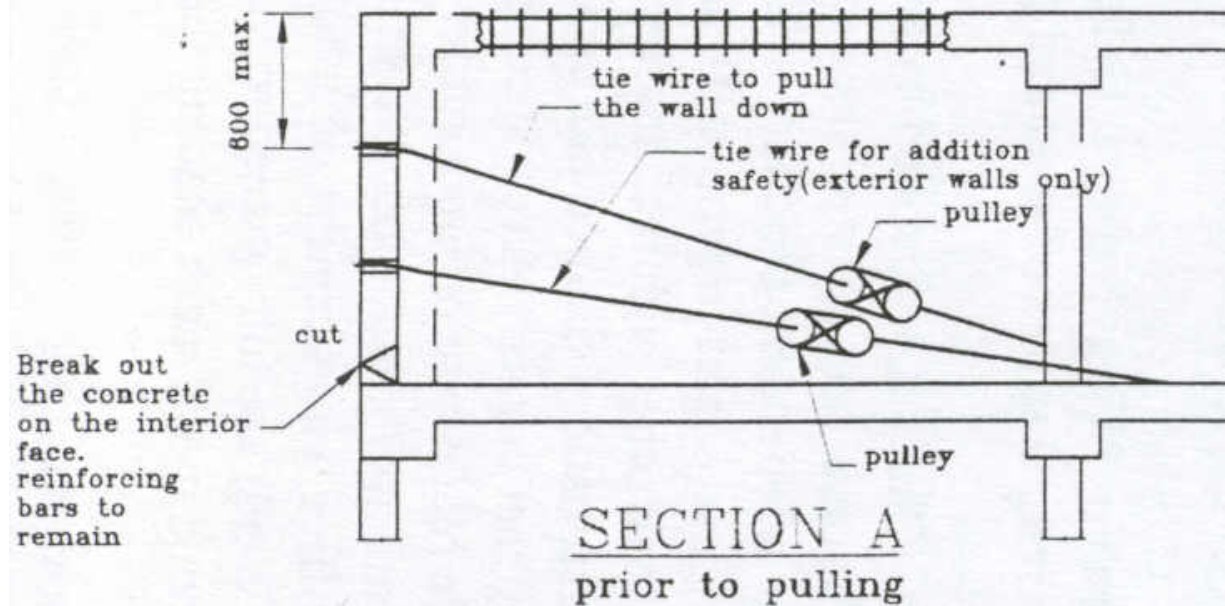
# **Method of demolition**

Using of applied pulling/pushing forces

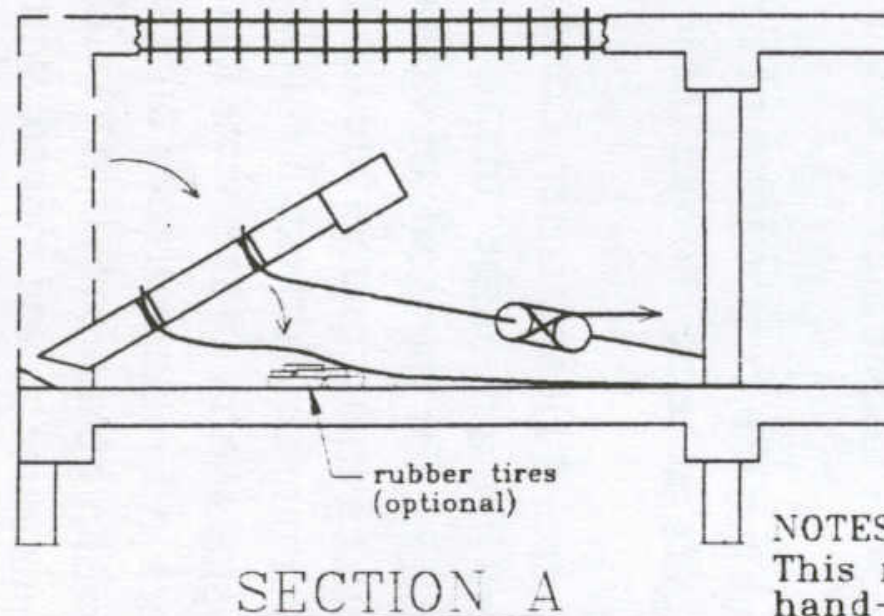
Connecting structural members are disconnected first allowing part of the remaining structure to be dragged down by the use of some pulling/pushing equipments such as powered jack, winching machine, pulley systems, pushing arms, powered blocks or from the pull/push of a hydraulic excavator.

However, a firm base in the demolishing building is required such as basing on an undisturbed core wall or a strong column section for the applying of the pulling/pushing force.

# Demolition of an external wall by pull-down method using pulley



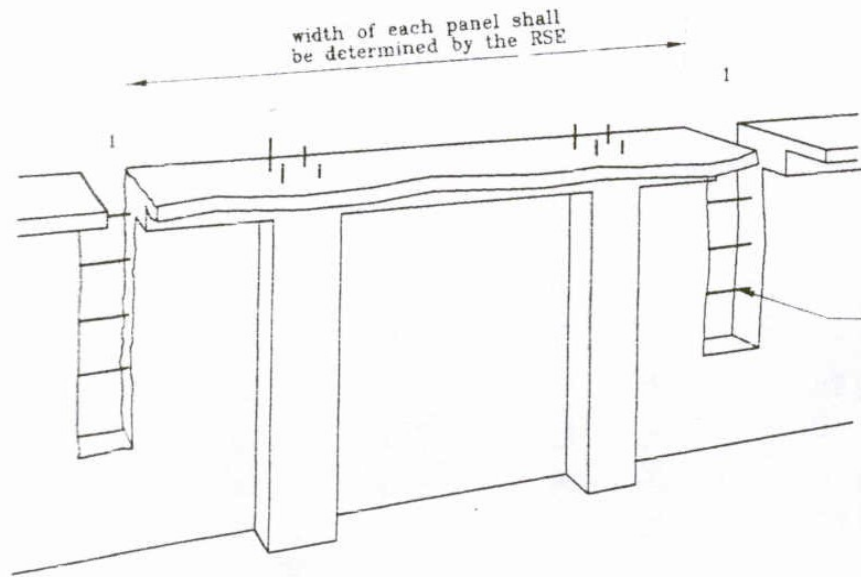
Cutting away the reinforcing bars connecting the wall section. Reinforcing bar at the bottom to remain. Pulling down the wall section by wire and winch in a controlled motion.



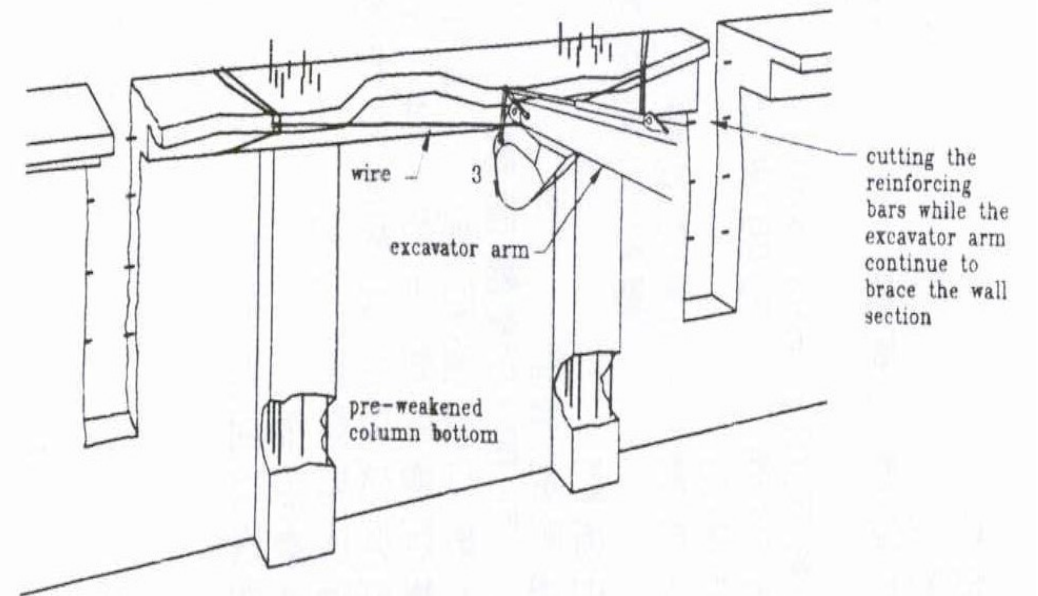
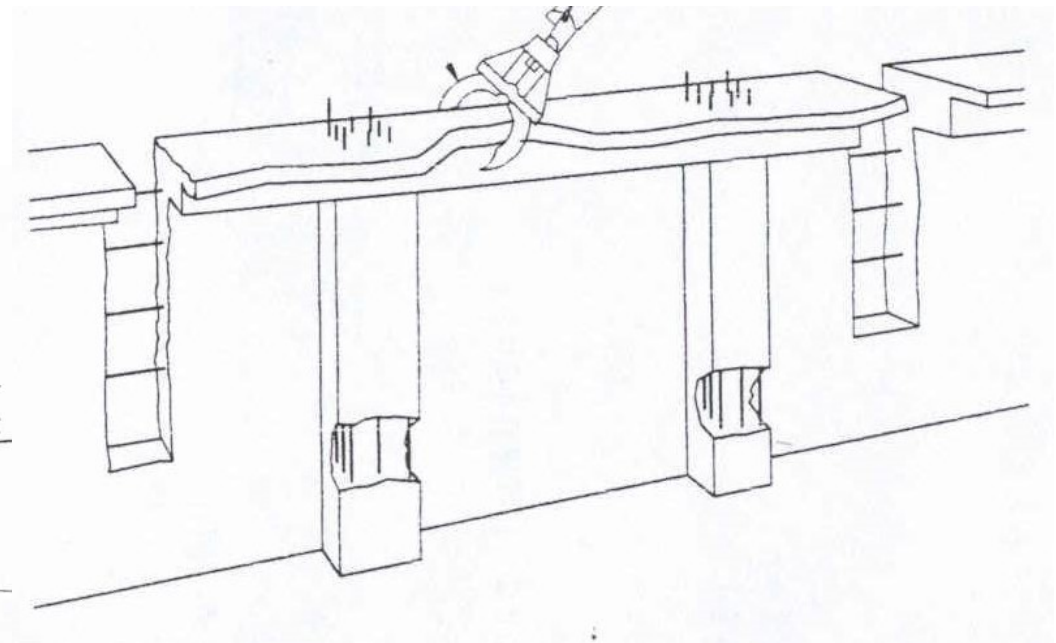
NOTES :

This method may apply to both hand-felling of interior and external walls.





Demolition of an external wall by pull-down method using excavator arm





Disconnected  
external wall ready  
to be pulled down  
by an applied force

Demolition done by  
applying a pulling force to  
a portion of structure

Remain fragments from  
pulled-down structure to  
be removed afterward





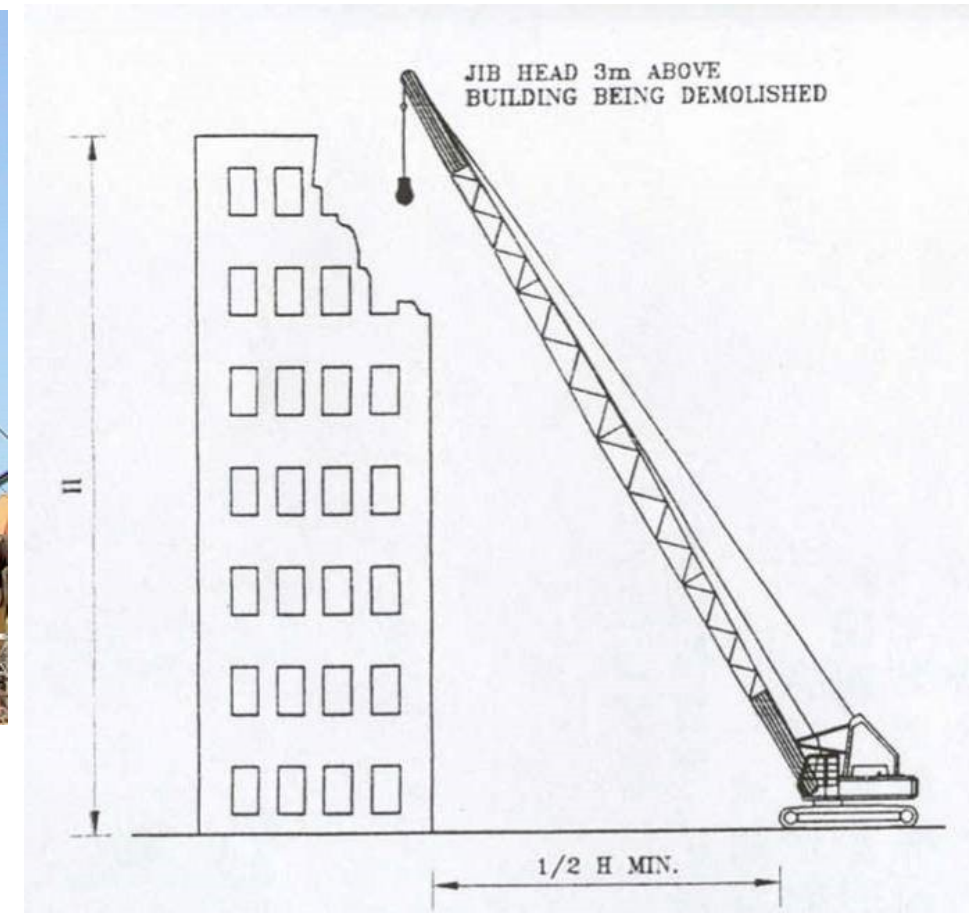
# **Method of demolition**

## **Using of wrecking ball -**

The use of wrecking ball method requires a crane equipped with a steel ball. The destruction of the building is caused by the impact energy of the steel ball suspended from a crawler crane.

The wrecking ball can be operated outside or inside a building. In case the process is operated inside a building, sufficient clearance from the building interior should be made first (by having the interior portion of the building demolished)

This method also demands experienced operators in order to handle the wrecking ball and control the demolition sequence in a safe manner.





# **Method of demolition**

Use of powered plant or demolition machine -

The principle of demolition by machine is typically the same as the top-down manual method, except that most of the demolition begins with the lifting of the mechanical plant on to the building top floor.

Powered plant such as crawler mounted breaking hammer are used in the demolition process and excavating machines with bucket are used in the removal or handling of the demolished materials.

However, due to the weight of these machines, they should be properly supported such as by the use of steel props no matter in still or in operating condition.



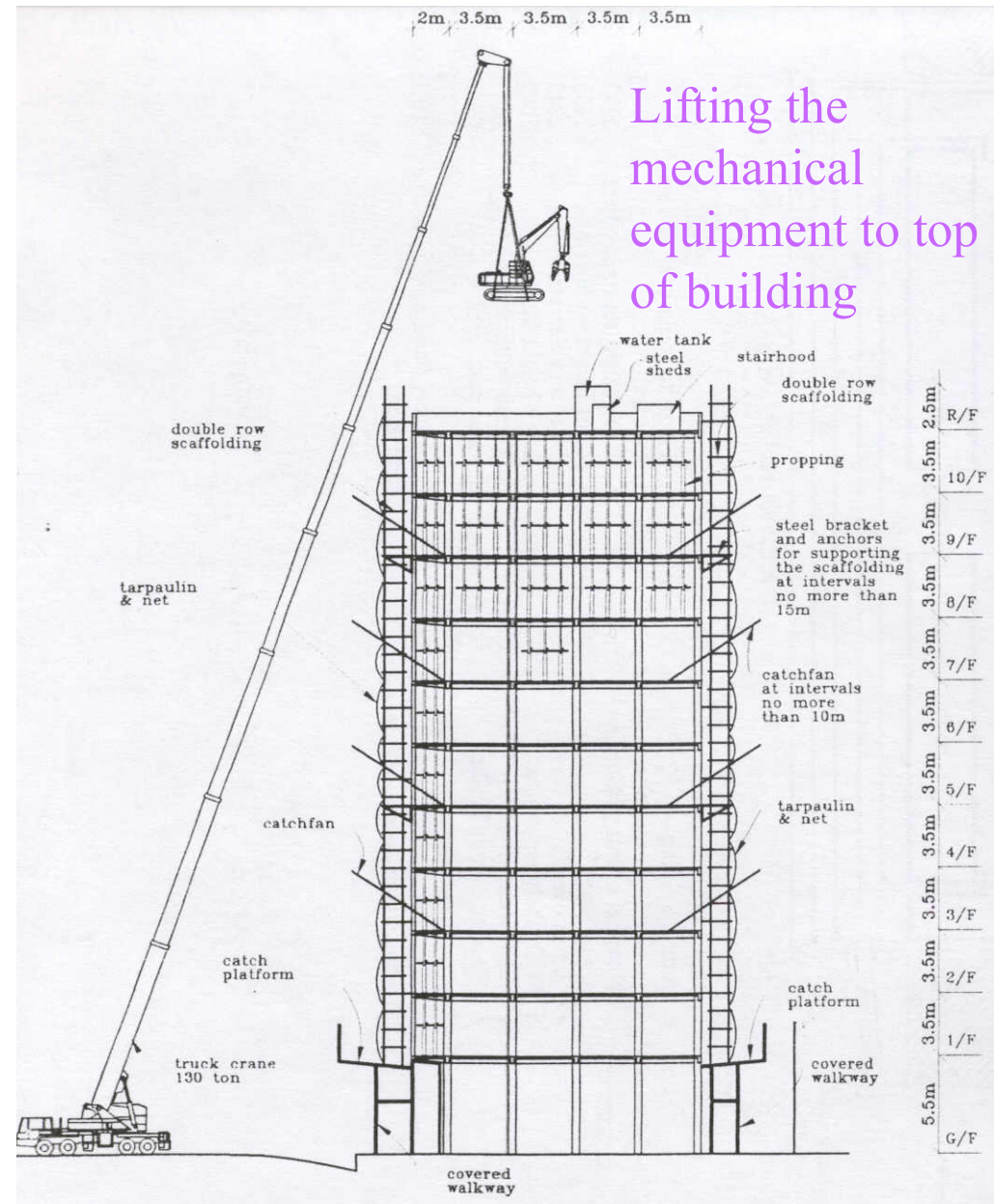
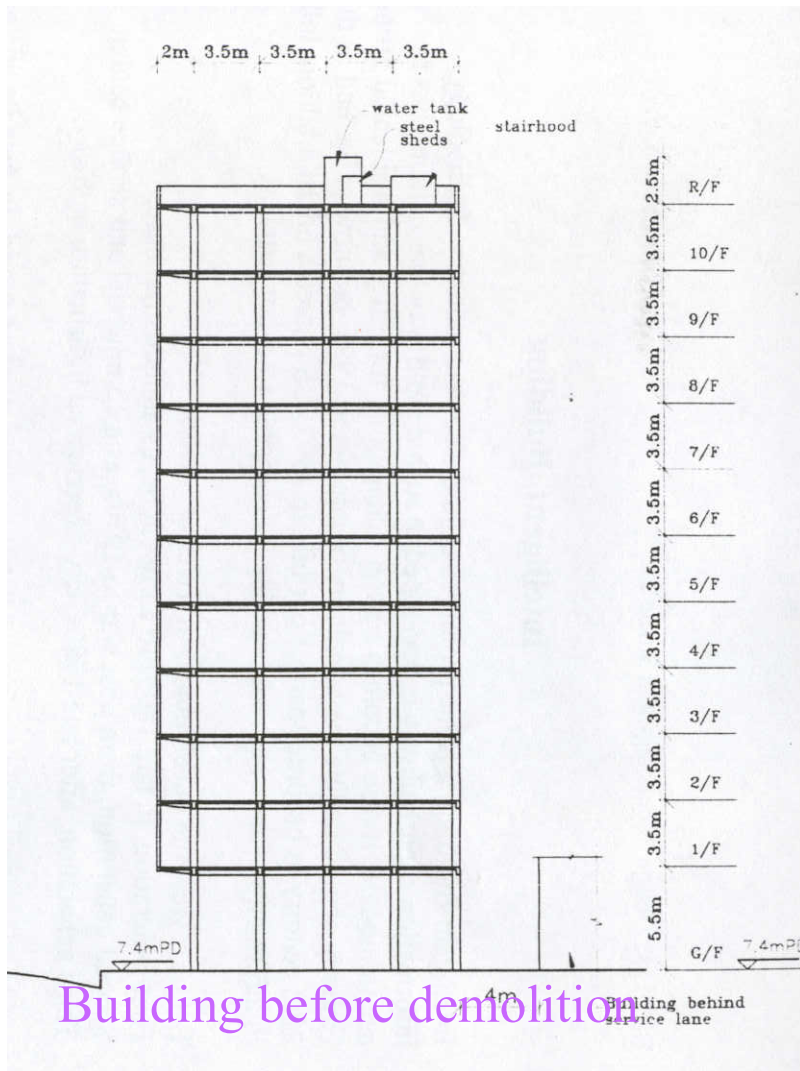
Demolition by the help of mechanical plant –  
pneumatic breaker and bucketed excavator





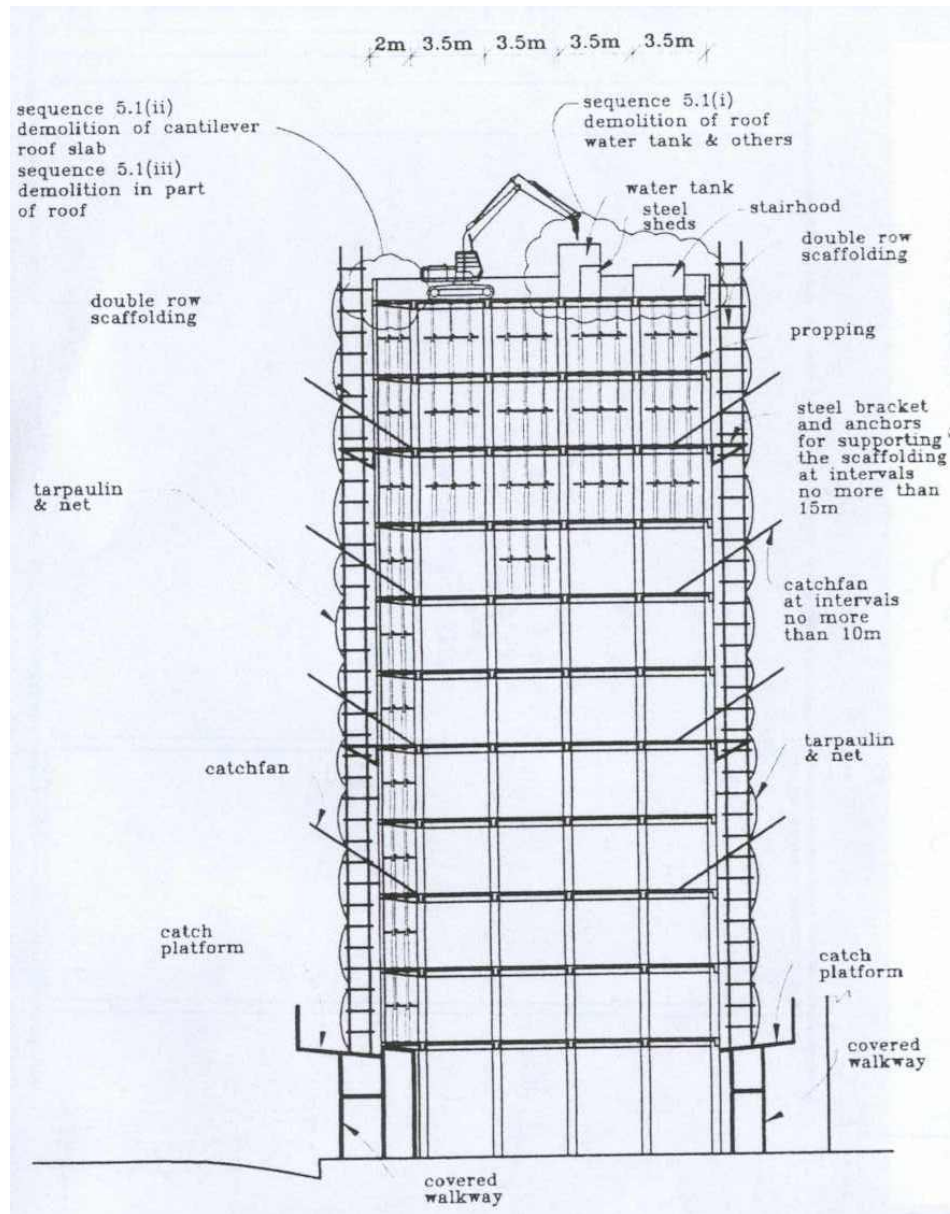
Close-up view of the  
pneumatic breaking machine



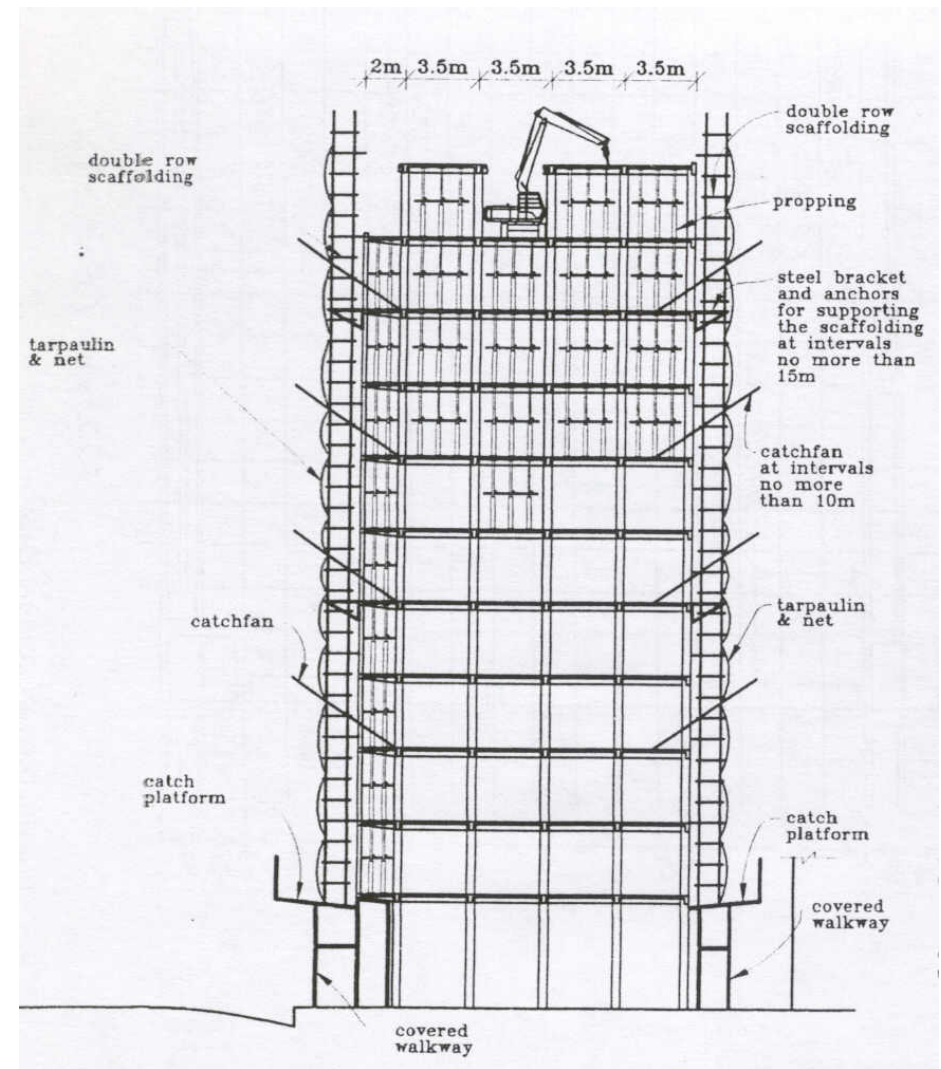


Demolition using top-down method using machines

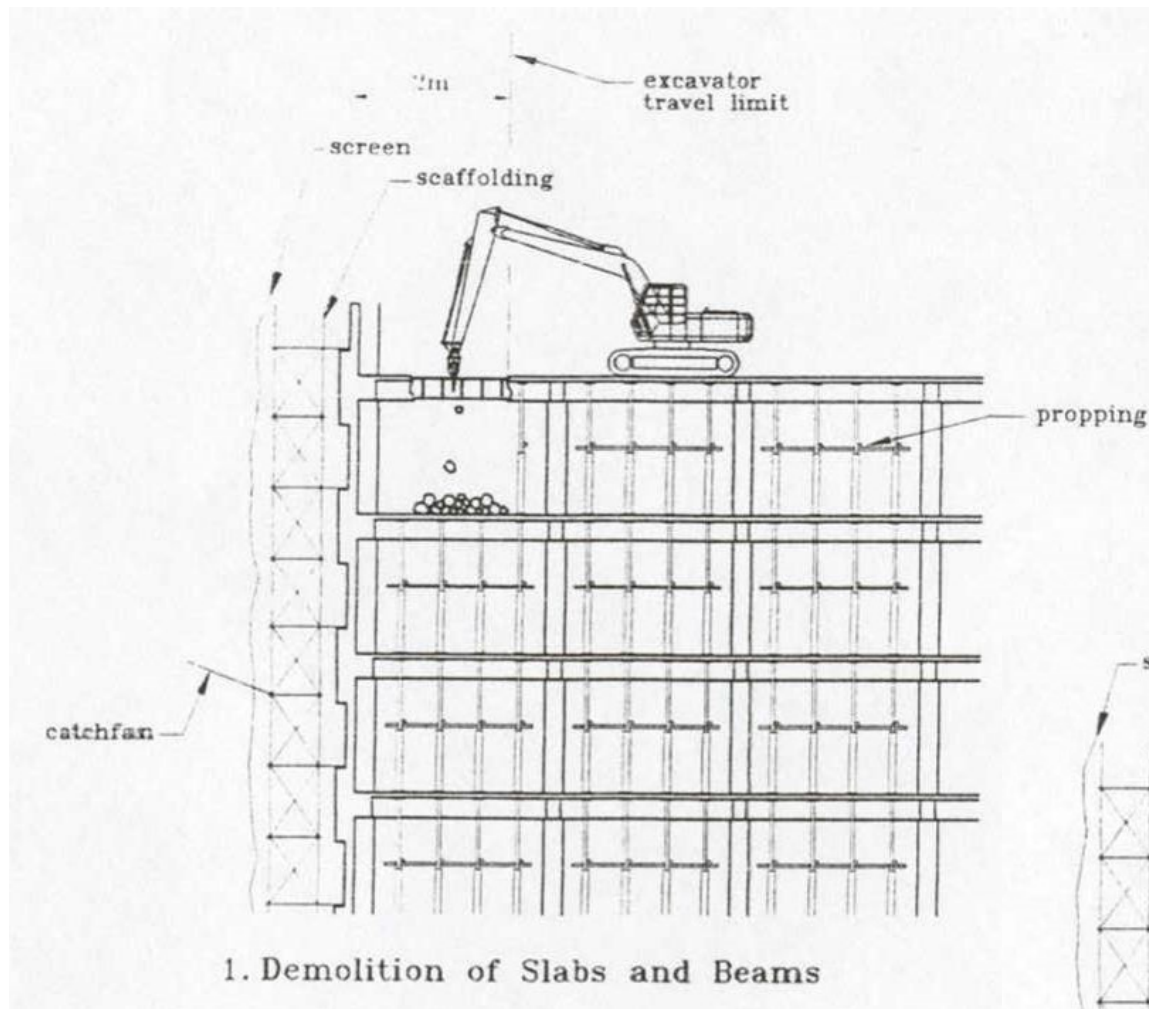




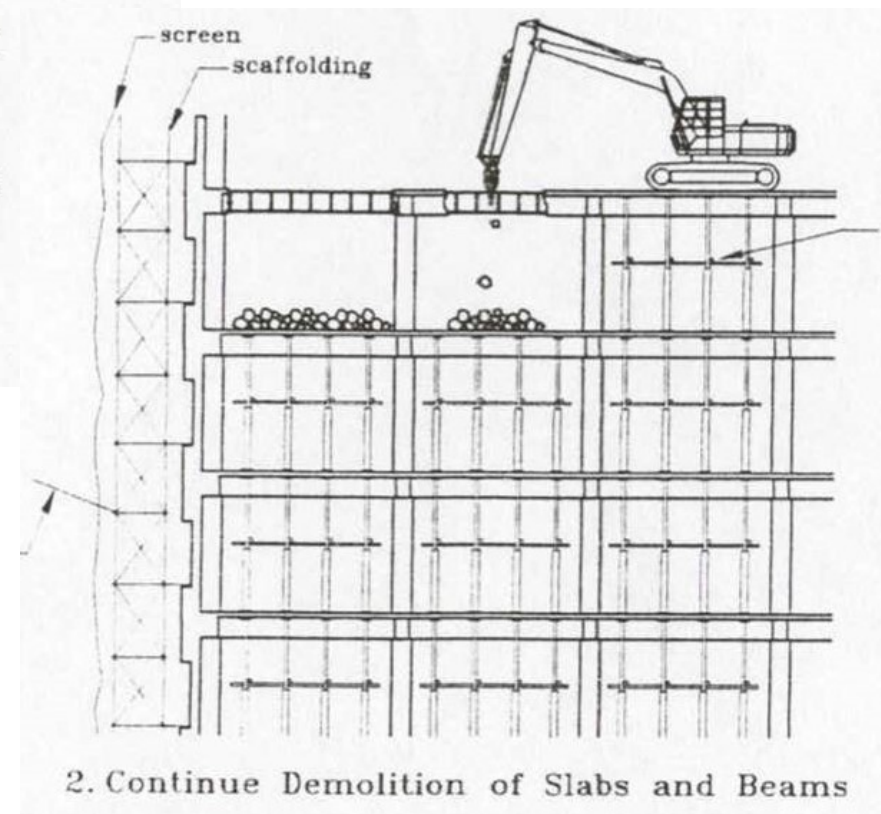
excavating/breaking machine should  
be properly propped



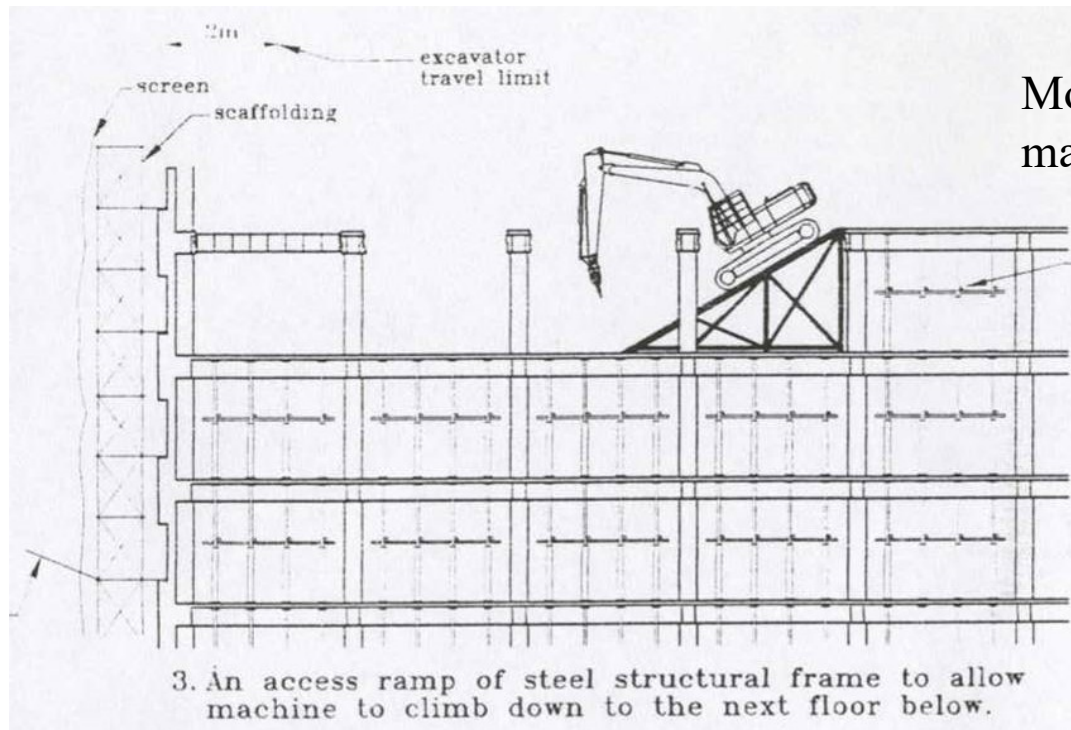
Demolition using top-down method using machines



Demolition using top-down method using machines – typical floor cycle and machine movement

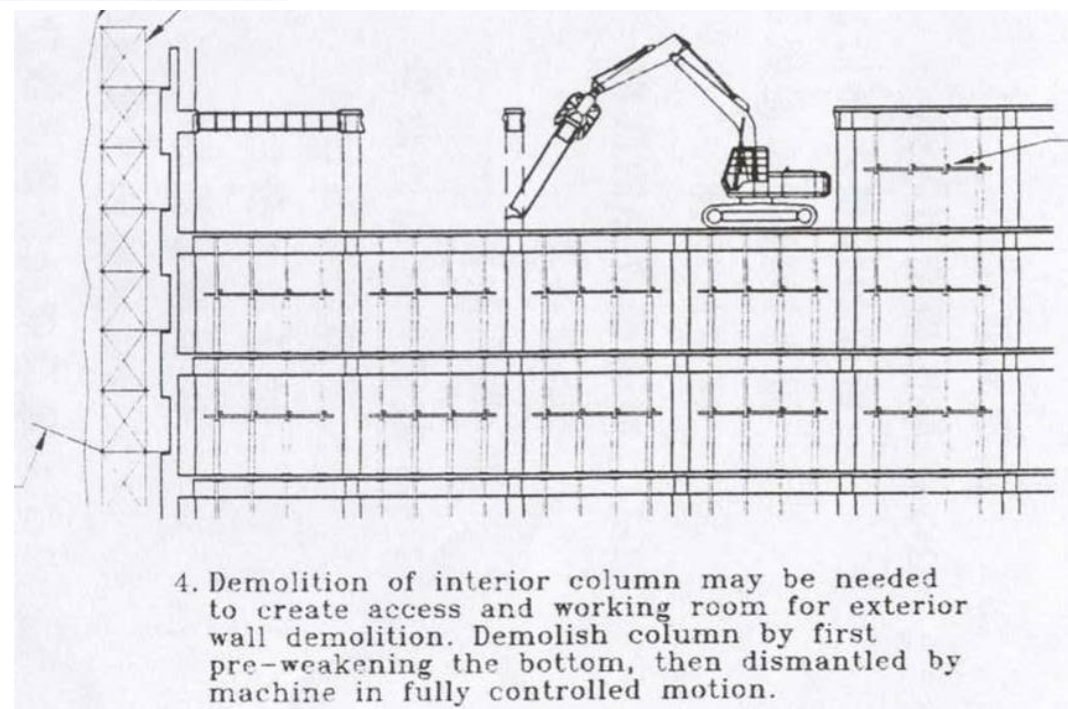


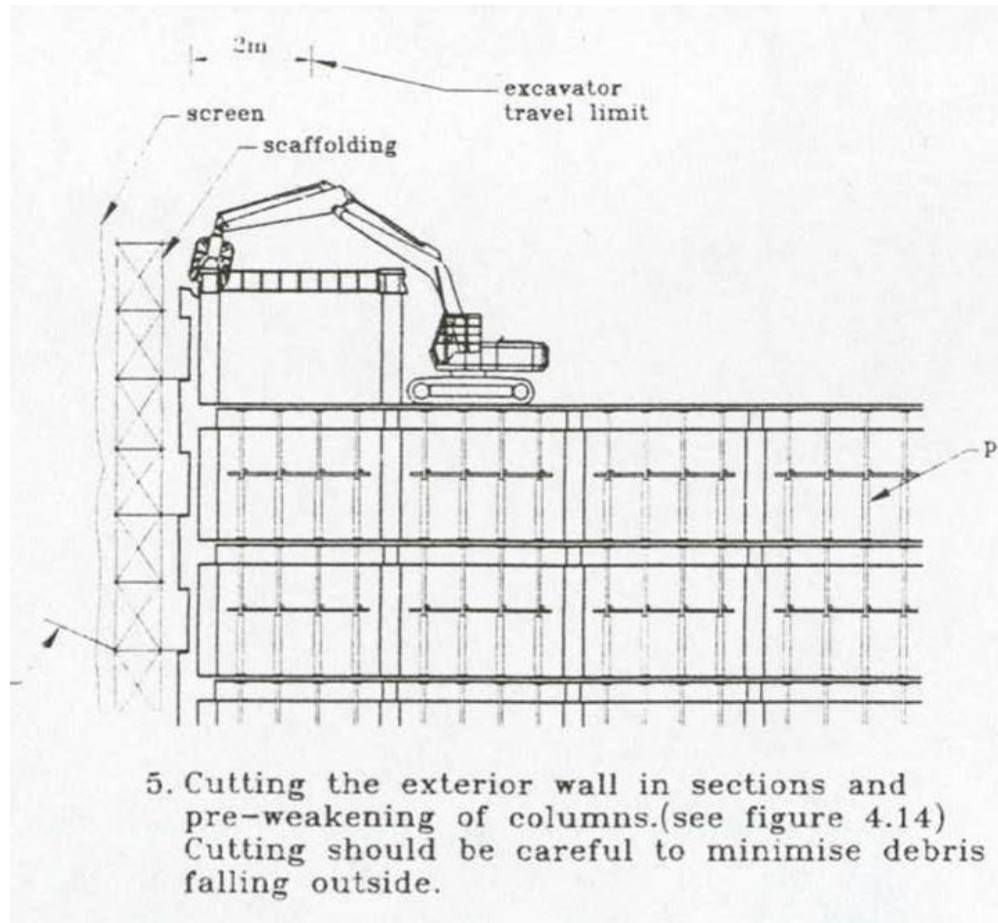




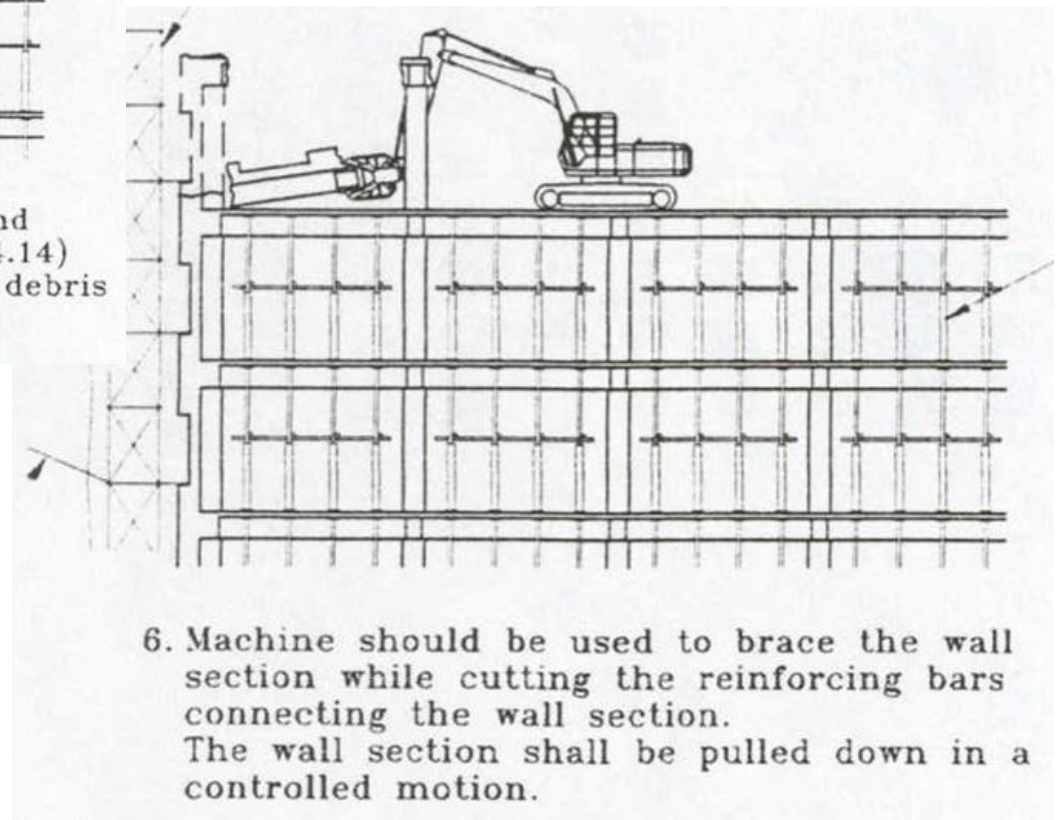
Moving down of the breaking machine to the lower floor

Demolition using top-down method using machines – typical floor cycle and machine movement



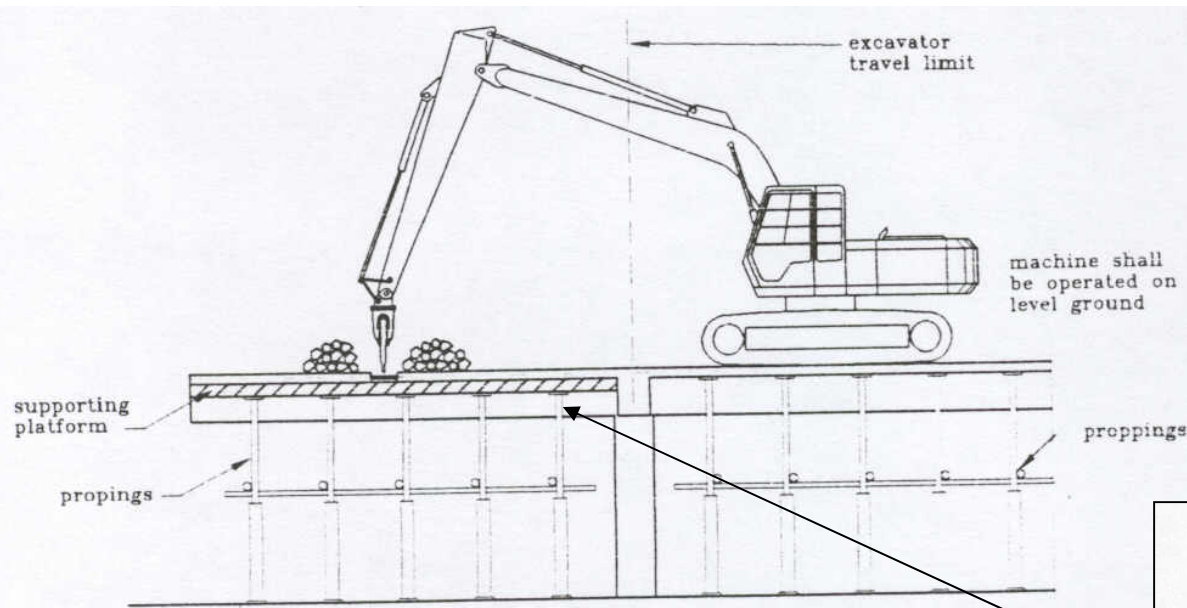


Demolition using top-down method using machines – typical floor cycle and machine movement

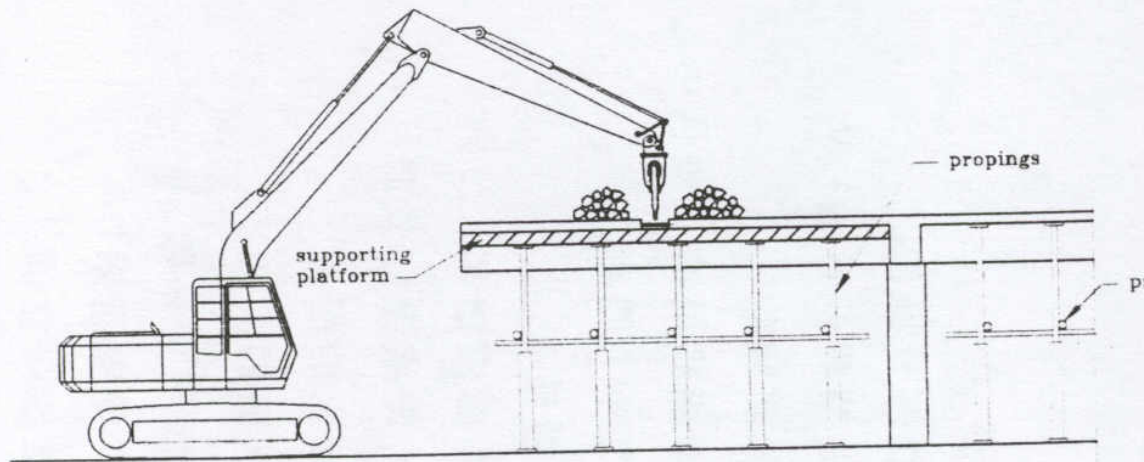




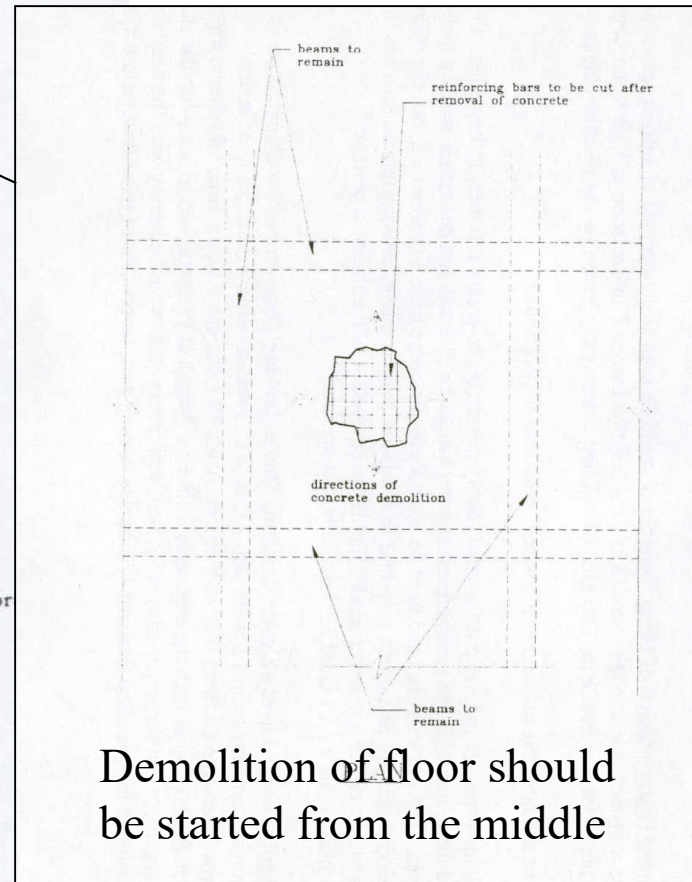
## Demolition of 2-way floor slab using mechanical breaker



CASE 1. MACHINE MOUNTED ON SUSPENDED FLOOR

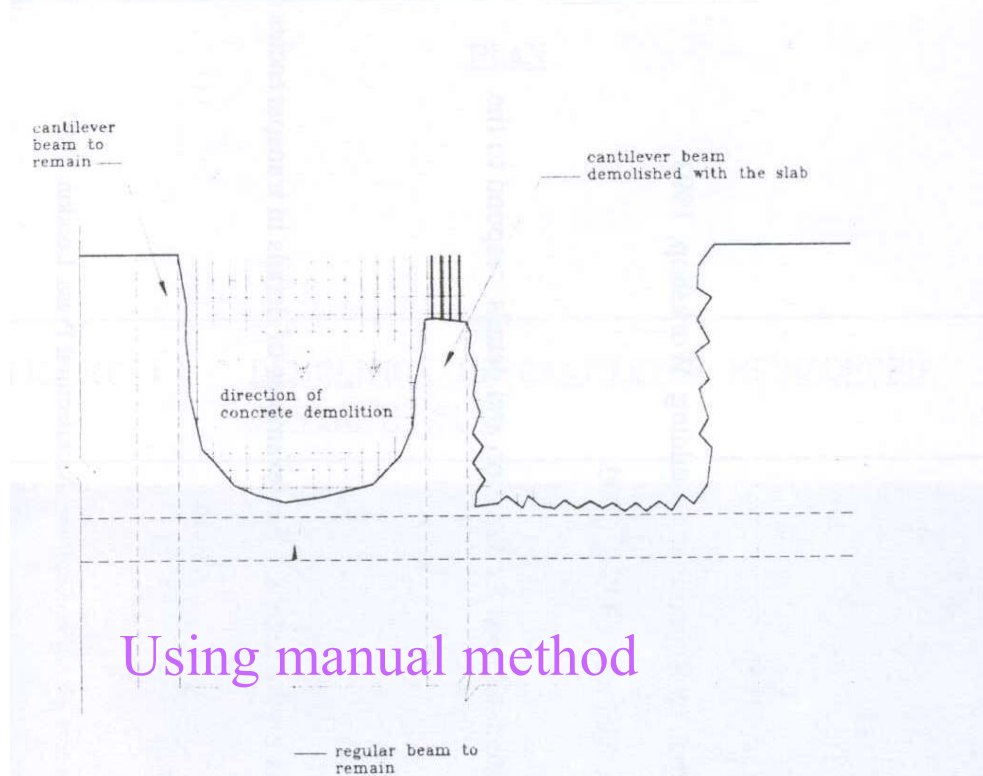
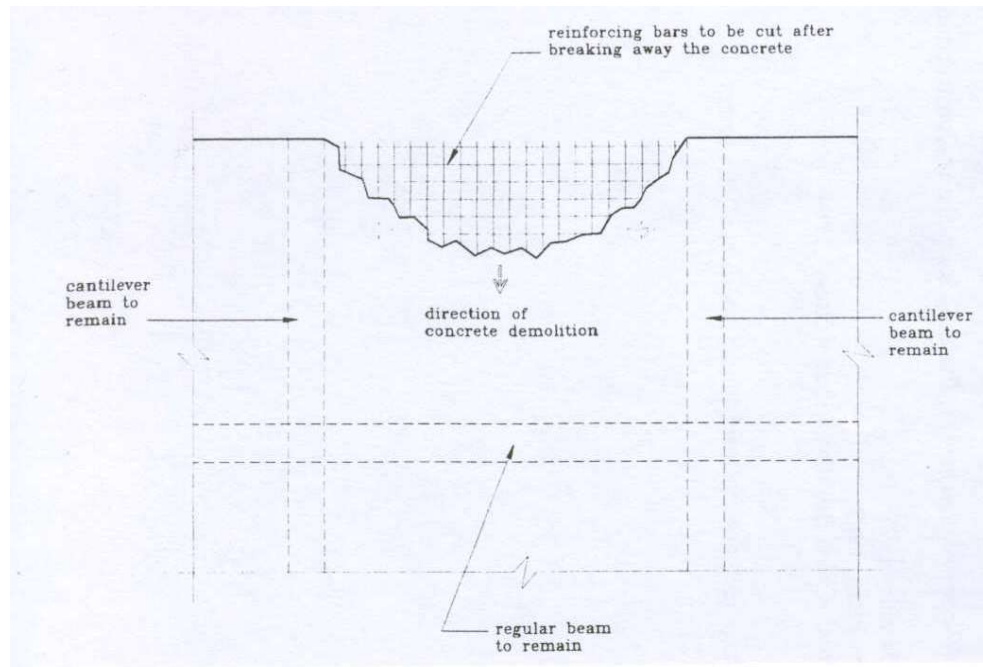


CASE 2. MACHINE MOUNTED ON GROUND

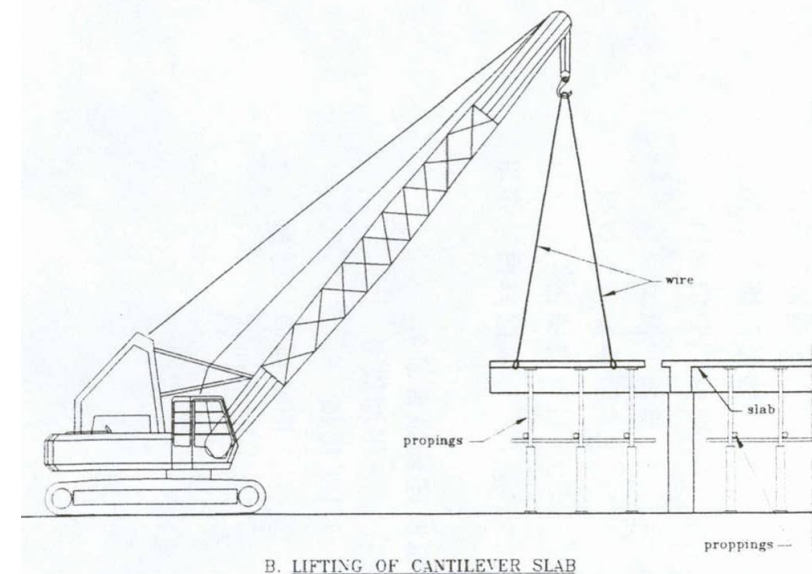
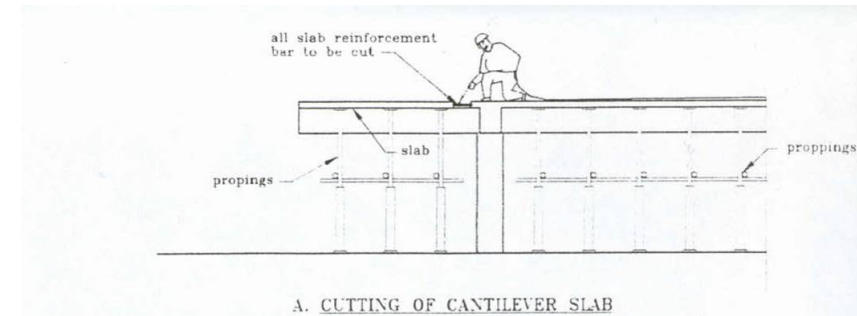


Demolition of floor should be started from the middle

## Safe practice – Demolition of cantilever slab



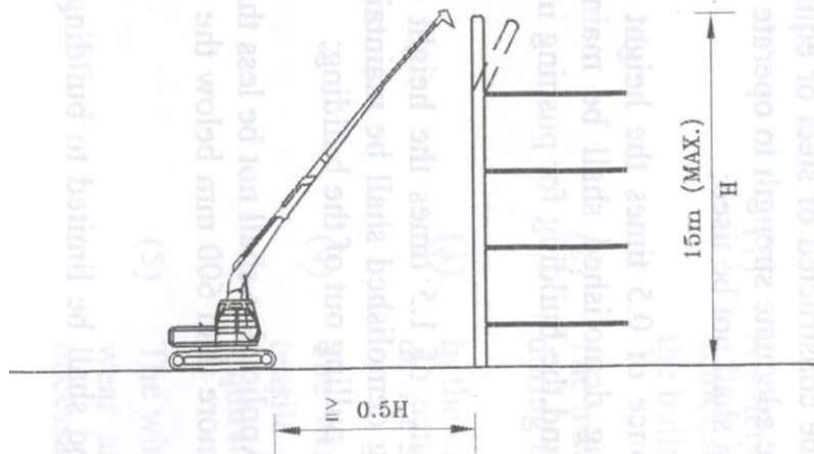
Using manual method



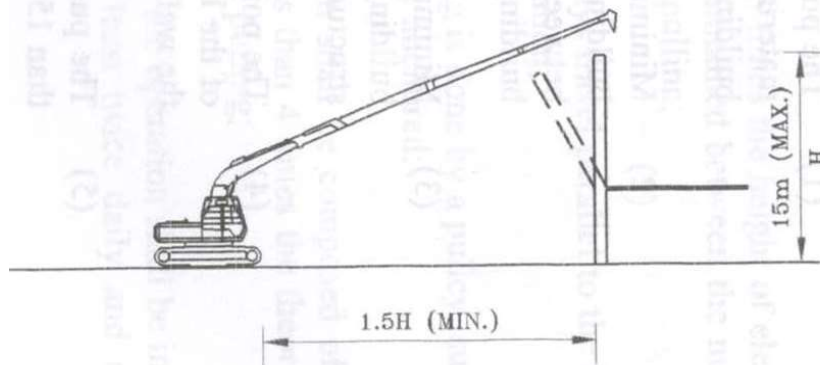
Using cut and remove method



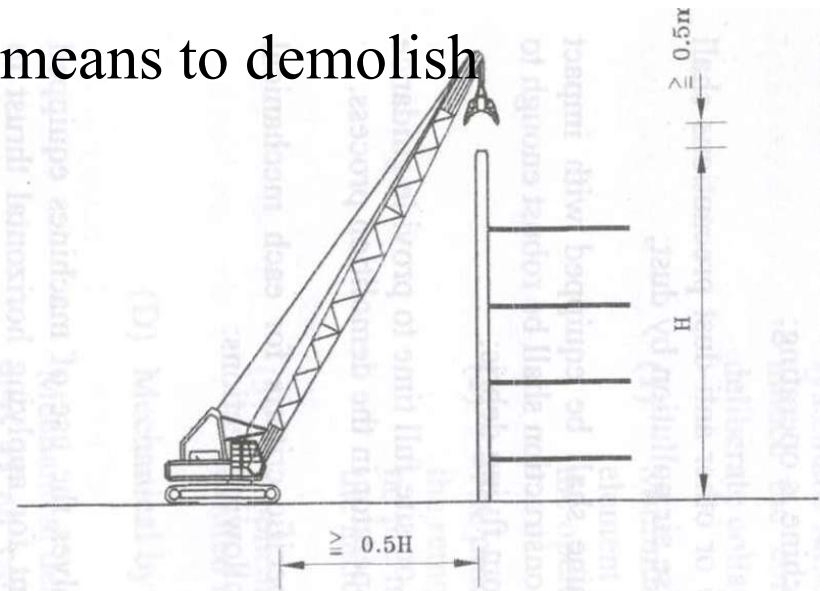
## Some more examples of mechanical means to demolish



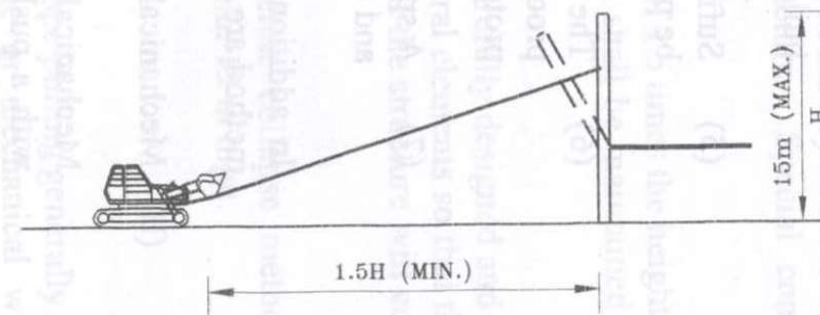
(i) MECHANICAL BY PUSHER  
ARM - PUSHING IN



(ii) MECHANICAL BY PUSHER  
ARM - PULLING OUT



(iii) MECHANICAL BY CLAM SHELL



(iv) MECHANICAL BY WIRE ROPING

## **Method of demolition**

Using of hydraulic arm with clamps mounted on excavating machine –

One or more demolition machines similar to normal excavator will be used to perform the demolition work. This machine is mounted with a long hydraulic arm with a crusher or clamp to do the actual breaking. Sufficient working space is an essential criteria in using this method.









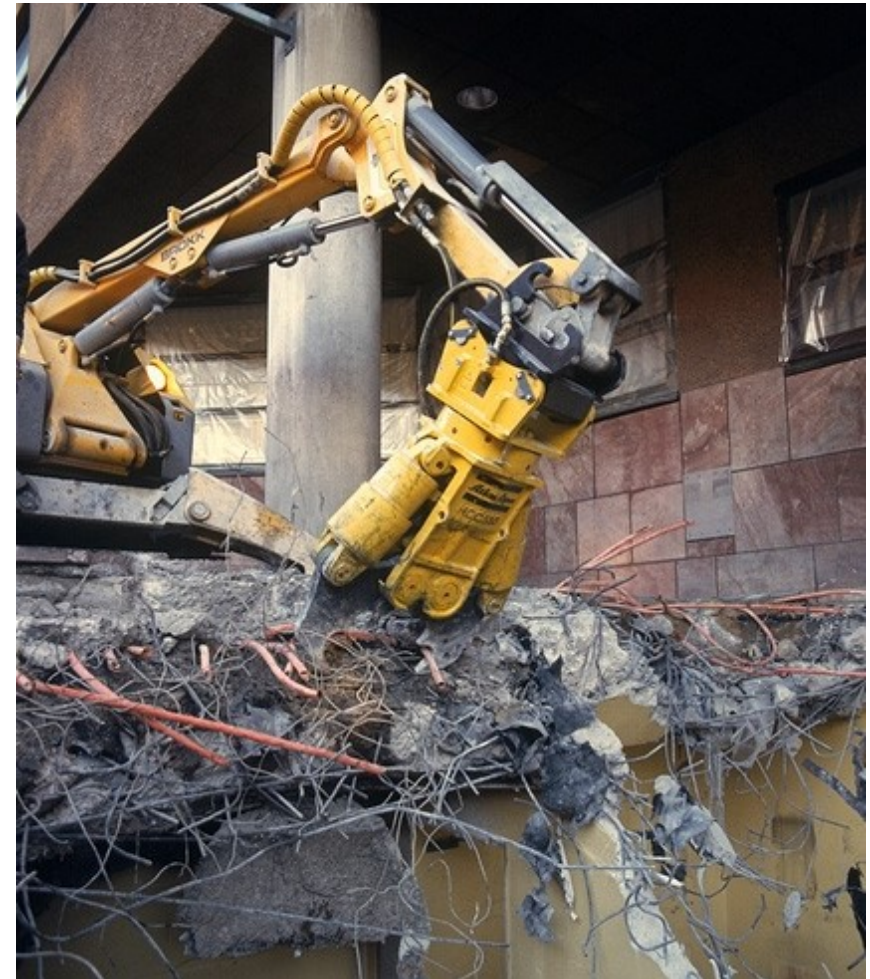


## **Method of demolition**

Using of hydraulic clamp or robotic breaker –

Specially designed breaking/cutting machines, usually track mounted, are used to demolish some smaller structural elements such as thin walls, stairs, slab or parapet etc. when using this kind of equipment, planning for accessing the machines into the working spot is essential.





Demolition using  
hydraulic clamp or  
robotic breaker







Using saw cut method –

This method is suitable for alteration and additional works where accuracy is important and restriction on noise and vibration is required.

It can be used to cut concrete slab and wall elements into segments or for the forming of openings, breaking into existing structure like a basement, servicing tunnel, flyover, or other part of an inhabited building in the process of alteration or renovation works.

Using saw cut method (continue) –

Saw cutting can be done using the following methods:

- wire saw cutting
- diamond core stitch drilling
- disc saw





Set-up and mounting of the  
saw dis on wall



Demolition using disc saw cutting



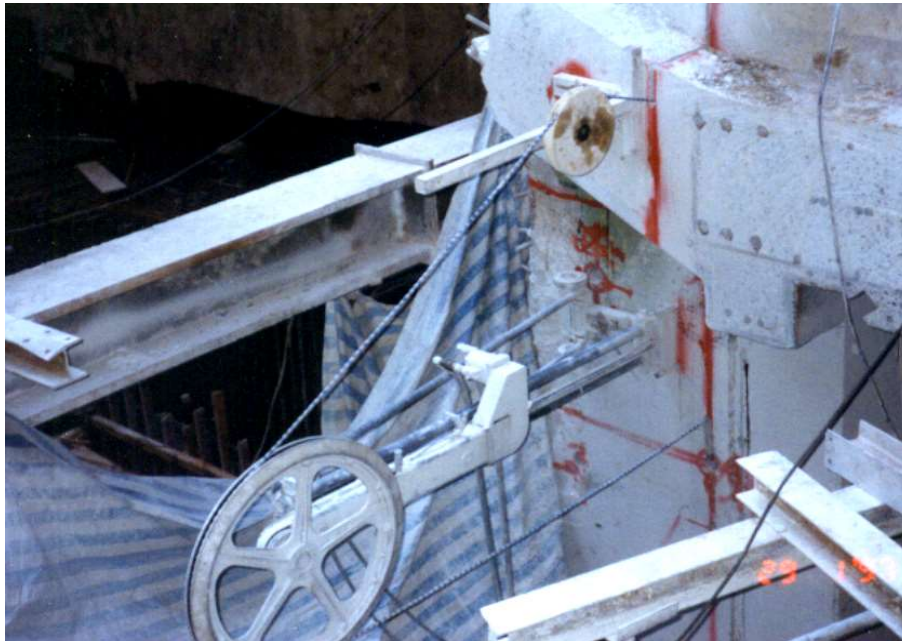
An opening  
formed on floor  
for the insertion  
of a steel prop

Demolition using diamond core





## Demolition using wire sawing









Demolition using saw-cut and boring method for the diversion of a storm water discharge culvert



Demolition using saw-cut  
to demolish a long section  
of bridge











Using core and drill method to demolish a pedestrian subway









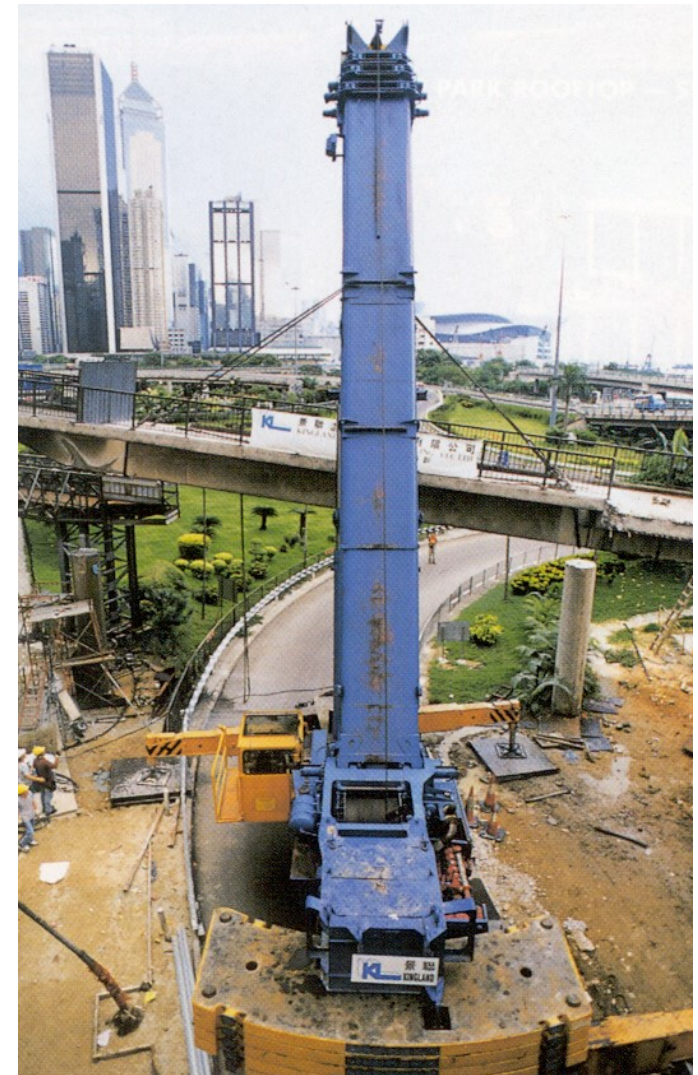
# Method of demolition

Using cut and lifting method –

Cut and lifting involves the initial cutting of the structure into individual pieces or segments, and then lifting the pieces by crane onto the ground for further demolition or hauling away.

Special precaution should be made when applying this method for demolition such as:

- weight of the cut segment may cause extra loading to the remaining structure
- lowering of the segment can be dangerous



Lowering of segment from a footbridge after dismantled by saw-



# Method of demolition

By implosion (explosive) –

If using this method to demolish a building, contractor should carry out a comprehensive risk and environmental assessment on the effect of implosion on the neighbourhood.

A detail demolition design is also important, which should cover:

- Method to pre-weaken the structure (e.g. demolish some load taking structures)
- Placement of explosive
- Time-delay design to allow the building to collapse under control direction and location
- Case examples <http://www.youtube.com/watch?v=sK50So-yYRU>

Example – to demolish 7 building  
range 16-storey tall using explosive  
the land for the HK-Shenzhen border  
at Huanggong















How to clear and clear away the unfinished structure after the explosion?

# Method of demolition

By implosion (continue)

charges of explosive are placed within the fabric of structure and detonated to cause partial or complete collapse. Competent explosive specialist is required when demolition is to be done by using explosive.

There are numerous types of explosives for use for various types of demolition (sometimes including non-explosive agent). Consideration such as the spacing and depth of explosive to be located, the amount of explosive to be used, or the degree of fragmentation required in order to control the boundary of demolition etc., are required throughout the planning and operation process.



## **Removal of demolished material or debris**

Demolition will generate huge amount of debris. The safe and effective removal of such construction remains will be a prime concern in the operation.

In this case, before and during demolition, the following provision should thus be provided:

- Overall debris disposal planning
- Traffic routing for debris handling and vehicular access etc.
- Adequate number of chutes/shaft for debris disposal
- Sorting of non-structural materials such as timber and metal for recycling.

## Removal of demolished material & debris

Debris created by demolition is usually collected to one or two **pre-arranged shafts** in the building and the debris are allowed to fall or drop freely from the shafts, by the push of a bulldozer or alike, down to a safe debris collecting areas for further deposal. Since the accommodation of a certain amount of debris is expected, the areas around the shaft should be properly fenced or propped so that the extra weight of the debris can be taken up.

Accommodation of debris is often dangerous for they may **impose extra load** to the floor or wall (if leaned against onto). Debris should be cleared away the structure at the earliest possible.



For **larger demolished materials**, such as a section of a beam or column member, they can be hoisted down using steel rope, lifting arms or winch etc.

If the site area is large enough or where situation allows, a section of building may be demolished first. The area vacated can be used for the handling of the debris. In this case, **a mobile crane may be employed to lower the debris using a bucket or skip.**



**Rebate, light-well or temporary  
floor opening for the falling of  
debris onto ground level**





**Interior layout of building being cleared during demolition  
for the purpose of equipment movement and debris handling**







Removal of debris in downtown congested site – using small loading vehicle to take debris from site through public roadway to dumper truck





Removal of debris in downtown congested site – using small loading vehicle to put debris directly onto a dumping bucket placing just outside the site exit.







Portion of the building  
interior being cleared out for  
debris handling purposes



Collected metal and other  
valuable scrape for recycle



# **Demolition for special structure**

The following structure should require very special attention during demolition:

- Precast elements
- Prestressed elements
- Cantilever structure
- High headroom or Large-spanned elements
- Structural elements under special jointing arrangement (e.g. hinged or pin-jointed)
- Composite or steel structure



# **Demolition for special structure**

The following structure should require very special attention during demolition (continue):

- Hanging structures
- Transfer plate and deep beams
- Special floor structures - waffle floor, flat slab
- Arches, trusses or girders structures
- Cladding or curtain wall

## **Demolition for special structure**

The following facilities or buildings should require very special attention during demolition:

- Buildings located in contaminated site
- Buildings used as oil or dangerous goods storage
- Marine structures
- Underground structures (tunnel, basement or foundation)
- Soil retaining structures



# **Disconnection of utilities services before demolition**

The following utilities should be properly sealed or disconnected before the commencement of demolition:

- Electricity and gas
- Gas and water supply
- Vent shaft or any underground access
- Drainage and sewage systems

Majority of these utilities services are located underground and can hardly be seen visually. A detail survey should be done before hand to ensure they are found and disconnected.

# Environment concerns in demolition

Demolition is a dirty and dangerous process. In view of ensure such works are done properly without causing any unnecessary interference to general public, the following areas of **environmental concern** should be noted.

- The proper recycle or disposal of the construction waste
- Treatment of harmful material (e.g. asbestos or contaminated waste)
- Control of dust generation
- Control of noise
- Control of waste water (including rain water carrying large amount of mud running out from site)



## Other precautions to be noted

1. Provision of **temporary propping support** for extra loading (mainly for demolition machines)
2. When handling the debris, continual **spraying of water** onto the debris can help suppressing the creating of dust.
3. Better work coordination should be maintained to ensure no worker is working inside the building when the debris is being pushed down from the debris shafts.
4. Secure all the partially demolished structures by prop, wire or bracing etc. to ensure the areas are safe and will not fall down, at least temporary, and hurt the workers who are working around.

5. When a building is attached to other buildings nearby, the structure to be demolished should first be detached from the adjoining structure by hand demolition techniques.
6. Very special attention should be made to any demolition work that is carried out along the **external perimeter of building** for the falling of objects may cause great casualty to third party below.
7. Maintain a **safe emergency access** for manual operators all the time during demolition.
8. Maintain a non-obstructing route for moving of equipment and clearing of debris materials





Normal propping arrangement



Adequate propping support for the machine?





Shoring support  
for retaining  
structure nearby



Propping  
arrangement for  
cantilever balcony





Jetting water to the spot  
where demolition takes  
place

Protect by secure a free  
standing external wall  
section by steel ropes







Fence off the vertical shaft  
for the removal of debris

Maintain a safe access for  
worker during demolition













Protect exposed retaining structure after demolition by steel shoring or by remaining building frame of the old structure



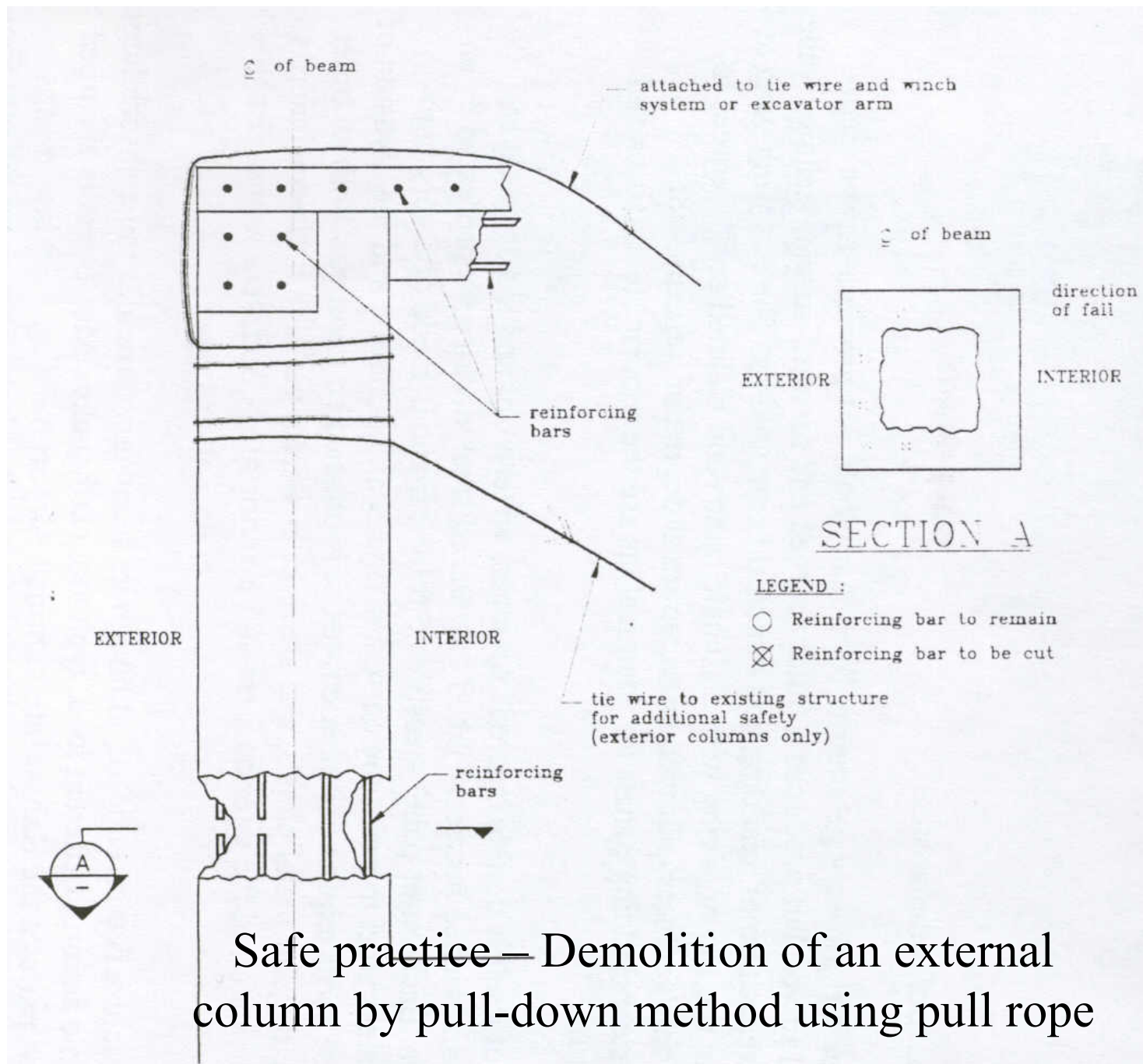




Avoid letting a long section of wall free standing without support

Free standing wall without support





Safe practice—Demolition of an external column by pull-down method using pull rope



Some other very complicated  
demolition cases



## The redevelopment of the Lee Gardens Hotel

Various phases of basement  
demolition – part of the  
basement being removed for  
construction of the pile cap  
for the future building



Continual stages of the basement demolition with the incorporation of other substructure of the future building











The demolition of the basement structure working at the same time with the construction of the future building





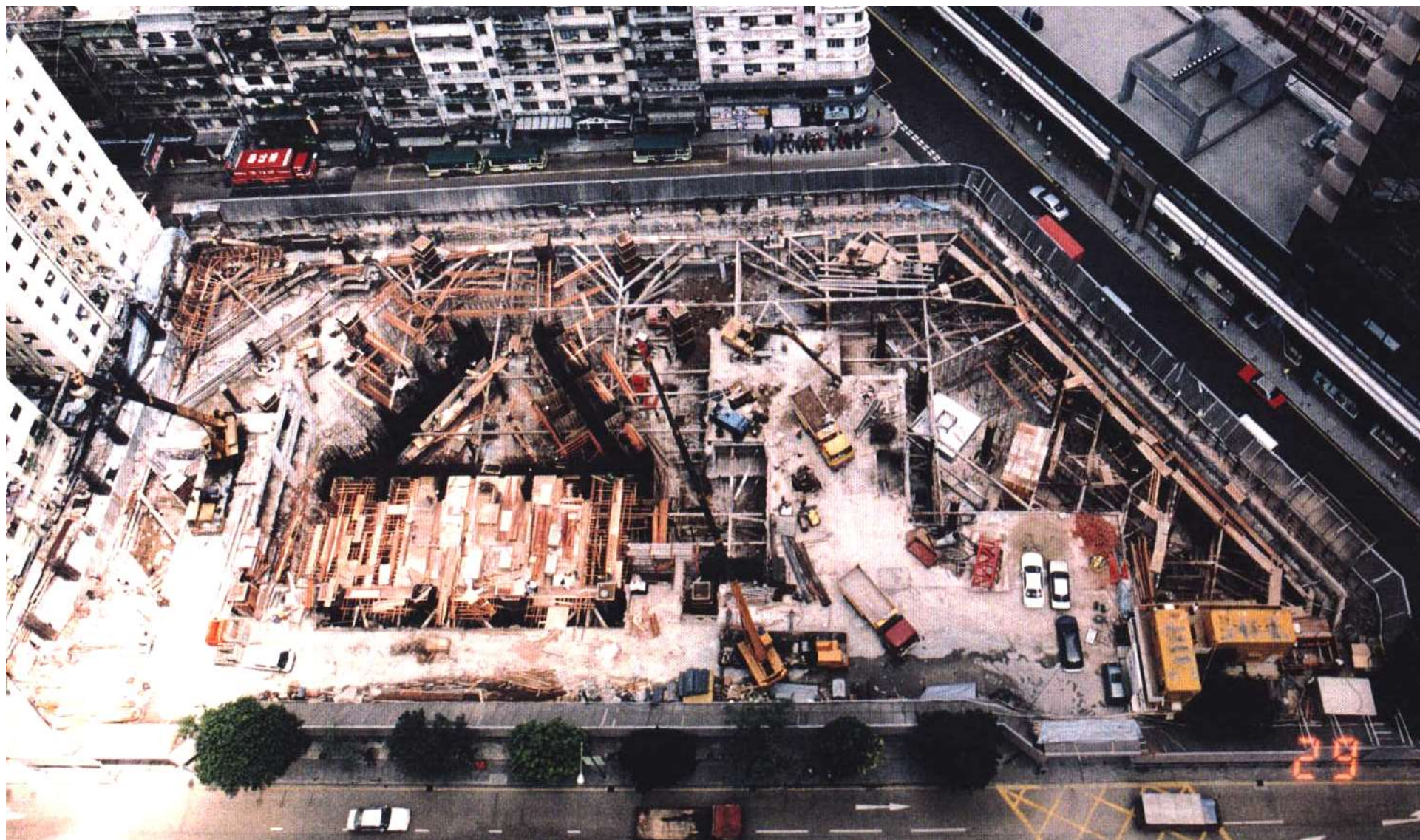




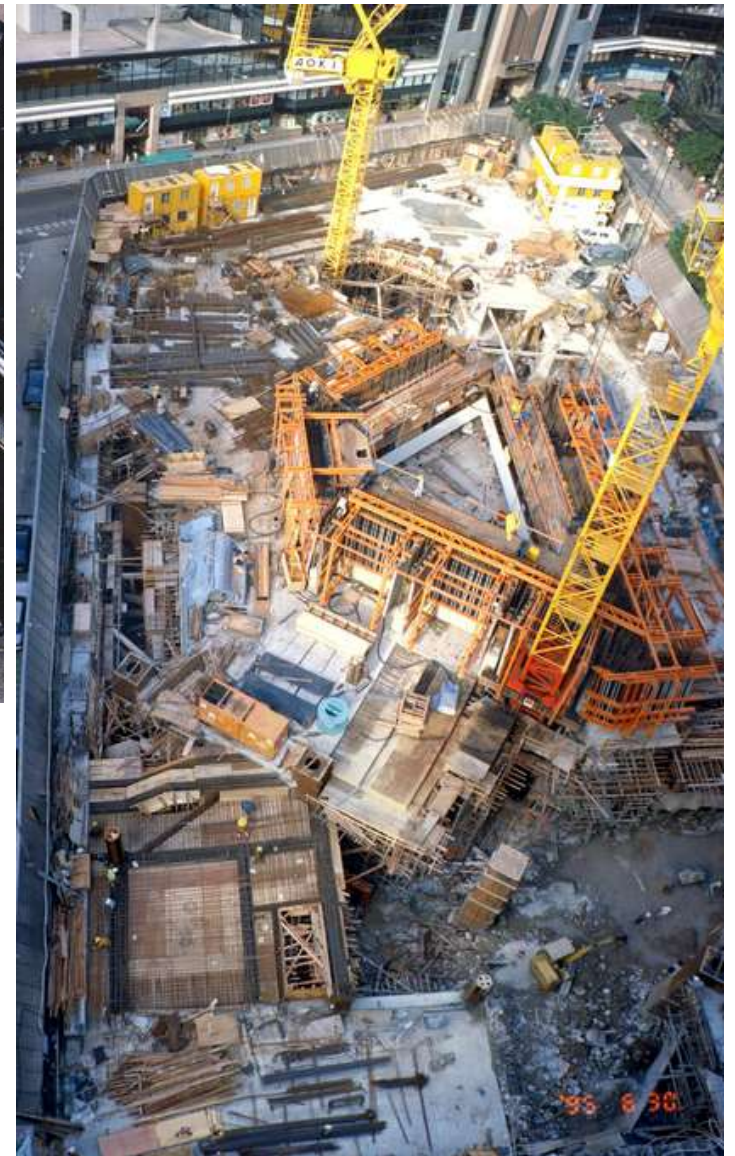




















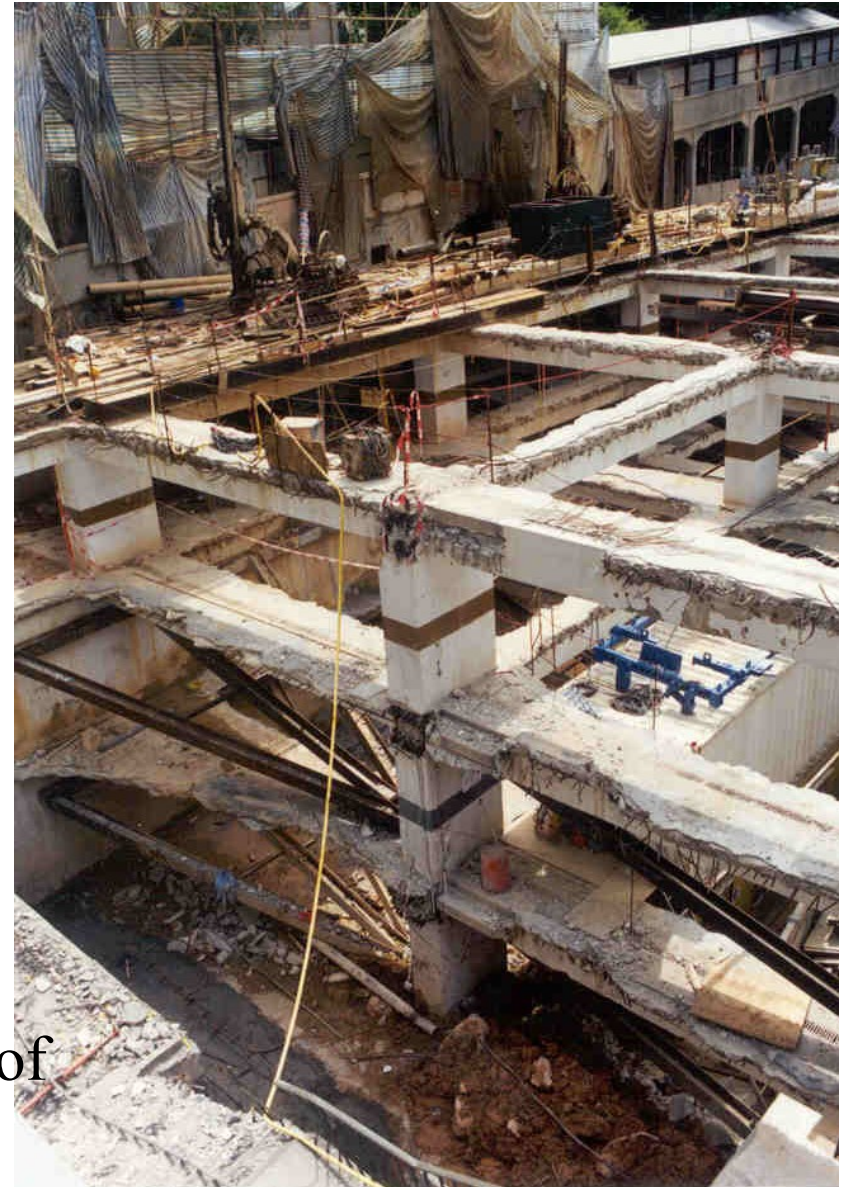




Demolition of the basement structure of the previous Hilton Hotel – the lower basement was backfilled to maintain stability of the disrupted basement structure before the commencement of the new basement



Demolition of the basement structure of  
the previous Garden Road Carpark











Demolition of the basement working at the same time with the building foundation





Demolition of building constructed using precast method –  
Ngau Tau Kok Lower Estate







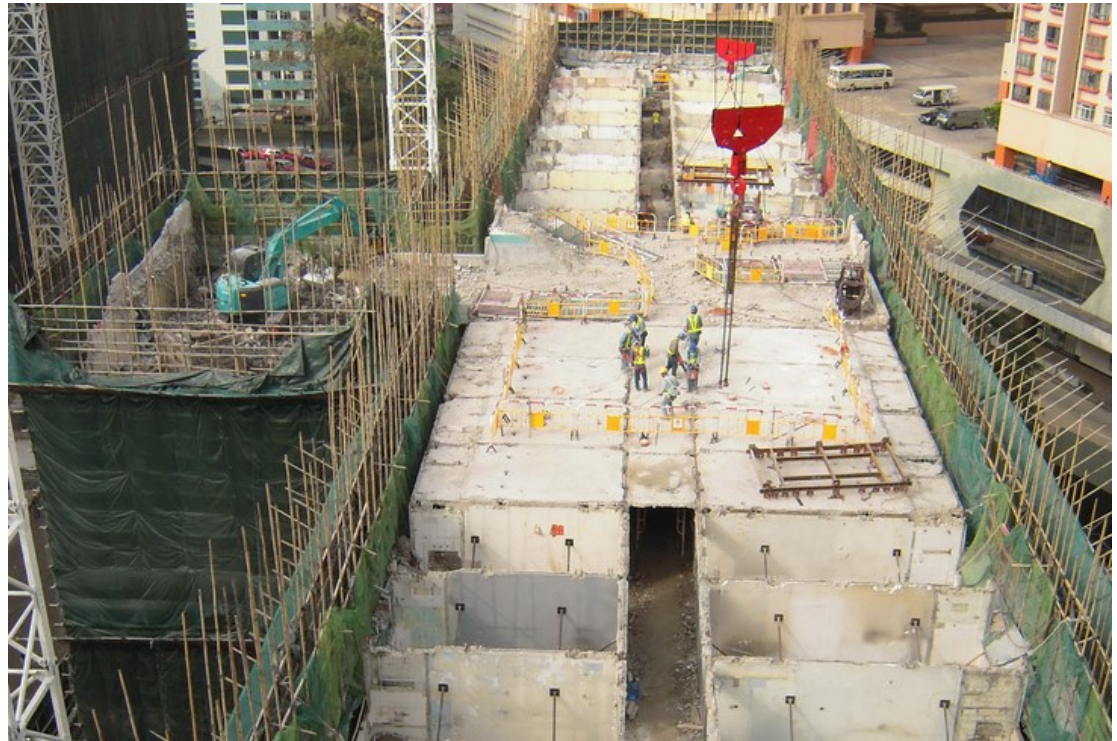




Dismantling the wall units  
and floor planks









# **Concerns when demolishing a basement**

Basement is a soil retaining structure. If demolished not in a proper manner, the basement and the surrounding may collapse and cause serious damage both inside and outside the basement boundary. The following concerns should be taken when doing the demolition work:

- Careful planning of work is important (usual to demolish in smaller section and in coordinated phases)
- Proper shoring should be provided to the basement during demolition



## **Concerns when demolishing a basement (continue)**

- Because the upper structure has been remove, the basement (and the soil below) may have uplifting problem.
- There may have ground water problem.
- Existence of old foundation structure (usually required to be removed)
- Accessibility into basement (and removal of debris) is difficult.

# Demolition cases, China practices



## Special features China practices:

1. Use of lots of mechanical plant due to sufficient working space.
2. Use of lacks of human workers.
3. Safety awareness and precautionary measures are insufficient.
4. Recycle materials are carefully handled. All valuable items are basically re-collected

















Removal of the Sen Village in Guangzhou











Demolition in congested urban environment –  
Redevelopment project of URA in Wanchai  
(Spring Garden Street and Lee Tung Street)



Site with old buildings to be demolished for redevelopment

Site C

Site A

Site B

Site D





Preparation for Site A before and during demolition





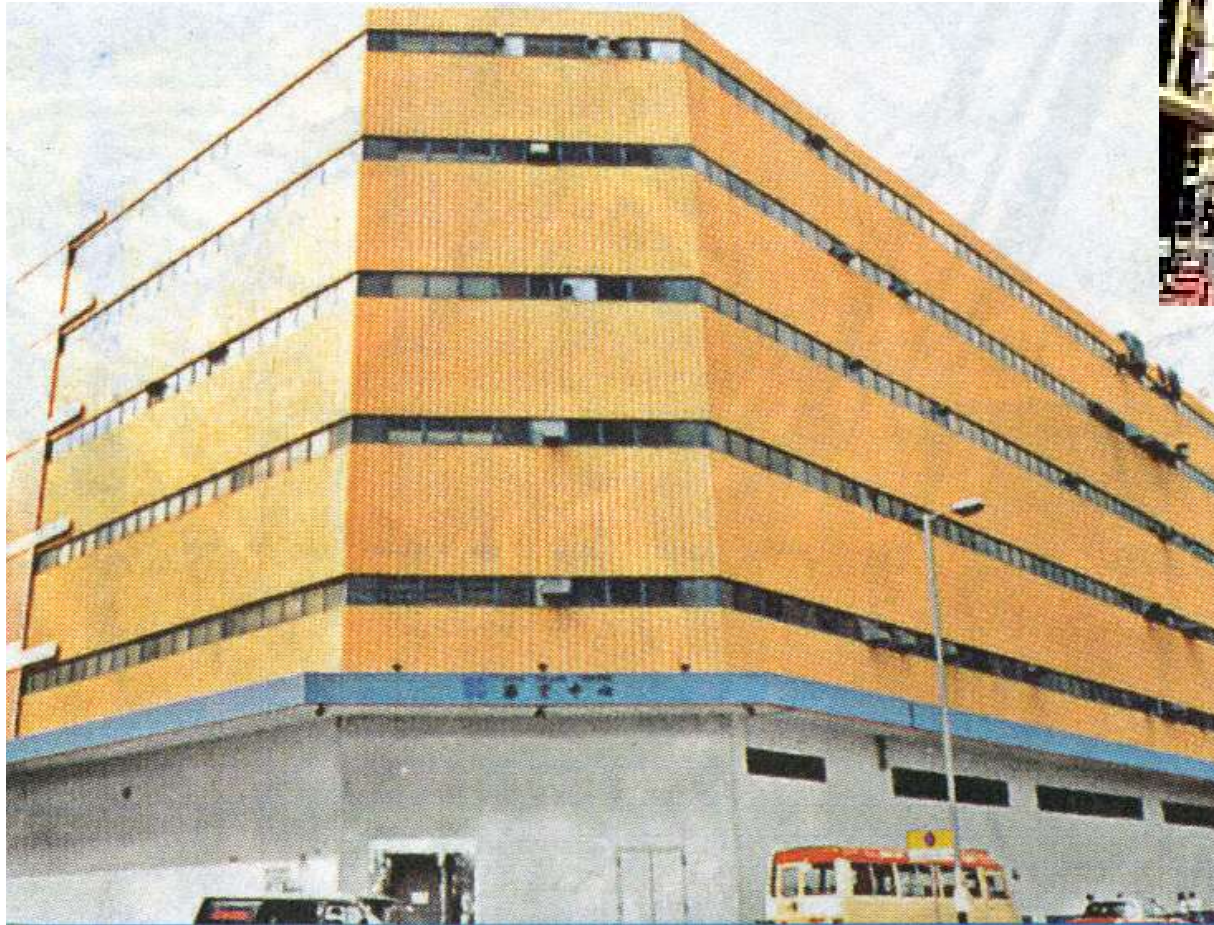
Preparation for Site A before and during demolition



Carrying out  
the demolition  
at Site C







The Asian Trade  
Centre before  
the collapse

1. Building size:

about 45m by 50m on plan and 25m high

2. Structural form:

- flat slab structure with limited amount of beams on the building edges and corners
- non-load bearing reinforced concrete external wall
- arranged in approx. 8m span in 5 x 6 bay grid
- strength of concrete 30 N/mm<sup>2</sup> (judge according to speaker's experience)





Typical layout of floor using flat slab design



The site as seen after the collapse on 30.11.01 (viewing north)





The site as seen on 30.11.01 (viewing south)





The site as seen on 30.11.01 (viewing west)





The site as seen on 30.11.01  
(viewing at J/O Sze Shan Street and Shung Shun Street)





The damage – the wreck of two out of the five breaking/excavating machines used for demolition





The damage – the 6-storey building collapsed inward forming a heap of debris about 6m high from ground





The damage – fortunately, the collapse does not damage the adjoining building which separated from the collapsed building by a separating joint only a few millimeter apart





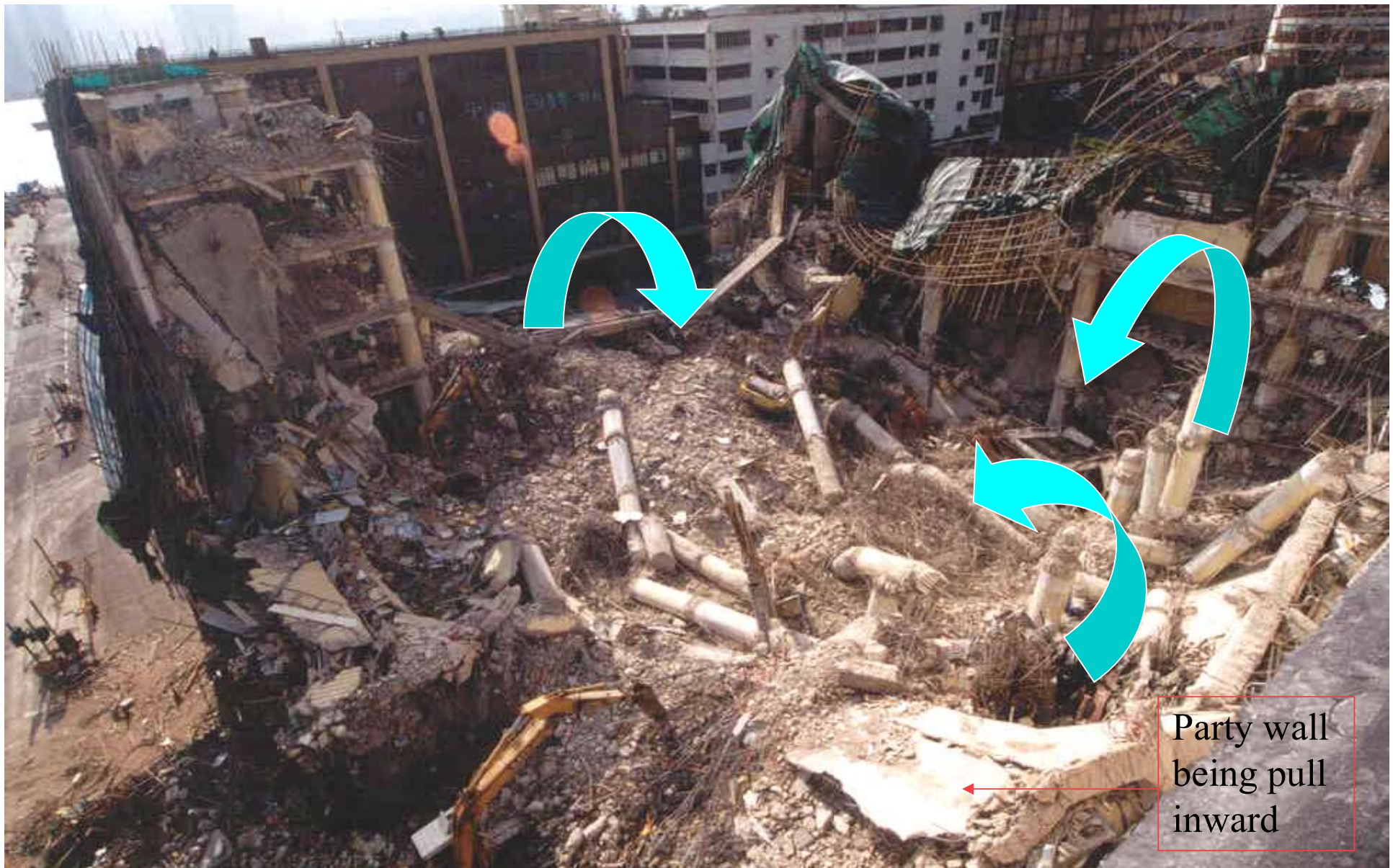
The remain – a section of the external wall on the west side of the building





The remain – a portion of building structure at the corner at J/O Sze Shan Street & Shung Shun Street





Observation – all the fallen columns centered inward indicates that the collapse orientated somewhat from the building center





Observation – with the columns basically remain intact while no trace of floor slab can be observed in the remain indicates that the floor structure in general is a weak source that may cause the collapse





Observation – the exposed steel bars on the cut-edges indicates the collapsing structure fell rapidly and produced tremendous pulling force that fail to keep the floor in position. There is no trace of floor concrete adhered to the bar, again indicates that strength of concrete may be sub-standard



Observation – further evidence of possible floor failure.  
More than 3 storeys of floor slab crushed to rubble and detached completely from the columns





Observation – the steel props used as temporary support for the positioning of the heavy breaker machines seem insufficient for the purpose



Props should rest on bearing plate rather than directly on floor to avoid concentration of loading





Observation – the accommodation of large amount of debris above the floor impose great loads to the structure

Building collapse in Gwangju,  
South Korea kills 9, injures 8  
June 9, 2021











## End of Presentation

Please refer to the “Code of Practice for Demolition of Buildings” published by the Buildings Department, HKSAR Government