Tower Block Demolition

An objective look at the comparable methods utilised to reduce tower blocks and the hazards inherent to each method

PERSES LTD

Perses Limited
info@perses.org.uk
07595 293058

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Instructions and purpose of this report

INSTRUCTIONS AND SCOPE OF THE DOCUMENT

Perses Ltd was instructed by Mr Kenny Crookson of the Glasgow Housing Association to provide an objective look at the different methods utilised in the reduction of high-rise tower blocks, considering the merits for the various options and outlining the pros and cons of each option.

The information gathered for this report is based on the on-site observations during my site visits across the wide berth of demolition projects focusing on the safe reduction of tower blocks across Glasgow, on behalf of Glasgow Housing Association,

PURPOSE OF THIS REPORT

To provide an independent report which considers the health, safety, environmental and quality issues that must be addressed to ensure safe, sustainable and effective removals of high-rise tower block.
The report considers the pros and cons of the various techniques to determine the most appropriate techniques and sequence to undertake the work safely and effectively.

LIMITATION OF THE REPORT

The contractors are absent in name and from, to remain impartial the differences in the contractor's workforce may prejudice the objectivity of this report.

Costs
This report will not consider the costs required to implement any of the listed controls, nor will it compare the costs for each of the listed methods. This report is strictly a comparison of the methods to establish the safest method.

Structures
This report is on the various techniques and does not include the removals of asbestos materials, or the internal soft strip of the structures but looks at the actual execution of the demolition works.

This report cannot deal with every eventuality, structural inconsistency and/or site condition and as such this report and the recommendations herein are strictly on the methods described in this document is based on a generalised stable structure.
There have been successful demolition contracts carried out using bottom up piece-meal demolition which will not be covered in this report

Regulations and legislation
While all works mentioned within this report are in accordance with current standards and good industry practice, some dates of standards/regulations may not be listed within the document in an attempt to future proof this report.
This is largely based on the fact that the British Standards for Temporary Works (BS 5975) and the Safe Use of Explosives (BS 5607) are due for updates.

Planning
Contract specific methodology prepared in accordance with the requirements of Clause-5.2.3 of British Standard 6187 Code of practice for full and partial demolition, and Regulation-20 of the Construction (Design and Management) Regulation 2015 (C.D.M-15), must be produced, and should take cognises of any issues pertaining to each structure as noted in Clause-9 of BS 6187.
Further detailed paperwork such as specific risk assessments (outlining the hazards and control measures) and lifting plans must be completed prior to and must be specific to the works.

Application of the various methods to different structures
While the findings in this report is based on a like for like structural comparison to ensure that the comparison is correct i.e. apples for apples however, I offer the following caveat: Each of these methods have their own distinct strengths just as each of the structures have their own attributes. Each of these methods are irreplaceable in certain environments i.e. explosives in power stations demolition.
A full assessment should be carried out at the initial stage to determine the best method based on the particular site issues; the most appropriate method should then be selected.

General background information

Panels
The use of large precast concrete wall and floor units were employed in the construction of high-rise buildings during the 1960's and 1970's.
The system was particularly prevalent in high-rise blocks designed for domestic dwelling developments.

This type of construction used the reinforcement in the connections and cross walls for framing support. The structures were built on a floor by floor basis and assembled using cranes.
Shear loadings were applied via the reinforced in-situ concrete stairs and lift cores.

Structural integrity depended upon the panels being joined and secured by bolted and concrete grout infill connections which, over the years, have been found to be inconsistent in terms of quality and must not be relied upon during deconstruction/demolition.

The process of the floor by floor erection entailed lifting each unit by the inbuilt lifting eyes and bolts and the propping of wall panels was necessary to stabilise them in position before bolting and infilling with concrete was completed.

The simple multi-box structure was brought under official and professional engineering scrutiny by the collapse of a high-rise block at Ronan Point, London in 1968. This catastrophe was pivotal in the implementing of the Mandatory Standard for disproportionate collapse.

Numerous serious accidents occurred during the erection of the structures of which three hazards, in particular, have been identified. The prime cause of injuries was as a result of persons falling from edges where guard rails and toe board protection were non-existent.

The second largest cause was a failure of the propping systems either through insufficient props or the inadequacy of their fixings.

The third largest cause was a failure of the various components of lifting equipment, including the lifting eyes which were built into the panels. These issues should be considered at the demolition design stage and will be required to be covered within the method statement and monitored throughout the works.

Shear Failure
A number of buildings being demolished top down have suffered from partial collapse during demolition, this usually results from the building carrying larger loads than originally designed.
The established procedure was to assess the capacity of the existing building by investigation and analysis and then either use plant that could work without overloading the structures without propping, or to provide props to distribute the loads. The assumption is that the building is generally in the condition it was constructed.

It is become common practice to load test buildings to establish that larger plant can be used than can be justified by back analysis. However, the nature of testing has generally been to establish mid-span bending moment other than shear capacity and check the shear capacity by calculation.

Shear failures may be a significant risk during top down demolition of flat slab and hollow pot floors.
A bending failure may leave some residual capacity in a slab however a shear failure generally results in a major, uncontrolled collapse which may occur where implied loads during the demolition are inadequately controlled resulting in overloading.

Note: Where structural failures occur in buildings undergoing alteration or demolition part of the reason for this may be because of uncertainties with the condition of the structure. Factors such as shear or ductile failure should be considered and assessed.

A shear failure, being a brittle failure, can be sudden and lead to catastrophic results, whereas ductile failure usually gives warning, the structure can also accommodate more loading under serious deflection.
There have been concerns that some early examples of flat slabs had weaknesses associated with shear around columns and potential problems may have been exacerbated by water leakage and general ageing.

A good example of shear failure is to be found in the 1997 Pipers Row Car Park Collapse.

Executive summary

This executive summary provides an overview of my thoughts on each of the methods on a section by section basis.
Further reading of the individual sections of this report is required to gain a full understanding of the issues considered, and final recommendations.

SECTION-1: REMOTE DEMOLITION

This section covers the method of reducing high rise structures using high reach demolition rigs.
It covers specific controls required to ensure the safe implementation of this method, and outlines the key hazards faced while reducing structures using this method.

These hazards include:

- ✓ Exclusion zone;
- ✓ Plant interfaces;
- ✓ Premature collapse.

SECTION-2: PIECE-MEAL DEMOLITION

This section covers the method of reducing high rise structures using piece-meal.
It covers specific controls required to ensure the safe implementation of this method, and outlines the key hazards faced while reducing structures using this method.

These hazards include:

- ✓ Manual works;
- ✓ Working at height;
- ✓ Exposure to weather;
- ✓ Premature collapse.

SECTION-3: EXPLOSIVE DEMOLITION

This section covers the method of reducing high rise structures using explosives.
It covers specific controls required to ensure the safe implementation of this method, and outlines the key hazards faced while reducing structures using this method.

These hazards include:

- ✓ Manual works;
- ✓ Pre-weakening;
- ✓ Dealing with the remaining pile;
- ✓ Handing explosives.

SECTION-4: SUMMARY OF FINDINGS

I conclude that the safety overall method for the demolition of this type of structure using a direct comparison, is high reach rig using progressive fragmentation.

Of course, in real world demolition each structure should be considered on its own merits to decide which method is most suitable considering topography, height of the structure, proximity of neighbouring structure, and structural makeup.

This method, using the correct control measures is by far the safest method as it reduces exposure to dust, vibration, and other health and safety issues, while reducing the interfaces with demolition operatives.

Section-1: Remote demolition

DEMOLITION USING HIGH-REACH DEMOLITION RIGS

For the purpose of this section, it should be noted that there is no distinction between high-reach and super-high-reach demolition rigs. This is due to the fact that while there is a distinct difference in the movement of the rig and the skill of the operator, the fundamental principles remain the same for demolitions over the height of thirty meters (30m).

There is a plethora of information available on this method as the National Federation of Demolition Contractors and the European Demolition Association both give guidance on the use of high-reach demolition rigs. Currently, both of these groups have produced documents which offer differences of opinion on the method used to reduce the structure.

The European Demolition Association (EDA) prefer the strip-down method of demolition, reducing the structure back to the shear walls, while the National Federation of Demolition Contractors (NFDC) prefers to step down the building in stages giving maximum stability from the tied in floors and walls at all times during the phases of the works.

After observations of both methods of work, I have concluded that the reduction of the tower by strip down method offers easier access to the floors to clear the debris, lowering the risk of overloading the floors, maintaining higher structural stability at the initial stages, the final stages will in actuality have an increased issue of structural instability as the final rows will be left with limited lateral support.

The method of stepping down the structure while offering more rigidity also presents an issue of the debris overloading the floors and if materials fall, giving rise to potential bounce, sending the material closer to the rig.

As such I posit that both methods be utilised during the demolition of towers acknowledging the structures individual requirements identified at the planning stage.
It should also be noted that the subjective preferences of the person operating the rig may influence the method used.

From a risk exposure viewpoint, considering the potential for human exposure to working at height, manual handling, noise, vibration, dusts, and premature collapse the method of reducing the tower remotely effectively eliminates the majority of these on any real scale with the only operative exposed to any issues during the demolition of the structural fabric being the operator of the demolition rig[1].

This exposure is reduced as far as is reasonably practicable as long as the height to distance ratio as supplied by the manufacturer or found in NFDC guidance note for high reach demolition rig: DRG 101 guidance notes are observed correctly and sufficient safe working spaces (often, incorrectly referred to an exclusion zones[2]) are maintained. Safe working spaces once established may be altered as the work progresses.
A drawing should be provided as part of the site-specific method statement to illustrate the required zones, highlight any restrictions to the zones, and any specific risk sections.

Additional issues arise in the safe use and maintenance of the demolition rig; which requires daily inspections[3] by the operator, and an annual certificate of thorough inspection[4].

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[1] This method also observes the standard set within Clause-14.1 of BS 6187; that whenever practically possible, a remote mechanical process should be used to minimise the risk to workers.
[2] As set out in Clause-13 of BS 6187, and NFDC guidance note for exclusion zones: DRG 110. The safe working zone is in four parts and includes a buffer zone and the area of demolition. Sections of this area can be referred to as an exclusion zone.
In some zones, only trained demolition personnel will be allowed into the exclusion zone, in others, such as drop zones no one is allowed entry. The exclusion zone prevents untrained operatives from entering.
[3] Regulation-6 of the Provision and Use of Work Equipment Regulations 1998.
[4] Schedule-1 of The Lifting Operations and Lifting Equipment Regulations 1998.

There is of course a limit to the height of the structure which can be demolished using this method, as there is a limit to the reach[5] of the rig, and the size of attachment which can be used. The higher the rig reaches up, the lower the size of the attachment.

The key hazards for the high reach demolition include:

- ✓ Exclusion zone;
- ✓ Plant interfaces;
- ✓ Premature collapse.

[5] The highest reach currently in the U.K is approximately 70-meters which gives an approximate 70% maximum working height.

Section-2: Piece-meal demolition

The traditional technique of reducing tower blocks has always been piece-meal, this may be due to the limitations of technology within the demolition industry, our reliance on tried and tested methods, and our resistance to trying new methods; this of course is completely understandable considering the commercial and/or safety impacts if something went wrong.

In principle, the use of mast climbing work platforms (M.C.W.P), scaffolding, and vertically descending containment caps such as the cap created by Despe of Milan are variations of control measures, with the method of demolition more or less remaining the same.

As this section is focusing on the reduction of towers using piecemeal I will look at these different controls in turn and comment on the specific controls as well as the physical demolition.
There is guidance produced by the NFDC available on this method.

Plant selection
Remotely-controlled machines and robotic devices should be used where appropriate throughout this method of work, particularly when hazardous or potentially dangerous situations arise.
These machines effectively allow the operator to position himself out of harm's way while safely tackling the hazardous task.

The use of this plan is described in Clause-17.4 and 17.5 of BS 6187: which states that when compact machines such as mini-demolition rigs and skid-steer loaders are used for demolition on the upper floors of buildings, an assessment of the strength of the floor should be made, taking into account the possibility that the machine and a quantity of debris could eventually be supported on part of the floor before being removed, e.g. to the floor below.

Account should be taken of the weakening effects on the structure by the progressive removal of elements and the extra loading caused by any temporary access ramps.

These machines should be fitted with appropriate capacity hydraulic attachments that can be used, for example, for breaking out and cutting, handling, processing and soft stripping, the weight to which will also have to be allowed for in any calculations.

Precautions should be taken to prevent machines from falling down holes in floors or falling from the edges of buildings, through operator awareness by detailed instruction and where required by the provision of adequate edge protection, and/or a suitable restraint system.

EDGE PROTECTION USING SCAFFOLDING

Using the traditional method of wrapping the structure in a demolition specification scaffold[6] to provide a safe working platform from which the operatives can work.

With the platform wrapped in a mono-flex style sheeting it then offers a nuisance factor reduction screen helping to contain the effect of noise and dust in addition to the working platform. This method often entails the use of a tower crane (as in the photograph opposite) to allow the safe lifting of plant from one floor level to the other, and to assist in the removal of some of the arising debris down to ground level.

It is well known that the introduction of a control measure introduces additional hazards and is not the end of the problem. If we think to the finish, then we can establish that the introduction of the crane itself offers a risk of failure of the lifting equipment and accessories and other standard crane-related issues such as rescue plans for the operator and the erecting of the unit.

[6] Service Class 4 - 3.00 kN/m².

While the risk of falling from height is controlled by the working platform if the scaffold is correctly designed to the required standard[7], it should be noted that the scaffold ties and platform must be inspected every seven-days[8], the tower crane and crane base require their own set of checks

While the scaffold provides a control measure for working at height, the physical exposure to noise, vibration, inhalable and respirable dusts, premature structural collapse, weather, musculoskeletal fatigue, and vehicle and plant interactions still remains high.

This impact on the human body is significant at all times throughout the works and may run for many months while the structure is slowly reduced. In the case where the structure is much stronger than anticipated, the prolonged exposures impact greater on the workforce than the original estimate and as such the risk of near misses and injuries[9] is increased in line with the work program.

Looking at this method from a human behavioural view then the reliance on temporary works to provide the safe working platform (scaffold), the floor loading support (propping), and panel integrity give an additional issue of human error failures as each of the temporary works requires continual physical inspection by a competent person. This in the initial stages is okay but the longer the contract takes the more the opportunities for human error due to complacency begin to creep in. This is best explained by the four stages of competence model developed by Noel Burch.

As each of the floors of the structure may react differently the required checks to ensure the stability of the floors, structural ties and scaffold checks must remain at all time essential.

EDGE PROTECTION USING MAST CLIMBING WORK PLATFORMS (M.C.W.P)

The substitution of the traditional scaffolding wrapping around the structure with that of a mast climbing work platform is while controversial, very interesting as it is considerably faster to install than scaffold and as such may be more desirable from a commercial viewpoint.

This method also eliminated the reliance on a tower crane to lift the items of small plant up to the working levels by having one of the sections of the mast climber rated to take the additional weight of the skid steer, brocks and mini-diggers.

This meant that the items of plant could be moved from level to level in a much more cost-effective manner.

However, due to the fact that the section loaded for the plant has to be disconnected from the rest of the platform, this gives rise to issues to potential for issues as the edge protection is removed during these operations and relies on additional controls being implemented.

The lowering of the platform also gives rise to potential issues as the sections need to be disconnected and lowered independently and as always each of these movements increases the potential for issues arising.

The location of the mast climber supports is a concern and needs to be correctly planned so it is clear of plant interfaces such as the internal drop zone within the structure where the arising debris is being cleared.

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[7] It is a requirement of the Work at Height Regulations 2005 that unless a scaffold is assembled to a generally recognised standard configuration, eg NASC Technical Guidance TG20-13 for tube and fitting scaffolds or similar guidance from manufacturers of system scaffolds, the scaffold should be designed by bespoke calculation, by a competent person, to ensure it will have adequate strength, rigidity and stability while it is erected, used and dismantled. This will also require compliance with BS EN 12811-1:2003 Temporary works equipment. Scaffolds. Performance requirements and general design, and BS 5975:2008+A1:2011 code of practise for temporary works procedures and the permissible stress design of falseworks.

[8] And other instances such as after alterations, after inclement weather, et cetera as per the Work at Height Regulations 2005 (amended 2007).

[9] As suggested by Heinrich's/Bird's triangle.

Additionally, this method is not as efficient at containing the dust and noise compared to the others in this category.

As the scaffold section above outlined, there is an inherent issue of temporary works checks with this method as the mast climber requires to be in the temporary works register and should have regular inspections and as the works progress this may become less and less thorough.

While the mast climber is only on one level there is a lower level of wind loading on the working platform which affects the scaffold, making it a safer option from that respect, the mast climber is affected by high winds and can be winded off. This is a control that can be manually overridden or missed and requires planning in long range weather forecasts and vigilance for wind speed changes.

The mast climber can also be lowered and raised at will by the team and as such may be misused. The distance from the working platform to the structure's gable ends may vary with the construction and need to be taken up by an inner board which again needs to be regularly inspected and maintained due to the wear and tear, and other impacts imposed on it.

The human factored impacts remain the same as the method stated in the scaffold outlined above.
It should also be noted that once the mast climber is in motion during certain points in the demolition sequence, there is it the potential to have the edge protection removed.

EDGE PROTECTION USING VERTICAL DESCENDING CAPS

The use of a vertical descending cap as a safety innovation is remarkable and as the version, Top Down Way™ developed by Despe[10] is capable of covering three floors so nuisance factors such as dust are contained within the frame and do not escape.

This method offers a tight fixing around the gables as the unit has a hydraulically variable inner board. Top Down Way™ is reliant on the structure supporting the cap and not on the structural ties as is the case with both the mast climber platform and the scaffold and as such eliminates some of the reliance on human checks further reducing the risk factor, however, the floors are still supported by the use of propping which requires the temporary works checks to be carried out on each floor.

This method as can be seen in the photograph above also uses a tower crane to lift the plant and equipment from level to level and to remove some of the arising debris.

The actual demolition is still carried out mechanically on a floor-by-floor basis as with the scaffold and mast climbers but due to the reduction of human factor checks during the demolition, it appears to be a safer method.

However, this method is limited in its application as it is only capable, in its current form to work on standalone structures. If the structure is attached to another it would render this system impractical. Further, the cap is limited in height with the works being suspended at the 5th-floor to allow for the dismantling of the cap. This then requires the remaining structure to be demolished by the use of a high-reach demolition rig.

This method also relies on the structural integrity of the load bearing walls to support the large jacks which lower and raise the containment cap.

If the structure was unable to carry this safely as may be the case when looking to apply this method to a panel build structure, then it would need to be financially assessed wither the use of temporary push-pull props and their installation made it viable or if another method is then more practical.

The key hazards for piece-meal demolition include:

[10] http://www.despe.com

- ✓ Manual works;
- ✓ Working at height;
- ✓ Exposure to weather;
- ✓ Premature collapse.

Section-3: Explosives demolition

DEMOLITION USING EXPLOSIVES

The reduction of towers using explosives is very much a show that draws large numbers of spectators and requires the neighbouring residents to be decanted.

While this may be enjoyable, it is however from a safety viewpoint far from ideal and commercially very expensive.

There is very little information available on this method from any of the governing bodies of trade federations.

During the engineering preparation (pre-weakening) of the structure, the workforce is exposed to extremely high amounts of noise and vibration, dusts and fumes, and manual handling. The most physically impacting part of this work is indeed the engineered preparation as this exposes the operatives to the risks continuously for the entire time frame of the works.
Considering the amount of physical work required to successfully prepare a concrete structure, this could create a legacy issue for those involved in the works.

While placing the explosives there are many factors which require careful planning from a health and safety perspective, these include: handling explosives which should only be carried out by persons with specialist training, or who can demonstrate they have sufficient skills, knowledge and experience[11], and security and storage of the explosives.
The planning and placement of the explosives should be carried out by an engineer with a structural engineering qualification and a sound understanding of both explosives and the demolition process.
The charge weights of the explosives must be proven to create the desired effect. This is proven by the undertaking of test blasting which is carried out by the shotfirer and should be witnessed by the explosives engineer and explosives supervisor (where they are different people)

During the explosives event the contractor is required to put into place a suitable exclusion zone[12]. With this in place, the exposure to the operative during the actual demolition (as long as the hazardous materials are removed from the structural shell) is insignificant, with the main issue arising from the dust cloud.

Once the structure has been felled there can be a major amount of dust which is a significant health concern as this dust cloud may contain respirable crystalline silica[13], which is classified as a human lung carcinogen.

The control of dust takes considerable planning and consideration which include long range weather reports and dust suppression.

In the case where the explosives event has failed to reduce the tower, the stability of the tower needs to be assessed and the time frames set out in BS 5607 Code of practice for safe use of explosives in the construction industry, strictly observed. The contingency committee responsible for planning the safe reduction of the structure should consider this carefully and select a method of demolition while remaining as far away as possible to ensure no one is harmed if the structure fails later.

A crisis management plan should be in place and within the contractor's blast manual to ensure that the issues arising from a failure of an explosives event are considered as far as is reasonably practicable and planned form in advance.

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[11] As per Regulation-15 of the Construction (Design and Management) Regulation 2015.

[12] As set out in the Health & Safety Executive Construction Information Sheet; CIS 45 Exclusion zones for explosive demolition, Clause-13 BS 6187, and BS 5607 Code of practice for safe use of explosives in the construction industry, and NFDC guidance note for exclusion zones: DRG 110.

[13] Silica is present in large amounts in most rocks, sand and clay, and in products such as bricks, concrete and mortar. Some of the dust created by demolition activities is fine enough to be breathed deeply into the lungs; this is called respirable crystalline silica (RCS). Exposure to RCS over many years or in extremely high doses can lead to serious lung diseases, including fibrosis, silicosis, COPD and lung cancer. These diseases cause permanent disability and early death: it is estimated that over 500 construction workers die every year from exposure to silica dust.

The actual demolition event is very controlled and safe as no persons are permitted into the safe working space during the explosives event.

Once the structure has been successfully felled, the final phase of the works begins in the processing of the debris piles. Depending on the height of the structure, the debris pile may be of a significant height which may require the use of a high reach to process which in turn reverts back to the method discussed in the first section of this report: demolition using high-reach demolition rigs and all the hazards pertaining to that particular method plus further hazards such as the debris pile collapsing.

As the structure collapses during the demolition process voids may be present which can affect the stability of the pile, resulting in collapses of varying degrees. Further, with the removal of the debris pile, additional plant will be required during the processing which increases the plant interface which therefore increases the risks exponentially.

The key hazards for explosives demolition include:

- ✓ Manual works;
- ✓ Pre-weakening;
- ✓ Dealing with the remaining pile;
- ✓ Handing explosives.

Section-4: Summary of findings

SUMMARY

It has long been known and is one of the direct findings of Dr Terry Quarmby's Phd thesis Safe, Healthy and Sustainable Demolition, that the significant risk of an accident occurring is increased by the introduction of the man into the workplace and based on my research, I concur, and due to this it is of my opinion that the safest method of reducing tower blocks is remote demolition using high-reach demolition rig, this is due to the fact that exposure to risk is massively reduced when compared to the other methods of demolition.

If the contractor fully observes the industry specific guidance on the use of high-reach demolition rigs and the correct exclusion zone is planned and implemented, then the demolition operator will be out with the danger zone at all times.

The main risk involved in this method is the interface between the machinery and the operatives and as such the monitoring of the exclusion zone is critical.

As stated in the specific section above, from a risk viewpoint, considering the potential for human exposure to working at height, manual handling, noise, vibration, dust, and premature collapse the method of reducing the tower remotely effectively eliminates the majority of these on any real scale.

The second safest option would be the reduction of the tower using explosives. The human exposure to working at height, manual handling, dust, vibration, noise, et cetera is extremely high and may be in line, in part with the piecemeal method, as piecemeal relies on small plant over manpower, however, during the actual demolition works the exposure is low as long as the exclusion zone is maintained.

By its very nature, this is a high-profile method, the success of which can - and will - be immediately judged by those not involved in the project. Public confidence in the method (and therefore confidence that public money can rightly be spent on it) may be low. That issue can be successfully managed by (externally) citing lessons learned from Red Road and (internally) stringent project management that negates the possibility of future limited successes.

Third, the reduction of the tower by piecemeal as throughout the entire reduction the operatives have a continual exposure to all the listed health hazards even where the possible risks are managed and controlled, hazard exposure is still omnipresent.

Of the three systems covered in the report, I would list in the following order.

Top-Down-Way™; based on the significant risk controls this system implements it is my findings that while there are limitations to the use of this system, it is by far and away the safest of the methods.

Mast-Climber-Work-Platform; while this method offers a perimeter working at height controls, there are still too many factors to consider and I feel that the mast climber technology is not sufficiently developed to allow this to be a viable option on many structures, especially where the area is built up.

Traditional Scaffold support; due to the human factor checks required and the interface between operatives and plant I find this to be the least safe method, but as it is applicable to all structure types and shapes it will most likely remain the most selected within the piecemeal category.

CONCLUSIONS

I conclude that the safety overall method for the demolition of this type of structure using a direct comparison, is high reach rig using progressive fragmentation.
This is because there are less hazards faced by the demolition team and there are less members of the team exposed to the hazards, ergo, the likelihood of an issue arising is considerably reduced.

Yours sincerely
For Perses Ltd

Mr Stephen McCann CMIOSH MIDE MIIRSM FInstLM
Director
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