



National Federation of Demolition Contractors
Voice of the Global Demolition Industry

DEMOLITION EXCLUSION ZONES **GUIDANCE NOTES**



INTRODUCTION

The National Federation of Demolition Contractors (NFDC) is represented on the British Standards subcommittee which prepares the code of practice for demolition (BS6187) and is, along with the Institute of Demolition Engineers (IDE), the voice of the UK demolition industry.

Founded in 1941 to help spearhead London's post-Blitz clean-up campaign, the NFDC's members are responsible for more than 90% of all demolition that takes place in the UK.

Today, the NFDC is committed to establishing safe working practices for its members and to represent their interests in areas such as training, safety, the environment, waste management, industry guidance, legislative changes and codes of practice.

However, in researching and preparing the information contained within this document the NFDC cannot be held responsible for its subsequent use, nor for any errors or omissions it may contain.

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APPENDIX 1

1 Exclusion Zones

The British Standard Code of Practice (BS 6187) covers demolition and structural refurbishment. It provides good practice recommendations for the entire process from initial concept through planning and design to the execution stages. A most important aspect of this code of practice is the reference to Exclusion Zones and Safe Working Spaces for both the safety of those on the site and others who may be affected by the works.

This guidance informs contractors, designers, clients and other interested parties how to apply the principles of BS 6187 and current industry best practice to meet legislative and regulative conditions for safe working on a demolition or structural refurbishment site where the use of Exclusion Zones to form safe working spaces is critical to the application of good safety management.

1.1 USE OF THIS DOCUMENT

This guidance and its recommendations should not be quoted as a specification of the intended works. It has been produced to add a degree of consistency to the interpretation of what appears simple but proves difficult in practice. It is intended to be used by suitably qualified and experienced persons.

The reality of site and environmental conditions means that it may not always possible to completely comply with some of the standards contained in the guidance. It is strongly suggested the reasoning for deviation is written down as part of the site-specific risk assessment.

By using the familiar RED, AMBER, and GREEN colour coding for different areas of a site it is hoped that this technique can become as much of a day to day site tool as it is already a formal project planning one.

Figure 1: Fencing for an AMBER ZONE



2 Scope of Guidance

2.1 DEFINITIONS

When managing sites, it is common to have areas where for various health and safety reasons access may be restricted.

RED ZONE – *Is an EXCLUSION ZONE that is defined as being the most restricted and is “an area of a site where no person may work”. Different structures require different methods of demolition. Key to designing and selecting the method is considering what can go wrong. Those decisions will lead to the size and nature of the designed RED ZONE.*

AMBER ZONE – *There may be other areas on site where access will be RESTRICTED to work undertaken by specialist occupationally qualified personnel as required by risk assessment and method statements. These are called AMBER ZONES.*

REST OF SITE – *Access to other areas of the site, where demolition work is not being carried out, will be allowed for inducted and authorised workers.*

GREEN ZONES – *Some sites operate a GREEN or SAFE zone area where no PPE is required such as offices, site welfare and car parking.*

Demolition is a fluid process and the exact position of zones are likely to move and change with time.

RED ZONE = Exclusion Zone
AMBER ZONE = Restricted Zone
GREEN ZONE = Welfare / Office SAFE ZONE - NO PPE

Rest of site = normally permitted site access

2.2 WARNING

If something goes wrong within an exclusion zone the potential consequences may be severe. It is therefore paramount to consider what the foreseeable risks are and to put in place control measures in the light of current best practice for technique, technology, and equipment. What was acceptable practice five years ago may not be today.

Whilst UK readers will be familiar with the legal phrase so far as is reasonably practicable that underwrites the Health and Safety at Work Act 1974, they may not be aware that the same legislation also contains a reverse burden of proof in Section 40. That means if a demolition project went wrong it would be on the parties involved in any demolition work to be able to prove that their design, planning and control measures were not at fault.

3 Colour Coded Zones

3.1 RED ZONES – Exclusion Zones

Significant complications may occur if
the **RED ZONE** is not large enough
or
the method of demolition is unsuitable

The most dangerous areas on site are the exclusion or RED ZONES and these are quite simply places where no worker access is allowed. Obvious examples include inside unchecked dangerous structures and in the designed drop zone during machine demolition.

When a high reach machine is being used, the base of the machine will NOT NORMALLY be able to sit in the RED ZONE. This is because despite having cab, screen and falling object protection (FOPS/FOG and laminate glass) it is unlikely that the driver will have adequate protection if large pieces of the structure fall or slide down the boom and hit the cab. The boom and tools and therefore the slewing area/working zone of the machine will be in the RED ZONE.

Demolition works are progressive in nature and the RED ZONES may well move, change size and even category during the project as the works progress. A simple example of this would be during top down demolition when a lift shaft is used as a chute for the arisings; the area at the bottom of the shaft may alter from RED ZONE when materials are being dropped to an AMBER ZONE depending on if access is needed to remove the materials. Demolition contractors are experienced in managing this type of operation with normal controls including radio communications, locking out mid-levels, and physical barriers at the top to prevent material being put in the chute when loading operations are happening at the bottom.

Despite technological improvements such as the introduction of zero tail swing excavators, working around machines is still potentially extremely dangerous for people. Local areas can be designated as a RED ZONE where no one may enter when the machine is working. During processing and loading materials designating zones is only formalising what happens in practice on site.

During “top down” or multi-storey deconstruction projects consideration must be given to the need for RED ZONES to prohibit access on the floors below the working area. This will require a proof of concept, where engineering calculations are used to predict the worst-case outcome of falling materials or plant. The solution will then be site specific and will depend on the structure, its integrity, and the proposed equipment.

Explosive demolition only happens after extensive planning and a large part of the management action is in creating exclusion zones. A RED ZONE is already in place as extensive efforts are always made to exclude people from areas where they may come to harm. This terminology differs slightly from that used in BS: 5607 and HSE CIS 45 but the principles remain the same.

3.2 AMBER ZONE – Restricted Access

There are many reasons why access to parts of a site whilst permitted may need to be strictly controlled. Areas where work removing hazardous materials such as asbestos are carried out, or noise protection zones, may require specific training, PPE, and containment. The normal management of these makes them easy to designate as AMBER ZONES.

During machine demolition the areas where not only the machine sits but the supervisor, sentry banksman and dust suppression operatives work forms another obvious restricted access AMBER ZONE. The people working in these zones need to be well briefed so that they understand what the plan is, experienced so that they can understand when it is not working and capable of maintaining the necessary vigilance. It is strongly suggested that access to these areas is allowed only to NFDC CCDO or equivalent scheme card holders.

With machine demolition the physical location and size of these zones may change relatively quickly.

One of the reasons behind using the traffic light system of colours was that it is a clear and simple to understand message. That would potentially allow Demolition Site Supervisors and machine drivers to use the same concepts and wording when they are talking to each other about routine works as when they work on a large and complicated project. On projects where there is a need to control access it is quite possible to have amber (orange) stickers for hard hats that designate access to an AMBER zone.

3.3 Rest of Site - Normal Work Access

Demolition sites are invariably hazardous and as such anyone working on or entering a demolition site should have a site specific induction, be wearing the correct PPE for the site and have been briefed on the risk assessment and method statement for their work.

There are many operations that normally take place on site where only normal access controls are required. Three examples of this are

- servicing and repairing plant
- removing furnishings and non-structural elements (soft stripping)
- salvage work such as cleaning bricks.

Certain trades for example scaffolders may wish to create their own AMBER and RED ZONES, restricting access to their own personnel during build and creating exclusion zones underneath when they are moving boards and tube.

3.4 GREEN / SAFE ZONE – No PPE

The site offices, welfare and parking are normally considered to be an area where construction site PPE is not required and therefore, they form a GREEN SAFE ZONE

4 Barriers, signs, and technology to demarcate ZONES

4.1 Barriers, signs, and technology to demarcate ZONES

The normal options for temporary physical fencing include

1. Designed Timber Hoarding (2m to 2.4m high)
2. Metal Heras Type Fence panels with or without debris netting
3. Metal Crowd Control Barrier
4. "Chapter 8" plastic fencing
5. Chestnut Paling
6. Scaffold "A" Frames
7. Road pin and netting

As would be expected the types that are quick and relatively easy to put in place and move generally are there to prompt people not to enter and will not physically stop them from doing so. That means that the best solution will vary from site to site, and even on one site different types of fencing may be needed. Crowd control and "Chapter 8" barriers are quick and easy to move and are very useful to provide a physical separation between for example RED ZONES that are drop zones from AMBER ZONES restricted zones where only an experienced demolition team are on site. The chosen barriers need to be robust enough for where there are to be used; some may prove to be false economy. Road pin and netting rarely stands up long and plastic Chapter 8 barriers may not survive being hit by a machine or rubble and are unlikely to be suitable as edge protection for slabs and the like.

Perimeter Fences normally both require and offer an opportunity to explain why they are there and what action is required. This means that as well as basic keep out and prohibition signs they can be used as messaging and notice boards. Fences and signs need to be maintained. It is strongly suggested that external fence lines be inspected at the start and the end of each day. Even though it is a never-ending task, internal fences, barriers, and signs do need to be moved, picked up and re-signed constantly as the works progress.

Figure 2: Signage on an external fence line



There are many technological aids already available and it is certain that these will change with time. Currently they range from simple flashing signs to complex computer controls.

They include:

- Flashing warning signs that may include verbal messages, written messages, and audible alarms
- Using programable slew and boom / dipper arm lock functions on the machines control unit
- Various proximity warning devices that set off vibrations or alarms in a helmet and or cab
- Geo Fencing systems that use combinations of GPS, infra-red technology, and satellite communications to carry out a wide range of functions even down to immobilising plant if it strays out of its allocated zone
- Projection systems on the excavator itself that mark out the danger areas with red light on the ground and have directional arrows that mark the direction of travel
- Use of drones for monitoring areas and other purposes
- CCTV cameras can be used to add to visibility and can be placed in **RED ZONES**

Figure 3: Helmet Mounted technology means that the wearer of the hard hat is alerted by a buzzer in the helmet when they are close to a machine.



4.2 External Fence line

It would be extremely unusual to undertake demolition work where there was no physical segregation around the external perimeters of the site. The standard will vary depending on the level of risk. Some sites may require a 2.4m high designed timber hoarding to prevent access, others will use an existing fence line or Heras fence panels to provide a similar standard. If the site is on a strictly controlled location for example a refinery or military base, then a lower standard of site fence demarcation may be acceptable. The NFDC Guidance Note on Temporary Works – Hoardings provides details on the practicalities of external fence line solutions.

4.3 Internal Fence lines

It is increasingly common to physically separate the GREEN ZONE office and welfare area from the rest of the site with a physical fence and gate. On some sites “smart” gates with fingerprint, face recognition or card access is used. As well as providing a restriction gates, it offers an opportunity to use posters and signs to act as a prompt or “nudge” about PPE and working standards.

Within a working demolition site, the risk assessment process will again guide how an AMBER ZONE is segregated. Areas such as licensed asbestos removal enclosures have their own legal standards and signage to prevent unauthorised access, especially when there are Waste Routes for Operatives to walk from the enclosure to the waste skip.

Figure 4: Licensed asbestos removal work has its own specific standards for creating AMBER exclusion zones – signage on a 3-stage airlock



Normally no further measures are required for these types of activities, but this will depend on circumstances.

As part of demolition work limiting certain areas to access for trained and specified workers is a common procedure. The normal reason is because inexperienced people may accidentally walk into a dangerous area not appreciating that it was there or the risk that it poses. There are a multitude of scenarios which sadly have been known to cause fatalities that include

- walking into a drop zone
- walking behind a roll on roll off bin when it is being loaded and fell off the lorry hook

The extent that physical guarding using fencing is required will depend on the site.

Stairwells, corridors, and doorways must always be physically blocked and signed. There is always potential that trespassers and rough sleepers may access a building during non-working hours, and they are owed a duty of care.

Machine activity whether it is demolition work or moving or processing arisings will always create the potential for people to be hurt. The use of CCTV's and other viewing aids have improved a machine driver's ability to see. Despite this at some point they are likely to be concentrating on the job which means they may miss seeing the person they are about to slew into or track over.

It is normally possible to use fences to segregate the AMBER Restricted ZONE from the rest of the site. The nature of that fencing will largely depend on who else is on the site. On a small project where the demolition contractor controls the whole site, everyone on site may be actively involved in working in the AMBER Restricted ZONE. The role of any fencing in this instance is mainly to remind anyone else coming onto the site such as a company fitter that they are walking into a live demolition site. That means that crowd control barrier may be sufficient.

By comparison on new build secondary schools it has become the accepted method to build the new school and then demolish the old. This means the demolition work frequently takes place at a busy time in the build with far more people on site than would normally be the norm. It is common to find them still trying to shortcut through the now to be demolished building if it has been the quickest way to a shop. This means that robust segregation such as Heras fence panels is likely to be required combined with good clear warnings signs. The technological aids have already been described. Including flashing warning lights and sound signals on the fence line during live demolition work is remarkably effective.

Where fencing is being used for example around a lift shaft used as a rubbish chute then this is likely to need to be heras or hoarding as it is there to stop people entering a RED ZONE where materials will be falling.

4.4 Marking out of RED ZONES

There will be situations where a RED ZONE must be effectively fenced or guarded. Examples range from explosive demolition where large areas need to be closed off, to an individual room within a building with damaged floors, and various other examples such as around rubbish chutes, which are too numerous to list.

It may be difficult and, in many places, impractical to fence uneven areas where machines may be moving, and fallen material may bounce and move this does not however, mean that during the demolition planning thought should not be given to these zones and how to separate them. The same level of planning must be used however, the method to control the risk may differ.

The risk assessment process will identify areas that create concerns and the plan can then dictate what action is required. Whilst light beams offer a technical solution to allow a driver to see the limits of a zone, it is also perfectly possible to position paint marks on the side of a building that enable a driver to reference position in the same way. It must be remembered that when carrying out a risk assessment, whenever a control measure is implemented a different set of hazards may arise, such as light beams not being visible, or paint marks being worn away. This should be highlighted in the risk assessment and managed on site.

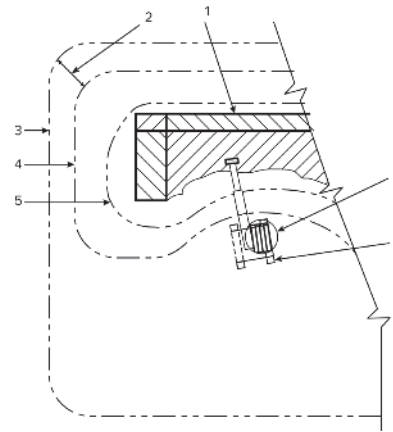
The level of action required will depend as always on the level of risk. A large machine demolishing a small building may well be able sit in one place and so if it was far enough back at the start of the work then no further input is needed. At the other end of the spectrum, buildings that have been damaged by for example fire or have a structural failing may require very disciplined marking of the extent of zones as the structure may collapse rather than be demolished.

There can be an underplay in understanding that zoning and marking also has an important part to play in relation to “human factors”. Physically being involved in demarcating ZONES with paint, tape lines or fences brings a method statement to life and it also means that the limits of where the driver is meant to be operating are reinforced.

5 BS 6187 and Zones

The British Standard clarifies a series of zones within the exclusion zone. **Figure 6**

Figure 16 Example of safe working space within an exclusion zone (typical for mechanical reduction or top-down demolition employing mechanical plant etc.)



Key	
1	Structure being demolished
2	Buffer area
3	Exclusion zone boundary
4	Limit of predicted debris area
5	Limit of designed drop area
6	Safe working space for operator in protected cab
7	Demolition machine

NOTE The safe working space is in a protected area within the buffer area and is therefore beyond the limit of predictable debris.

Table 1 is taken from the British Standard and describes the areas in question with a guide to ZONING.

Area	Description	Machine	High Reach	Explosive
Plan Area	The area of the structure or part of the structure that is to be demolished and is the subject of the assessment.	Red Zone	Red Zone	Red Zone During demolition Amber Zone During preparation and charging
Designed Drop Area	The immediate hazard area where the principal mass of the collapsing structure is planned to drop. Also included in this area is the plan area.	Red Zone	Red Zone	Red Zone
Predicted Debris Area	The perimeter of this second hazard area is the predicted limit or extent to which any debris from, or secondary material resulting from, the structure being demolished will travel and come to rest.	Red Zone	Amber Zone Access for Machine Driver Only	Red Zone
Buffer Area	A hazard area that is planned to allow for any unpredictable events. People beyond the external perimeter of this area (the theoretical boundary of the Exclusion Zone) are safe from the effects of the demolition activity.	Amber Zone Access for Machine Driver, Banksman, Sentry, Supervisor, and water suppression only	Amber Zone Access for Banksman, Sentry, Supervisor, and water suppression only	Amber Zone Access for shot firer and spotters only

The concept behind each area is one of diminishing probability of falling material landing in them. So, material will fall into the drop zone area; but it is unlikely (though possible) that fallen material will enter the buffer zone. If it is possible that material could go beyond the planned buffer zone outer boundary then either:

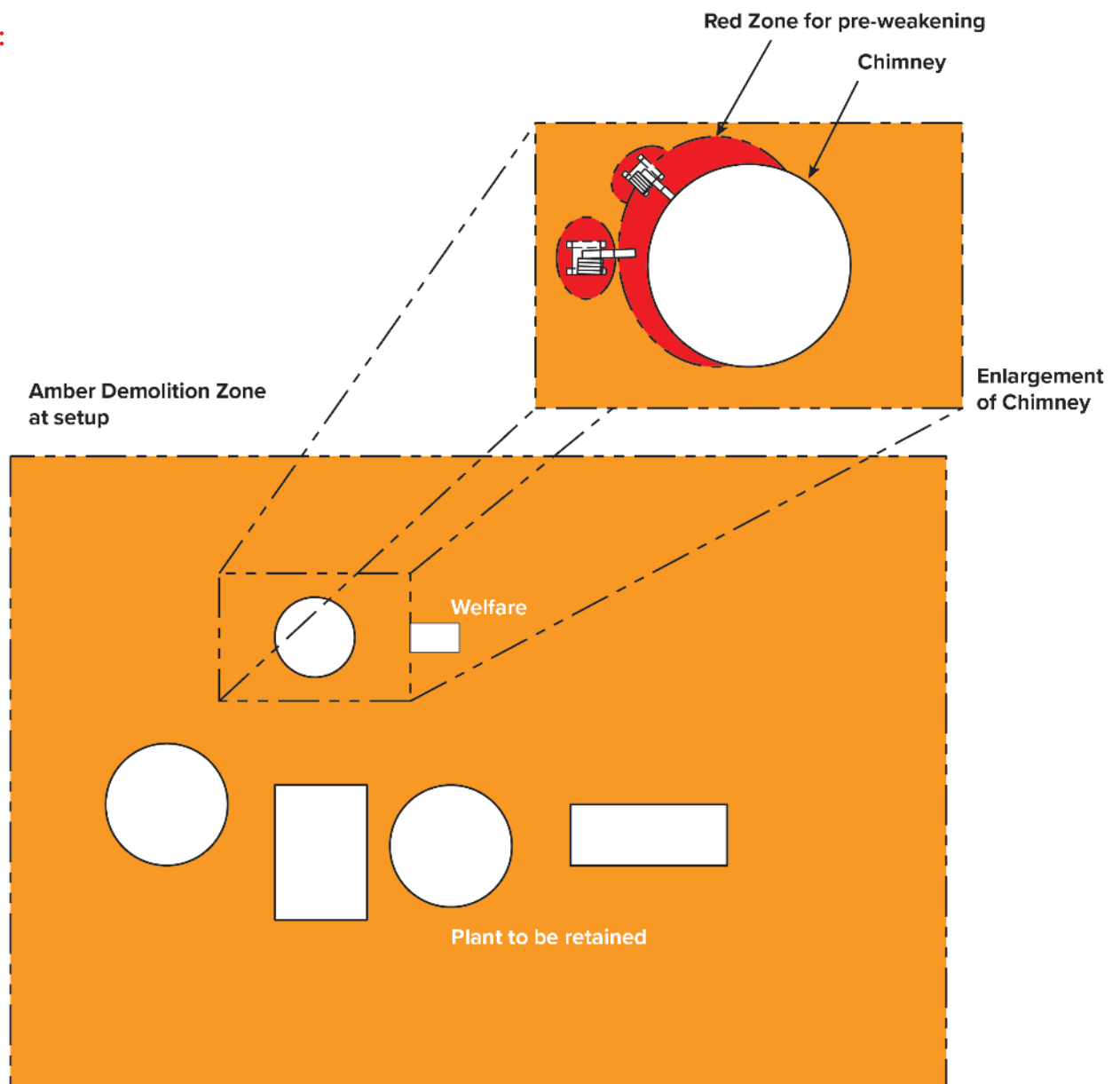
- the buffer zone is not large enough; or
- the method of demolition is unsuitable; or
- the containment measures for controlling fallen debris are not adequate.

6 Explosive Demolition

“Blowdowns” are by their very nature relatively uncommon and highly planned. During the set up works an AMBER ZONE will be in place restricting access to those involved in the preparation work. Depending on the nature of that where machine work for engineered preparation (pre-weakening) or drilling is required then there may be a need for localised and temporary RED ZONES. Once the planned demolition sequence is initiated then no one would be allowed to enter the plan area, drop zone, or predicted debris area which means that these are RED ZONES. The explosive engineer and sentrys are likely to be in the buffer zone in either selected or protected locations which makes this an AMBER ZONE and everyone else is excluded by a combination of fencing and marshalling. As has been stated before this is slightly different to the wording used in BS 6187 and HSE guidance sheet CIS 45. The principles are the same and the reason for change is to bring standardisation across the demolition sector.

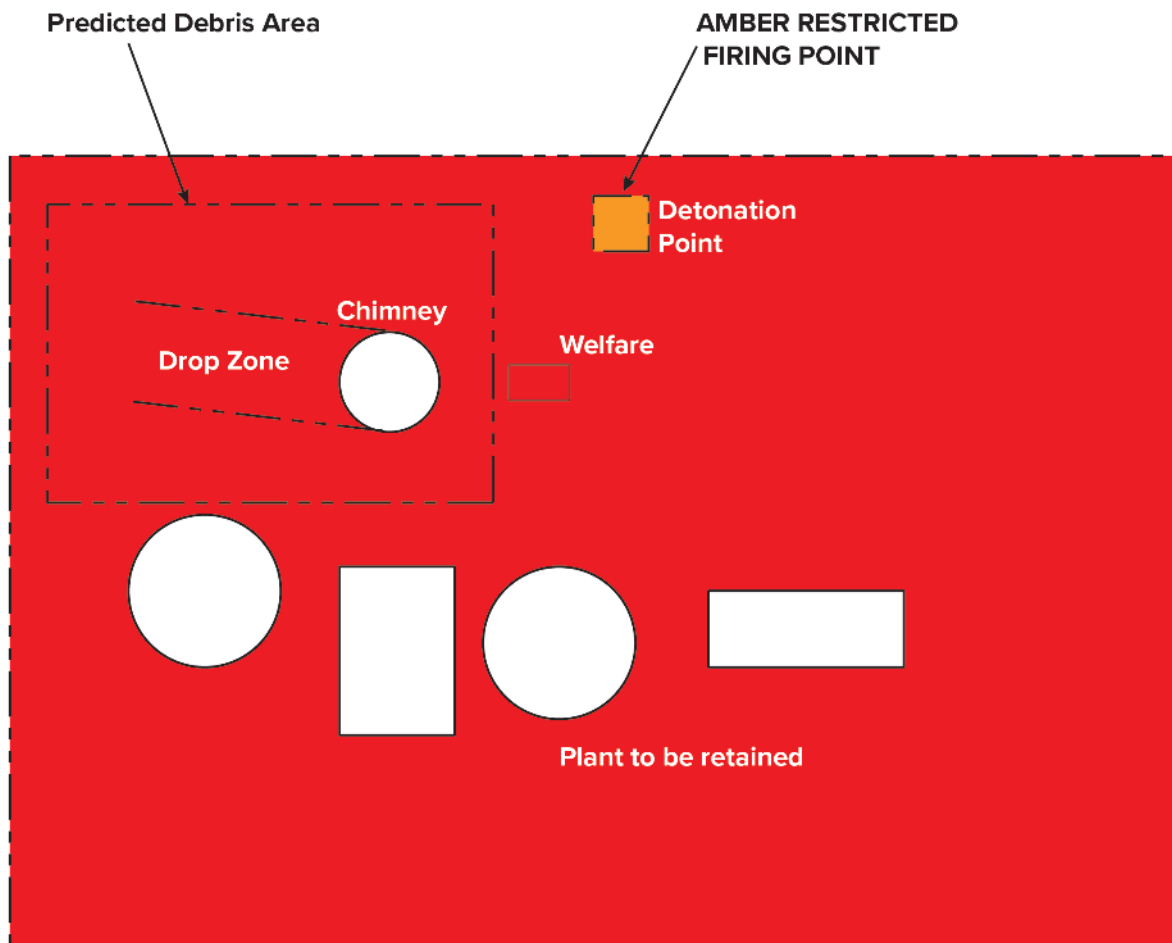
Figures 7 and 8 show how the zones would work on the explosive demolition of a chimney. Figure 7 has an AMBER fenced exclusion zone around the chimney during preparatory work. Two small machines are then used to carry out pre-weakening and there are RED ZONES around each machine and around the area that is being worked on. Figure 8 shows the situation during the blowdown. The Drop Zone and *Predicted Debris Area* and buffer zone are all in the RED ZONE and the shotfirer position is an AMBER zone in an otherwise completely red zone.

Figure 7:



Blowdown 1

Figure 8:



Blowdown 2

RED ZONE DURING BLAST

7 High Reach Demolition

7.1 Design

During the design phase there are several factors that must be considered before this becomes the correct demolition method. These included machine size, the structure, and the site. The NFDC Guidance Note “High Reach Demolition Rig Guidance Notes” contains detailed advice.

As the machine works the materials that it has released from the building naturally fall. Heavy material such as masonry and steel will fall vertically; lighter and particularly sheet materials such as cladding can travel further and indeed be caught by the wind. Where material is expected to land, commonly referred to as the drop zone is a RED ZONE.

If the High Reach Machine has an operator in it then it MUST not sit in the RED ZONE regardless of the cab protection fitted. Remote control technology is continually advancing and with time it is presumed that fully remote-controlled High Reach Machines will be developed. The only practical restriction on siting remote controlled machines in a RED ZONE drop area will become considerations of acceptable damage and the possibility of collapse and overturn compromising safety.

Because of the added momentum given to material by height of fall, materials such as concrete may break up on impact and some items will bounce when they hit the ground in the drop zone and continue moving. Where these will finally come to rest needs to be forecast so that this predicted debris zone can be worked out. It is common to try to reduce the momentum and hence impact of this material and measures include creating barriers typically using bunded materials or containers, digging pits and trenches, hanging screens, and using scaffolding frames. Standing the primary demolition machine on an engineered ramp not only gives it more reach but also uses gravity to reduce the momentum of any such “fly” material. The stability and integrity of any such measures must be considered as it is meant to be a control measure and most certainly not add to the risk. This will mean design calculations for screens and scaffold are vital.

7.2 Predicted Debris Zone – AMBER ZONE

The High Reach Machine may sit in this *predicted debris zone* depending on the measures taken to mitigate risk and the level of protection offered to the driver. If it would not be safe for the driver to leave the protection of the cab during the works, then the machine will need to track back and then track forward again to work.

Machine demolition is progressive by nature and that means that the zones will move and change and contractors should always calculate (by schematic drawing) if a machine is suitable in size and working height to assist in designing the zone. In high reach work that normally means that the RED ZONE will reduce in size and move closer to the building as the height is reduced. This should be recorded on the schematic drawing in phases to assist in the process and record the design.



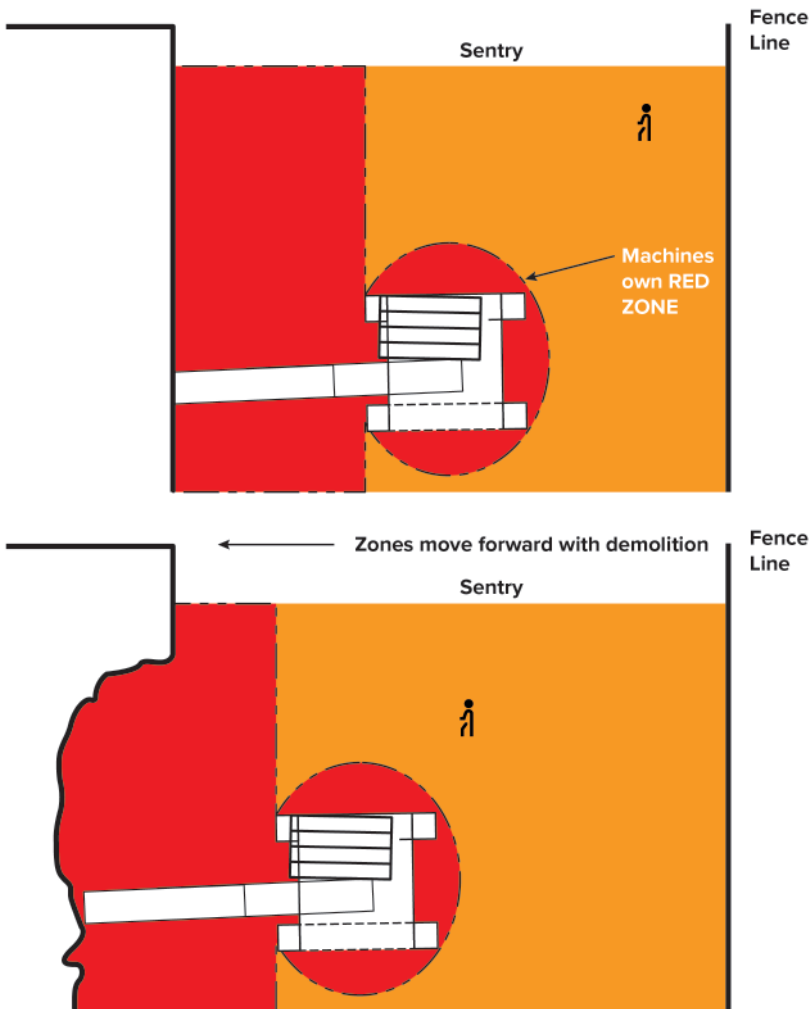
Figure 9: A high reach demolition machine using a ramp as protection from debris and to gain reach

Projects where ultra-high reach machines are used are often simpler to manage exclusion zones because the machines tend to be more limited in their tracking and work from one place for a longer time. This allows more permanent barriers to be used if required by risk assessment.

The machine is likely to sit with the front of its tracks at the edge of the RED ZONE. When a high reach machine is being used progressively then the RED ZONE may move forward with the front of the machine as it tracks forward. This movement and the extent of the movement must be planned and coordinated and be agreed and easy to see with simple end points such as to a specific floor level. If it is felt necessary, it is obviously possible to create reference marks on adjoining buildings or use light beams or even paint lines on the ground to allow the driver and banksman to ensure that the machine remains in the planned zone.

Figure 10 shows the AMBER Zone set up with a fence line and a banksman sentry working in it. The demolition machine is at the front of the AMBER and rear of the RED ZONE, with its own RED ZONE around it when the machine is working. This would be managed in the normal way by the driver to exclude anyone else, unless the driver agreed they could approach. In the drawing the bottom picture shows that the machine has tracked forward. If the machine is working around the height limits of its boom then this will need to be to an agreed point to maintain the correct distance off ratio.

Figure 10: RED and AMBER ZONES for High Reach Demolition



The high reach machines own RED ZONE is only live when the machine is in operation. It is not live when made safe or when the machine operator is out of the cab.

i.e. there will be a lag in the correct zone marking on the ground and the machine will be working in what was the previous RED ZONE.

7.3 Buffer Zone – AMBER ZONE

Additional controls for other hazards such as dust suppression and the use of sentries may mean other equipment and personnel must operate within the area. They can only access the buffer zone as outlined in Table 1, which is an AMBER ZONE. The siting of any banksman/sentries and dust control operatives needs to be well controlled to ensure that they remain within the buffer zone and well clear of any RED ZONES. This should be planned and agreed with the driver. Where the demolition is progressive, sentries and the like need to move before the zones can be reset then moving to pre agreed positions communicating with the driver by radio would seem a practical solution. No one can obviously work in the RED ZONE.

The position of a demolition machine will ultimately be dictated by where the driver can safely work, and it will be in a restricted AMBER ZONE. Commonly the machine driver works with a team that includes a banksman sentry and dust suppression operatives. They are likely to work in the AMBER ZONE and their location needs to take any potential “fly” material into account.

Where smaller machines are working close by to remove and process the demolition arisings then they will sit in the AMBER ZONE, but by slewing and moving materials they will create their own localised RED ZONE which again must be considered and managed.

The NFDC Guidance Note “High Reach Demolition Rig Guidance Notes” contains advice about how close a machine can stand, and this will form the basis for the site assessment of where the RED and AMBER ZONE boundaries will be.

“When setting up for work it is important to consider the predicted debris area, particularly when applying a sloping face on the building being taken down. Rubble running freely down a slope off the face of the building is likely to encroach within the footprint of the machine if the machine is positioned too close to the structure. It is recommended that for all high reach and or ultra-high reach demolition machines, up to a height of 40 metres, the working radius of the machine should be a ratio of 2:1, i.e. if the working height is 40 metres, the base of the machine should be at least 20 metres away from the face of the structure. 2 to 1 ratio is measured from front of cab at lower level (at fixed, un-raised cab position).

However, for all ultra-high reach machines over 40 metres reach, and due to the parabolic trajectory of falling materials, a reduction to the established ratio of 2:1 can be applied. For every metre over 40m height, 0.25m should be added (rather than .5m) to the distance that the machine stands off the face of the structure, i.e. at 50m height the base of the machine should be 22.5m from the face of the structure. (50m height = $10 \times 0.25 + 20 = 22.5\text{m}$) refer to attached drawing” Figure 11.

Figure 11:

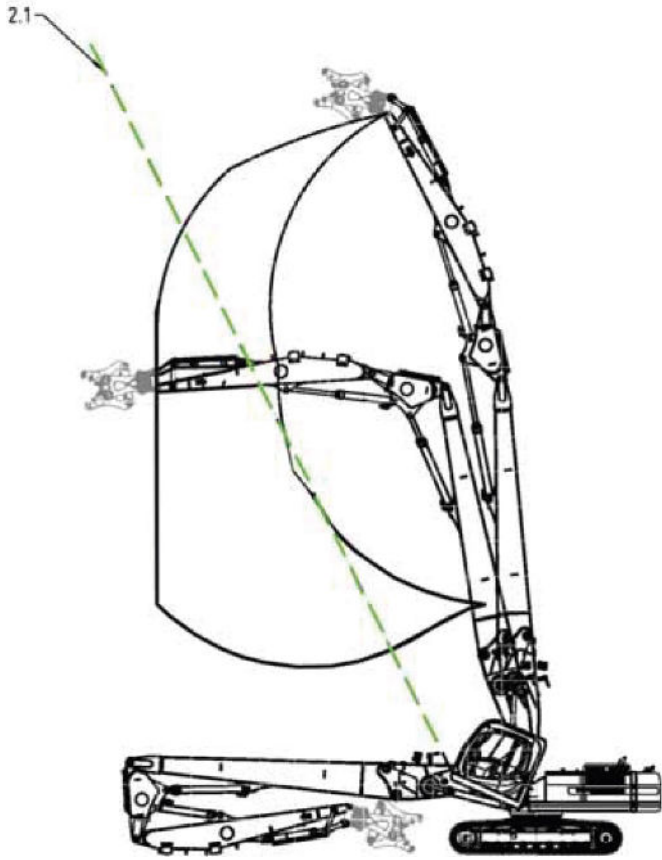
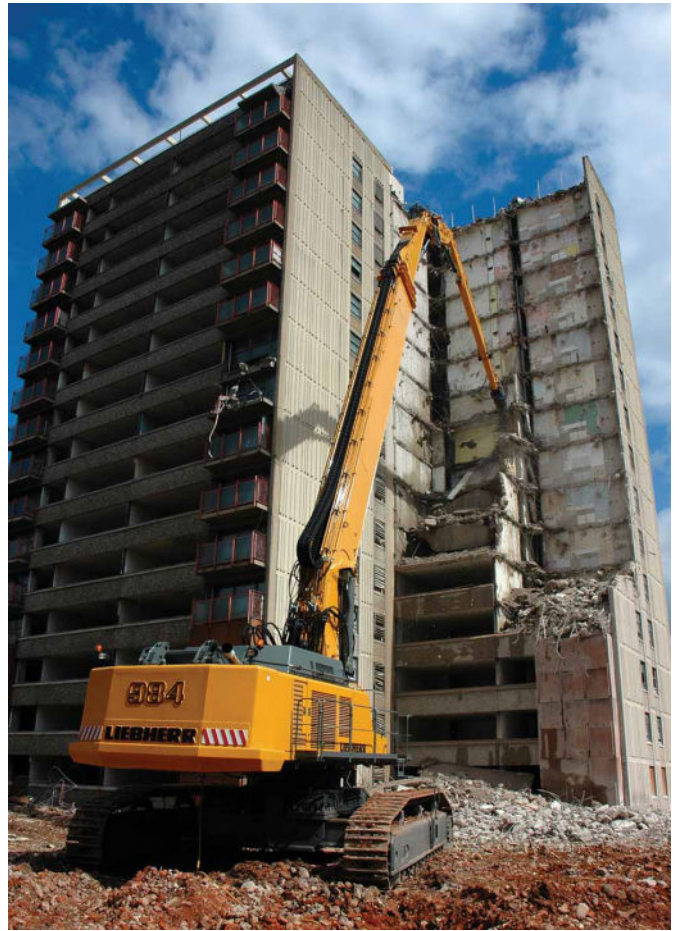


Figure 12:



8 Top Down Demolition

The NFDC publication Guidance for the Deconstruction of Tower Blocks floor by floor or piecemeal is the authoritative guidance on this process. The technique appears relatively simple but requires detailed planning and strict control measures.

Typically, a small machine is either lifted or drives its way internally to the top floor and then proceeds to demolish its way down to either a set level or back to the ground floor. Assessing the stability of the structure during planning is key as an inadvertent collapse may well kill all those doing the work. The design of any propping required must include consideration as to how the demolition work will be done to avoid instability when the props are removed.

If scaffolding and sheeting are included as part of the control measures to stop materials falling then there must be a detailed assessment of the loads that could be imposed. A doubled boarded fan over a pedestrian walkway and a well sheeted or wrapped scaffold will look impressive but may not stop very much. The design must also consider how stability will be maintained whilst the scaffold is reduced during demolition. A scaffold collapse in a city centre project normally creates significant public risk.

There will be several zones created at different stages of the project. From the start it is common to adopt a lift shaft to use as a chute. The bottom of this would normally be a RED ZONE. To either move the hook bin to empty it or to use an excavator to move the arisings this may have to become an AMBER ZONE with strict controls to avoid materials being put down during unloading. Later in the project the area around the shaft openings may also become an AMBER ZONE when Skid Steers Loaders are used to push demolition arisings into the shaft.

Once demolition starts, the live floor will become an AMBER ZONE with access restricted to the required staff who it is strongly advised will be CCDO card holders. There are two RED ZONES; the first is the leading edge where the demolition work is being undertaken. This will progressively move. The second is underneath. The extent of this will depend on engineering advice. This needs to consider the type of construction in relation to how large or heavy the maximum size of arising that can be created and then the worst-case consequence if the machine, this arising or even both together fell.

Whether the demolition process can be undertaken at the same time above floors with soft strip workers in will depend on the structural engineer's assessment of the worst-case outcome of any falling material or plant.

The sequence will depend on the situation, but it would normally include breaking in on through the top floor, ramping down a floor and then demolishing the top floor working from the floor below.

Where a remote-controlled excavator is used it can sit in the RED ZONE, but the operator must be in the AMBER ZONE.

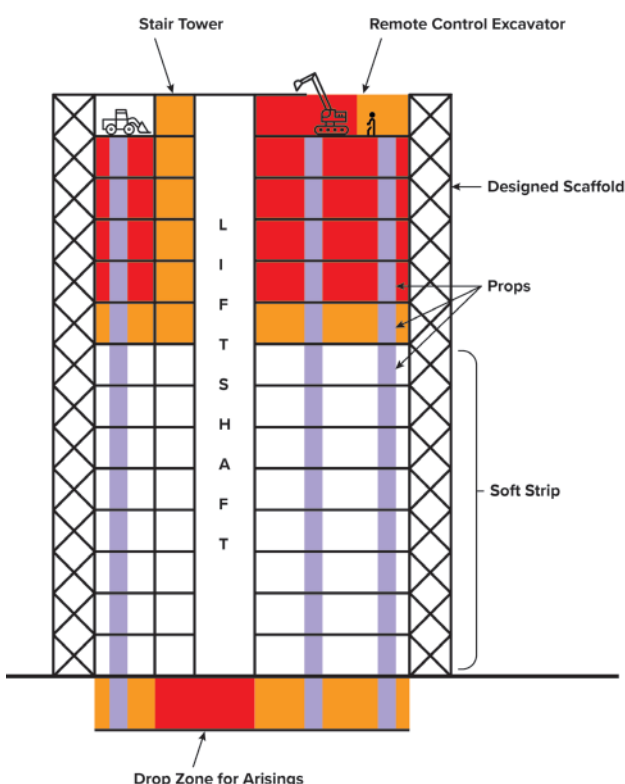


Figure 13 shows a tower block with a lift shaft and stair tower. The building has been back propped and scaffolded, and a four-floor exclusion zone specified for safety reasons during the machine demolition. Soft strip can continue in the lower parts and an AMBER zone has been set up to restrict access to the demolition floors. The remote-control machine sits in the RED drop zone working into the leading edge whilst the driver is in an AMBER zone. It would be normal for the arisings to be bulldozed by a skid steer into the lift shaft and this would work in the AMBER ZONE on the working floor. The bottom of the lift shaft would be a RED zone with a well-managed system to allow removal. The design of the leading edge and the exact position of the RED zone will be a matter of planning and sequence. The demolition is likely to be on a bay by bay basis. This means in the demolition area the RED zone will normally be fairly small and it will move. Most of the floor area will be available for removing arisings and standing power packs for the machine on. Multi-storey demolitions are normally mainly repetitive cycles on the same structural method with some exceptions such as internal plant rooms.

Figure 13

9 Machine Demolition

This is the most widely used demolition technique and ranges from multiple machines working alongside each other on bridges to a small excavator demolishing a single storey hut.

The significant difference between this and High Reach Demolition is that the demolition machines are likely to be more mobile. There is still the obvious need to exclude people from the drop zone but the slewing, tracking and creation of drop zones from sorting arisings creates additional risk.

The RED ZONE remains the drop zone i.e. no one permitted in the zone. The machines will sit in the AMBER ZONE, but it is likely that they will have a RED ZONE surrounding them. It may not be reasonably practicable to fence the machine, but there are both technical solutions such as better cameras, buzzers in helmets in cabs and Halo as well as the more basic management solutions that include eye contact, tool down and thumbs up from the driver. Where a remote-controlled demolition machines is in use, whilst the operator must not enter the RED ZONE the machine certainly can.

The AMBER ZONE is likely to require physical segregation from the rest of the site. On small sites where the whole team will be working in the AMBER ZONE then once machine demolition starts it would be practical to simply make the site AMBER and then introduce RED ZONES for phases of the works.

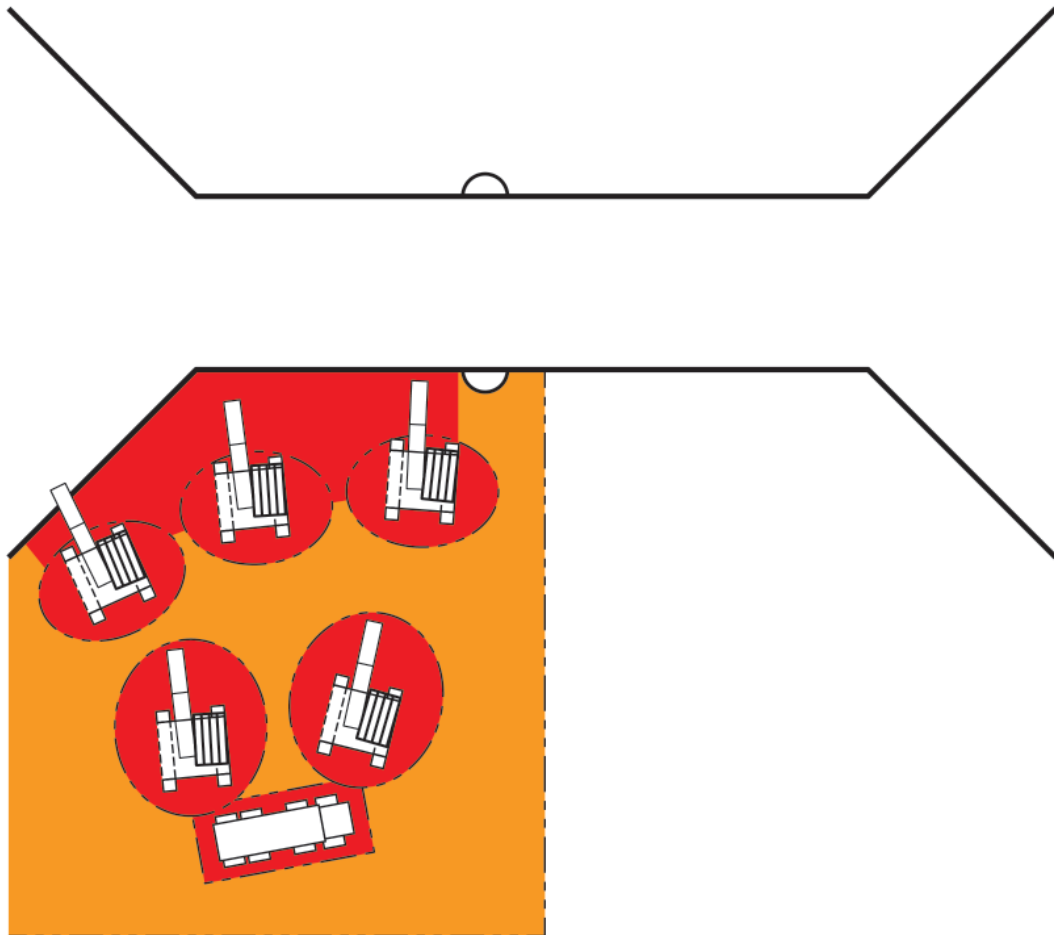
It is not that difficult to see how the concept of zoning works where the buildings are “square” and the work proceeds on a bay by basis or along one elevation and there is a clear separation between what has been demolished and what will be demolished. There are however many buildings with internal core walls or other structural strong points that mean that the machine has to “work” its way in. That could quite easily mean that the machine is sitting next to an internal edge of building that it previously demolished whilst working forward. To ensure stability the options include either leaving a clean edge by trimming back or create a stepped profile by raking back to a structural support. If the edge is stable then the RED ZONE will be the progressive face in front of the machine. If the edge is not trimmed or raked then it means that the machine is now potentially sitting where there is risk of collapse i.e. in the drop zone created by the previous and unfinished work or using colour coding in the RED ZONE which is not permitted. It is important to remember that lots of this type of building have been demolished safely and whilst the colour coding may be new, the basic parameters of safe practice and making an edge safe are far from new.

It is normal practice to have a primary demolition machine and then typically smaller machines that sort, process, and load the demolition arisings. All the machines will have a RED ZONE around them when they are operating. Whether this needs physically identifying will depend on the circumstances. On most sites it will be managed by creating an AMBER ZONE where the machines work. Access will be restricted to ideally NFDC CCDO card holders who understand the safety implications and using a tool down and cameras for the driver approach.

There will be sites where the risk assessment will identify that more is required. An example would be bridge demolition in night-time possessions. Working in the dark and potentially rain or misty conditions makes it harder for the driver to see pedestrians regardless of working lights, cameras, and high visibility clothing. Technology such as proximity detectors, illuminated PPE and light systems on the machine such as HALO may provide increased safety where there is a need for people to work around machines. Obviously, this would not be necessary if it is possible to make the area a machine only AMBER ZONE i.e. exclude anyone not in a machine.

Figure 14 Shows a bridge being demolished. The three primary demolition machines are about to start. There is a RED ZONE where the drop zone will be, and each machine has a red zone around it. Two machines and a lorry are shown behind to illustrate processing and loading or arisings. The entire work area is fenced off and made an AMBER. This is one of the most dangerous types of demolition mixing demolition, multiple machines, people, loading, traffic management, program pressure and frequently night-time working. In the example shown, the zones will simply move forward as the work progresses.

Figure 14



10 Small Demolition Site

Alongside the glamour of multi-million-pound projects there are countless small projects carried out every year. These are commonly carried out as site clearance or enabling projects and the demolition contractor is alone on the site. The work is normally done by a small team.

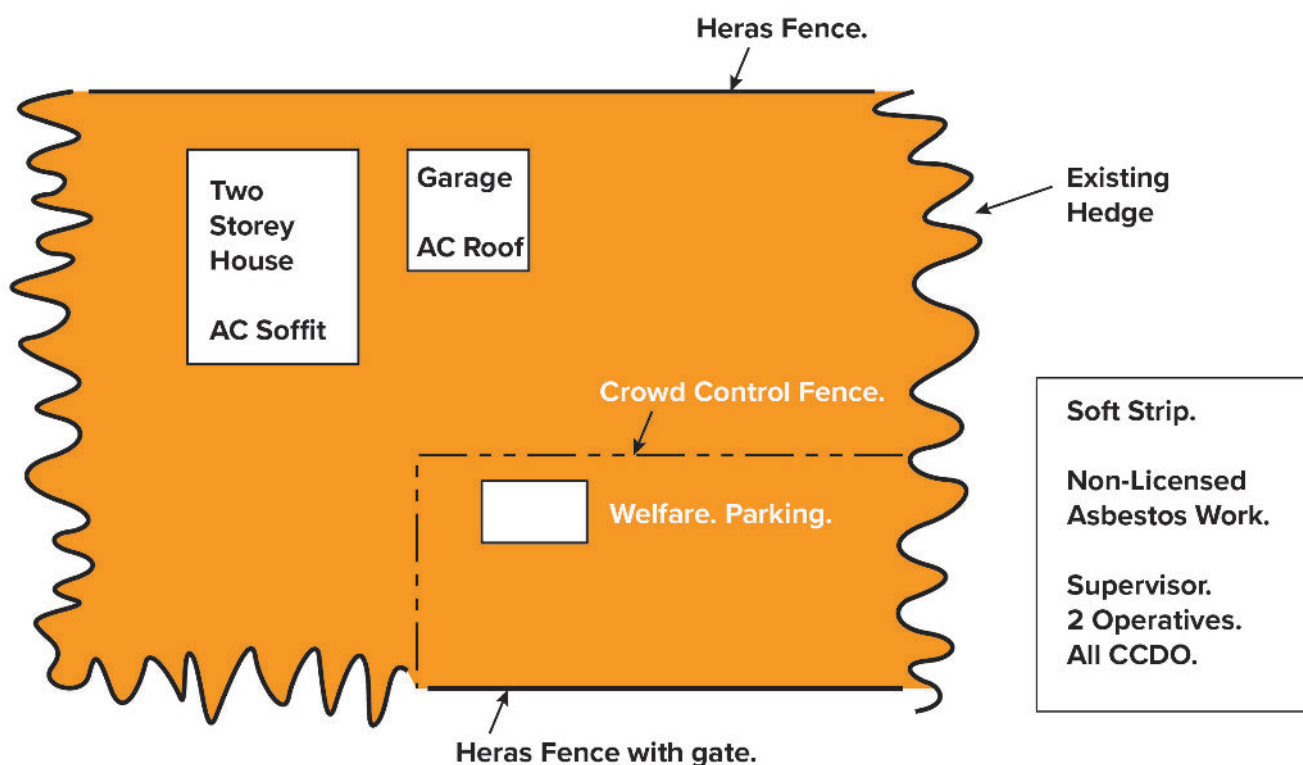
In the example below the site is in a residential area with existing boundaries around the front and both sides. The existing two storey house is a traditional built brick structure with asbestos cement soffits and the single storey garage has an asbestos cement roof. All buildings are stable and undamaged. The demolition team of three will be carrying out the entire project from soft strip and non-licensed asbestos removal to machine demolition.

Using some crowd control barrier, the welfare area and parking is split from the rest of the site. The site is designated as restricted or AMBER throughout. All the demolition team hold CCDO cards and can work in the AMBER ZONE. For the soft strip and non-licensed asbestos removal there are no further restrictions.

The buildings will be demolished by machine. This will create RED ZONE (exclusion zones). These will be in the plan and drop zone of the house and garage and then there will be a smaller machine zone around the machine as it sorts the arisings. Figure 15 shows the site in plan.

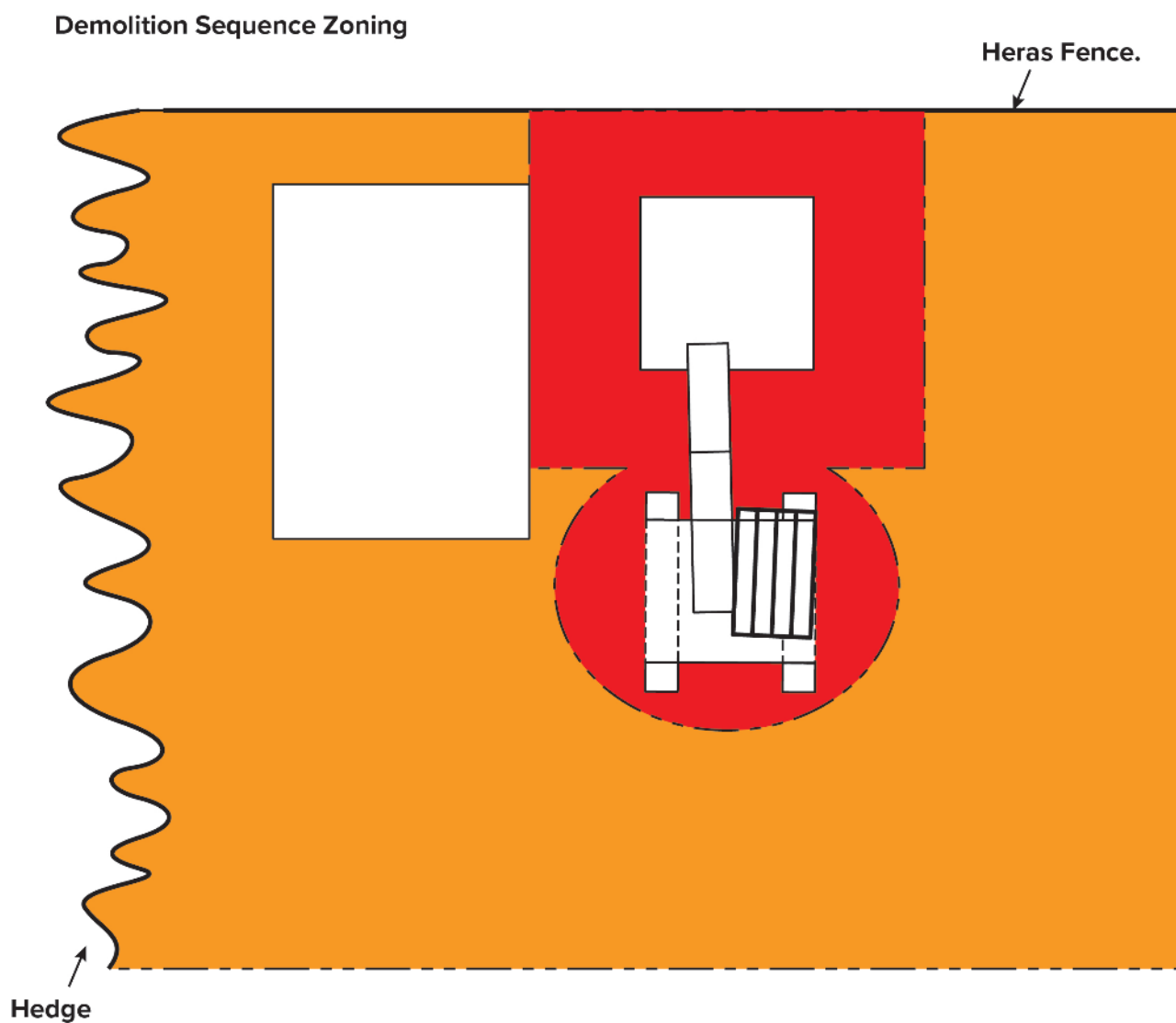
Figure 15

Small Demolition Site Preparation



In this example, the three operatives are all likely to be actively involved in the demolition. One will be driving the machine, the second acting as sentry and the third operating dust suppression. Whilst it is obviously possible to use crowd control or chapter 8 barriers to demarcate the AMBER and RED ZONES for an experienced team this should not be necessary. What is probably more important is that the zones are discussed in relation to how the demolition will progress so that everyone is fully aware of the plan. That not only means they each know where the other will be but also, they can all recognise when the plan is not working. Smaller jobs tend to have less planning and management input and rely instead heavily on the experience of the driver to decide exactly what to cut where and when, so it is particularly important that the team understand the plan.

Figure 16: Drawing showing zoning on a small demolition project



11 Soft Strip and Hand Demolition

Whilst soft strip is normally a lower risk process, using AMBER and RED ZONES may be necessary for waste removal. Using lift shafts has already been described, but it is also common in lower buildings to create a sheeted external Chute. Where a Chute is built it needs to be designed and be large enough to take the arisings without bridging. In some circumstances low level-controlled bombing may still be acceptable. This is unlikely to be possible above second floor level and requires a lot of space on the ground. Both examples will mean the creation of a RED ZONE managed to prevent all access and behind a robust fence line.

Principally during refurbishment works hand demolition is still carried out. There will be a need for a RED ZONE in any drop zones and a predicted debris zones where for example work is carried out from scaffolding or powered access. The type of fence or barrier required will depend on the risk assessment. The solution will be the same as on other sites and will range from total physical exclusion with locks and signage to chapter 8 barrier to act as a prompt to keep other demolition workers out. Again, the emphasis is that by using a simple colour code the site team running the job are given tools that they can use. Of importance in soft strip and hand demolition work is that the operatives may not be NFDC CCDO card holders.

+ NOTES

1. It is likely that English may not be their first language, but as traffic lights colours are universal then simple site sketches and plans with red and amber on are probably a lot easier to communicate than a long set of RAMS.

APPENDIX 1

Further Guidance

BS 6187 Code of practice for full and partial demolition

BS 5607 Code of practice for safe use of explosives in the construction industry

BS EN 1991-1-6 Eurocode 1 – actions on structures

BS EN 12811-1 Temporary works equipment part 1 -scaffolds

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