

High Reach

Demolition Guidelines

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1. Presentation

The 1st edition of the “*EDA High Reach Guidelines*” came out in 2010, and I had the honour to participate as the head of the Technical Committee that prepared this document.

More than a decade later, history repeats itself and the enthusiasm to participate in the creation of benchmarks is still alive.

EDA was not a pioneer in creating these guidelines. We had the help of some national associations that had already created a base of documents according to their national legislation.

I would like to think that with that first edition of the EDA guide, we did our bit by incorporating the knowledge of companies from different countries and creating a European reference document to be used in those countries where there was nothing, not even a national association.

Now, looking back over the past 13 years, we have experienced many changes in terms of technology, equipment, work methodology and, in short, we have compiled many lessons learned that we would like to share with all of you.

I would like to acknowledge the fantastic work done by all my colleagues who have been involved in updating this guide, and thank them for sharing their knowledge and time so selflessly.

We sincerely hope that you find the guide useful, that it serves as a dialogue between manufacturers and contractors, and that it helps to promote best practices in high reach demolition operations.

Yours sincerely,



Mr. Stefano Panseri
Coordinator of the Guide

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3. Introduction

3.1. Purpose and scope of the guide

In the year 2010, the European Demolition Association published the EDA High Reach Guidelines in 8 languages, and since then it has been translated into even more languages.

Such guidelines emerged from the need for a reference document for high reach demolition projects, suitable equipment and best operating techniques.

In this respect, this document aimed to catalogue the best operational techniques which had been gathered by the primary European firms through years of experience in the field and make them available for those operators in the sector who intended to use this type of excavators.

Nevertheless, the sector has advanced significantly from the technological, methodological, and regulatory points of view since then.

Consequently, in 2022, it was reactivated the working group to update this document and it hold several meetings during the whole year to create this new edition.

In this working group, professionals shared knowledge, experiences, doubts, and problems common to the sector. In this regard, the following text reflects the results of many reflections, exchanges of information, and mutual learnings that went into creating this guide.

It must be said that once it was shaped, it was such a big change from the previous document, both in content, approach, and form, that more than an update of the first version, it is almost a new document.

In closing, just to point out that this document will provide a comprehensive overview of high-range demolition and will outline appropriate demolition techniques and methods for construction contractors.

3.2. Target audience

The target audience for this document is specifically demolition contractors. Additionally, it can be valuable for other general contractors or engineering companies, who can be involved in high reach demolition projects in some way, in the course of their work.



4. General concepts

4.1. Definitions

1. **Arms:** Mobile elements interconnected with pivots, operated by hydraulic cylinders. Usually made up of multiple units which allow the elevation and use of the attachment.
2. **Attachment (working tool):** Assembly of components that can be mounted onto the base machine or equipment for specific use. ^[1]

Demolition and recycling attachments are those tools designed and manufactured specifically to be attached to the dipper arm or main boom of demolition and recycling machines, either directly or via a quick coupler.

3. **Boom:** One of the elements which composes the front linkage.

^[1] Definition according to the standard ISO 6746-2:2003

- 4. Carrier / Base machine:** The machine where the attachment is fitted, allowing this way its use. Demolition and recycling attachments always require a carrier to provide power and to move them into the working position.

Attachment and carrier must be compatible, and the carrier should be powerful enough to get maximum productivity out of the attachment, but not so powerful that it causes damage or premature wear to the attachment

- 5. Control Measure:** A process or procedure - physical or otherwise - that is put into place prior to the commencement of a task to eliminate or mitigate against harm occurring.
- 6. Counterweight:** Element usually located in the back part of the base machine with the purpose of balancing the weight and the dynamic actions of the arm.
- 7. Demolition excavator:** Demolition excavator designed and fitted with bespoke or specialist demolition attachments to make it suitable for demolition work.

It must have sufficient size for the work to comply and the activities to carry out, such as height enough to reach in a safe manner the structures to be demolished.

- 8. Demolition excavator with high reach arm:** Specific machines which constructed to carry out specialised demolitions of buildings and structures of high elevation and designed to operate high reach work equipment.

High reach work equipment is a multi-piece rigid, pin jointed or telescopic equipment with the primary function of operating specialised attachments for the demolition of structures at heights that cannot be reached by standard backhoe work equipment. Typically, the operating height of the attachment on a high reach demolition excavator is above 15 m, although this number may vary, as what truly defines a high reach excavator is its particular characteristics, rather than the height it reaches.



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9. **Distance to the building:** The measured distance at ground floor level between the face of the building and the front of the machine track. A minimum of a 2-1 ratio should be considered.
10. **Exclusion Zone:** The swing or working area, of the machine, in which all workers shall be prohibited from entering in the event that an attachment or material held within the jaws may become detached and fall.
11. **Equipment:** The set of components mounted onto the base machine that allows an attachment to perform the primary design function of the machine. ^[1]
12. **Excavator:** A self-propelled machine on crawlers, wheels or legs, having an upper structure capable of a 360° swing with mounted equipment and which is primarily designed for excavating with a bucket, without movement of the undercarriage during the work cycle. ^[2]
13. **FOGS (Falling Object Guarding System):** Cabin resistant to shocks due to falling objects, directly connected to the structure of the base machine.
14. **Fore boom:** One of the elements which composes the front linkage of high reach demolition machines.
15. **Height of demolition:** The height of the demolition measured from ground level.
16. **Height of the building:** The height of the building measured from ground level.
17. **High reach equipment:** It is multi-piece rigid or telescopic equipment with the primary function of operating specialised attachments for the demolition of structures at heights that cannot be reached by standard backhoe equipment. ^[3]
18. **Inspection:** A process and procedure to be enacted prior to the operation of the attachment in which any defects or irregularities should be noted and dealt with.

- 19. Operating mass:** The mass of the base machine, with equipment and empty attachment in the most usual configuration as specified by the manufacturer, and with the operator (75 kg), full fuel tank and all fluid systems at the levels specified by the manufacturer and, when applicable, with sprinkler water tank(s) half-full place before the beginning of a job in order to eliminate or mitigate against harm occurring. ^[2]
- 20. Operational height of the excavator:** With the machine fully extended to its maximum height measured from the centre of the tool mounting pin to ground level.
- 21. Quick coupler:** A device mounted on an excavator to allow the quick interchange of attachments. ^[3]
- 22. Risk assessment:** A document or process to identify a significant hazard on site and the likelihood that such a hazard may cause harm.
- 23. Stick / Arm / “Dipper”:** One of the elements which composes the front linkage.
- 24. Track frame:** Track frame on the demolition machine composed of crawler tracks and side members.
- 25. Undercarriage:** Supporting framework located underneath the carrier; the structure to which the wheels, tracks, or the like are attached or fitted.
- 26. Upperstructure (superstructure):** Element of the carrier which contains the engine, hydraulic system, cabin and/or counterweight.

^[2] Definition according to the standard ISO 6165:2012

^[3] Definition according to the standard EN 474-1:2006





4.2. What is high reach demolition?

High or ultra-high reach demolition is understood to be a demolition carried out in height -operating from ground level - with the aid of special machinery specialized for demolishing structures at high elevations.

In modern demolition, high reach equipment is an indispensable tool. With the right tools, high reach demolition machines can be used to perform controlled demolitions of reinforced concrete, masonry, steel, and mixed materials structures.

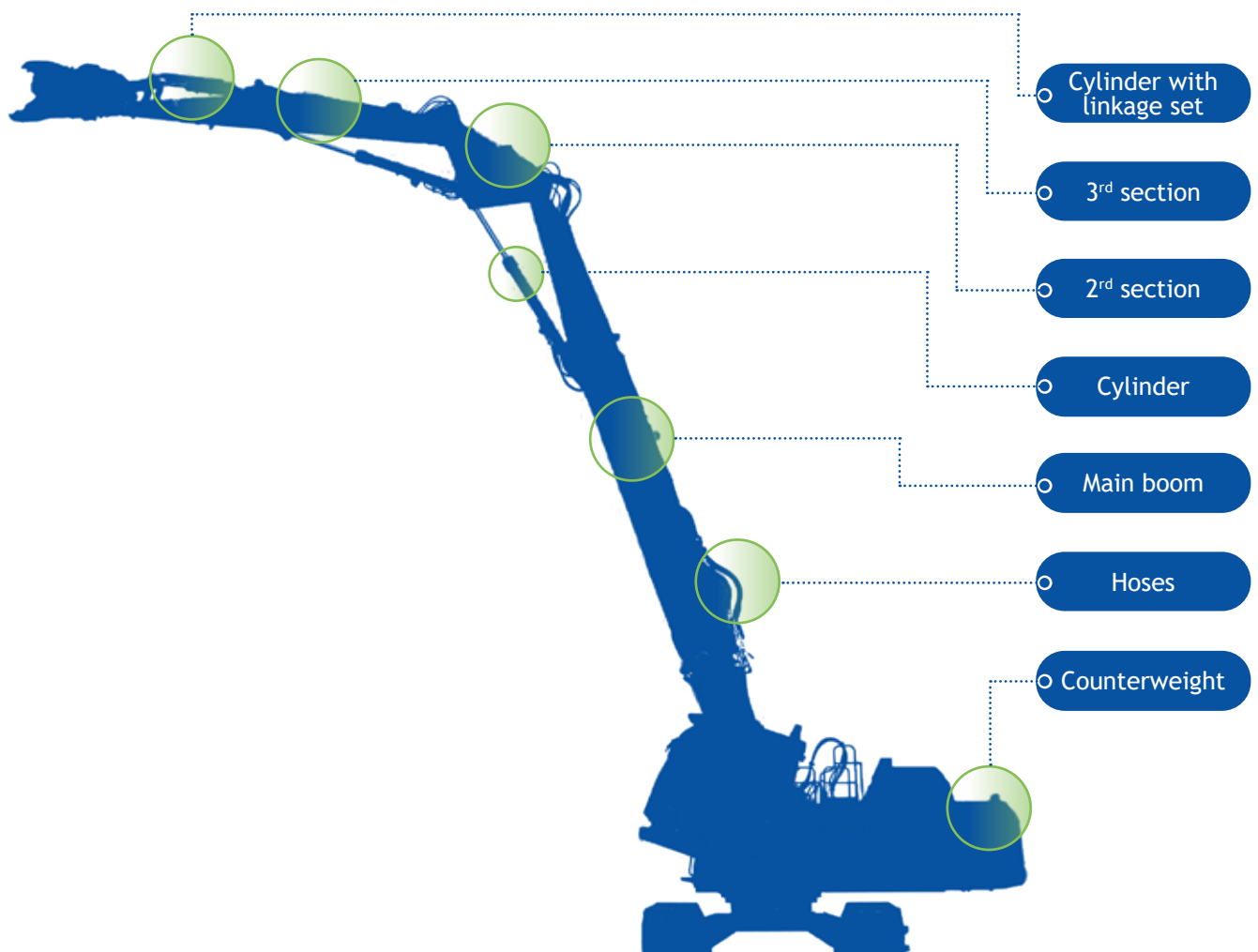
Even so, it is vital to always make very sure how to best proceed with a demolition project, even if this equipment is often the best one for the job in many cases. A factor to consider is the height of the structure. The height can indicate whether high reach equipment is fitting the purpose, as well as what size will be able to reach and work safely. Nevertheless, the safety of delivery to the site and the accessibility of the workplace must also be taken into consideration. It is essential to have access to the area where the equipment is required, as well as sufficient space to operate. That includes considering the proximity to other buildings and how vibration, noise and dust will affect them. It should also be considered that when repurposing buildings, the building structure may need to remain intact, but the remainder must be removed. This requires a different set of equipment and work methods.

Anyway, high reach machines are essentially used for primary demolition of the building, they are not used for secondary demolition, crushing or screening of material, as these are undertaken using machines with different attachments. The operational requirements of the high reach machines are determined by factors such as the type of structure being demolished, the height of the structure being demolished and site conditions (such as sloping sites, ground conditions, etc.).

Also, consider that some structures are of a height that no high reach machine can reach. On some occasions, deconstruction may be required to lower a structure to a sufficient height to enable high reach demolition to take place.

Moreover, it must be mentioned that when safety protocols and procedures are not followed, high reach equipment can be hazardous and dangerous. Training and continuing education are therefore vital to ensure that each operative involved knows how to handle and work around this equipment.

In this sense, a detailed method statement and task-specific risk assessments should be produced and developed for all work involving high or ultra-high reach machines.



4.3. What machines are used for high reach demolition operations and what are their special characteristics?

High demolition operations involve the use of specific machines, constructed to carry out specialised demolitions of buildings and structures of high elevation, known as high reach demolition excavators or demolition excavators with high reach arms.

In this sense, a high reach demolition excavator is an excavator designed to operate high reach work equipment.

High reach work equipment is a multi-piece rigid, pin jointed or telescopic equipment with the primary function of carrying and operating bespoke attachments for the task being carried out in the demolition of structures at heights that cannot be reached by standard backhoe work equipment.

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To enable this, high reach excavators have a particular boom specific for this type of machines. Typically, the operating height of the attachment on a high reach demolition excavator is above 20 m and they can reach more than 60 m. For its part, the operating weight is from 23 to 200 tons.

Generally, a high reach demolition base machine can be fitted with a wide range of interchangeable work equipment to allow it to carry out many different applications, but the manufacturer's guide must be reviewed to clarify the size and weight of attachments that the machine can handle at full working height.

It must be taken into account that for machines with weight and operating length like these ones, it is always necessary to carefully choose the location and setup considering ground conditions, piping or cellars location, public areas, etc.

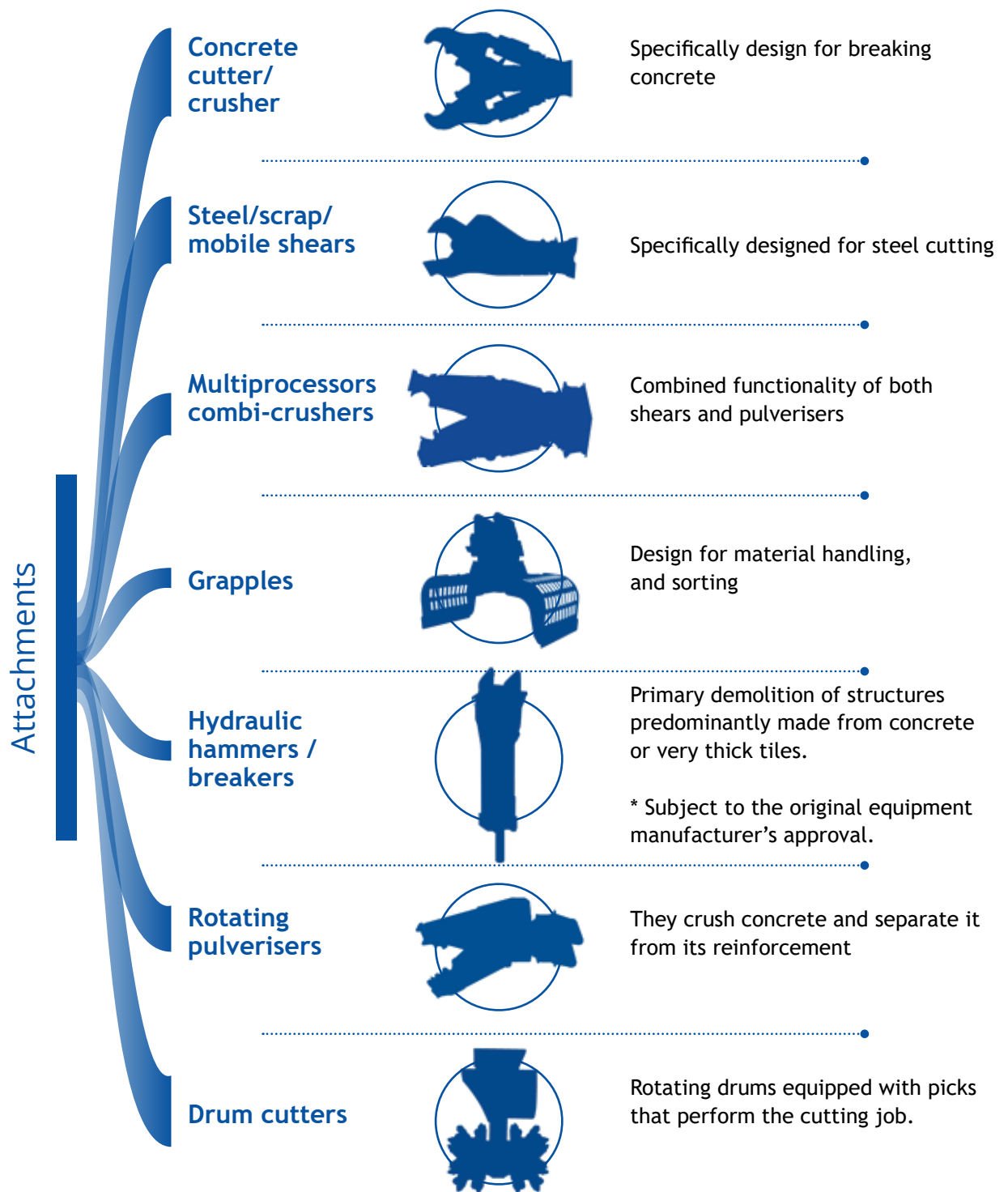
It is also important to be aware that high reach demolition excavators always have special limitations for attachments weight and features, and that the allowed attachments depend on which work equipment is installed. In this regard, the manufacturer's guide must be reviewed to clarify this issue.

High and ultra-high reach machines are not designed as cranes and should not be used to carry out any form of lifting duties. Care should be exercised, when cutting into structures, against retracting the arm with materials lodged in the jaws of the attachment. Pushing against a structure with the attachment should never be attempted.

Finally, it must be mentioned that these machines must be fitted with a Falling Object Protective Structure (FOPS) and a Falling Object Guard Screen (FOGS) cab to conform to EN ISO 3449 & ISO 10262 to protect the operator. In many instances, the machines may also be equipped with additional protective equipment including laminated glass.

4.4. What attachments can be used with high reach demolition machines?

By definition, high reach excavators carry out work at height. Typically, the attachments used to perform these operations are the ones included in the following table.



NOTE 1: The equipment supplied with the rotator (hydraulic or neutral) should be installed on the high reach demolition machines. Taking such precaution when working with yielding tools, avoids torsion of the structural elements of the arms.

NOTE 2: In cases of work on poorly established structures, it is advised to carry out the demolition with hydraulic hammers - if they are approved by the original equipment manufacturer - as the shape of their heads makes them better suited for avoiding contact with reinforced bars.



5. Planning the high reach demolition operation

5.1. How should it be determined the necessity of using high reach demolition methods and equipment?

Even if the building or structure to demolish is very high, it does not automatically mean that the high reach demolition is the right procedure to level it. Other demolition methods might be just as or even more effective.

Other demolition methods



Manual demolition



Mechanical demolition



Deconstruction



Use of explosives

To determine the suitability of high reach demolition to perform a particular job the following steps should be followed:

Steps to follow when determining the necessity of high reach demolition	
1	Conduct an ocular inspection of the work site
2	Compare other methods of demolition before deciding on the high reach
3	Determine if the high reach equipment - in particular, the rig - to be used by the company to execute the works can reach the rise of the structure
4	Evaluate if the ground is stable enough to support the weight of the carrier with its equipment
5	Consider with which demolition method the timeline to execute the works can be realistic

During the process described in the table above a feasibility study must be carried out. That will lead to the necessity of answering some of the following questions that may arise during the process. The information compiled with it should be taken into consideration to decide the adequacy of a high reach rather than other demolition methods:

- How stable are the ground conditions?
- Should the previous uses of the ground be considered for the planning of the job? (e.g. grounds with unexploded bombs)
- Are there other adjacent buildings or structures near the work site?
- Is the location densely populated? (consider arisings/ejecta)
- Can the heavy equipment be transported to the site without any problems?
- How stable is the building?
- It is necessary to brace and buttress it to prevent a premature collapse?
- Is there enough safe distance between the rig and the structure?
- Is there a safe area for the plant to work and for the debris to fall?

In any case, the criteria that should always prevail is guarantying the safety of the workers performing the job and the people in the surroundings of the jobsite.

5.2. What information is needed to plan a high reach demolition operation?

Depending on local jurisdictions the local building code may require a licensed structural engineers review and sign off of the work plan or methodology. This practice is to ensure a safe dismantling of the structure and prevent an uncontrolled collapse. Some companies operate with an in house engineer to review and develop the procedure, while others will retain a 3rd party to design a plan with. This procedure is generally used for a permit to demolish and then followed by the field team executing the work, should a change be required as the work progresses the engineer of record is consulted and the change in plan is signed off on by the engineer and documented on a field report.

Once having determined that the demolition jobs will be carried out using high reach equipment it is necessary to plan de operation in a very detailed way. For this planning, it is indispensable to have compiled all the required information. The table below includes the issues that generally should be considered.

Information needed to plan a high reach demolition			
1	Equipment	1.1	Size of the machine to carry out the work. *Confirm that it has the correct size to carry out the work. In this respect consider that the safe working reach is not the same dimension as the machine's maximum reach.
		1.2	Demolition attachment(s) needed to carry out the work. *Ensure that the equipment can safely carry the right demolition tool at the end of the high reach boom.
2	Ground conditions	2.1	Ground investigation/survey
		2.2	Temporary works required *The ground investigation report will be used to assess the need for any temporary works and then the design of such temporary works.
		2.3	Identification of the location of any weak and variable areas.
		2.4	Identification of the localisation of other weaker zones in the sub-grade, such as backfilled and compacted excavations, existing or abandoned services and hard spots - i.e. old basement walls - which can be just as hazardous as weak zones.
		2.5	Identification of the presence of overhead hazards. * Where overhead power lines are noted, the electricity supply company should be contacted to determine the safe working parameters and the placing of any warning markers - i.e. 'goal posts' - prior to working close to overhead power lines.
3	Structure	3.1	Need of identifying the type of structure
		3.2	Condition of the structure: defects, corrosion, cracks and general stability.
		3.3	Any documents that provide information about the structure, such as drawings or its construction design.
		3.4	Information on any tests and trials carried out on the structure and providing information on it
		3.5	Temporary works to be designed and installed to facilitate the demolition. *This is particularly relevant for pre-cast concrete large panel high-rise structures, that become very unstable when using High Reach Demolition techniques.
4	Organisational details	4.1	Access for the equipment when delivered to the site and possible locations for it to work
		4.2	Environment: proximity to other buildings, sensitive activities, vibration, dust, noise, etc.
		4.3	Possible location of the Exclusion zone
		4.4	Programme: timing of demolition, duration to suit school holidays, public transport not running, etc.
5	Others	5.1	Appraisal of the entire site by the machine operator and site manager in order to count on their opinion and expertise to design the demolition planning.
		5.2	Characteristic weather conditions of the area that can potentially condition the execution of the jobs. For example, in very windy areas many problems can arise if it is not taken into account; turbulence can be caused in the buildings. Measures such as the using of hanging screen could be needed.



5.3. How should the risk of the operation be evaluated?

A risk assessment must always be performed in order to correctly plan a high reach demolition, as it plays a fundamental role in the prevention of hazardous situations.

Risk assessment should identify the presence of any significant hazard, i.e. overhead hazards such as power lines, the presence of asbestos should be surveyed prior/removed and the proximity of other structures within the operational envelope of the machine.

In this regard, the following - not exhaustive - table indicates the principal risk factors to consider during the risk evaluation.

Principal risks in a high reach demolition job		
Phase of job	Associated risks	Notes
Load and transport	Falls from height	During the cargo phases, the operators often access elevated workstations.
	Crushing	Activities are planned for lifting and mounting/dismounting components as well as harnessing them to the trailer.
	Turnover	Planned activities with cranes for lifting components of significant weight. In the case of loading onto a trailer with ramps the stability force return conditions are to be considered a critical. A factor SWEPT path ANALYSIS should be carried out to confirm that introducing the machine in the jobsite is feasible.
	Shocks	Performance of various manoeuvres with either suspended loads or with self-moving components, shock can be caused to the machine and compression to operators.

Assembly/ dismantlement	Falls from height	The assembly operations often foresee the performance of operations at elevated heights superior to those of usual standard excavators.
	Crushing	Lifting loads of great importance often with special conformations and associated handling.
	Turnover	
	Bumps	
	Errors of assemblage	
Operational use	Material fell from above	Risks increased by elevated operational units.
	Untimely collapses	Risks are increased by minor visibility of the operator and by minor precision of movements due to the length of the arm, such as for the floor overloading, or the demolition arisings.
	Turnover	The risk is determined by the average position of the centre of gravity of the machine with respect to the standard machines which increases the risk of dragging the arm in case of sudden collapse.
	Contact with lines in tension	Less precise movements and less visibility significantly increase this risk.
	Dust development	The development of dust at elevated heights is more difficult to control and contain with the spraying water systems.
	Investment of things	The rubble falling from elevated heights is more difficult to control and contain. In case of errors in manoeuvre, the security area of the high reach machine is extended.
	Investment of people	The rubble falling from elevated heights is more difficult to contain and control.
Maintenance	Mechanical break-ups	In case of manoeuvre errors, the security area of the high reach machine is extended. In the case of mechanical break-ups, the effects, above all, of structural yielding, can be more evident than for standard machines.
	Work at height	Due to the high weight of the machines and the extension of the arms, maintenance is frequently performed at an elevated height.
	Risks associated with lifting	The high mass motion and the use of lifting equipment, especially on the site, increase the risk of machine rollover.
	Contact with harmful substances	The volumes of hydraulic oil used and the largest number of connections to monitor and maintain them can result in greater exposures than with standard machines. Take special consideration for snagging of pipework at height/visibility in this sense.

The risk assessment is an indispensable document when planning the demolition. Additionally, prior to the beginning of the works, it should be read and understood by all persons who are required to carry out work on site.



5.4. What criteria should be followed when designing the operation?

Having compiled all the information required (see section 5.2) and having performed the risk assessment, the demolition works can start to be designed, which will culminate in the drafting of the demolition project.

That project and the technical documentation in it will be the main tool to monitor and keep under control the parameters required for the safe operation of the high reach machines. The minimum contents are:

- Identification and specification of the building/structure to be demolished
- Identification of the characteristics of the high reach machine to be used
- Ramps and embankments sizing
- Indication of the debris and dust control systems to be assembled
- Time sequence of events
- Necessary graphic support

During the preparation of the project documentation, some fundamental technical issues, derived from the experience of employing high reach machines on site, should be taken into account and which application can significantly increase the security level of demolition activity. That technical issues are described in the following tables.

Relation between the height of the building and the distance of the machine

A

The relation between the height of the building and the distance of the operating machine is of great importance to the safety of the operation. The passive and active security systems installed on high reach machines, though very sophisticated, do not guarantee the protection of the operator, especially in cases of sudden collapse or projection of debris at high speed. The occurrence of these events is influenced by several factors including the type of building, conservation status, presence of concealed defects, etc., and therefore it is difficult to predict.

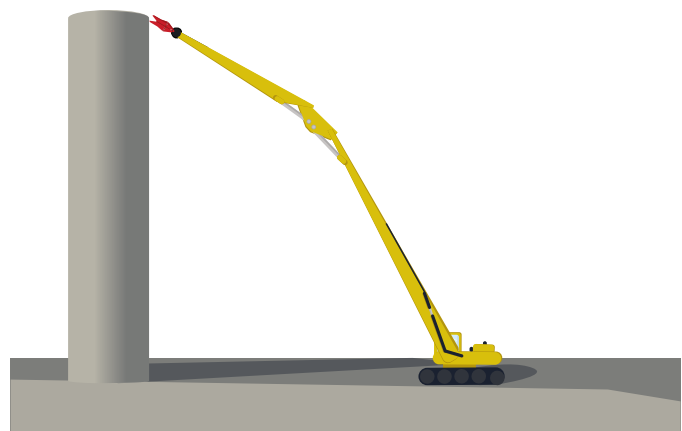
In this sense, it is important to establish a minimum distance measured from the base of the excavator (the front of the crawlers) to the base of the manufactured article (or the most prominent element on the ground), in a way to be a suitable margin of safety as dictated by the distance.

Technical recommendations

Although manufacturers state a machine height within their sales brochures, this is not necessarily the safe working height and contractors should always calculate (with schematic drawings) if a machine is suitable in size and working height.

The experience of leading demolition companies shows that the optimal ratio between the height of the building and the distance from the building is currently 2:1 (on average).

Building Height (m)	Distance from Building (m)
10	5
15	7.5
20	10
25	12.5
30	15
35	17.5
40	20



These parameters should be considered indicative and susceptible to change, depending on the result of the evaluation of the risks derived from the investigations carried out on the building and its surroundings.

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 should be applied. For every metre over 40m height, 0.25m should be added 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 ($50\text{m height} = 10 \times 0.25 + 20 = 22.5\text{m}$).

It is necessary to confirm that insurance cover is inclusive and that it extends to the height at which work will be conducted, taking into account any raised platforms as well as the working height of the machine.

Positioning of the machine in relation to the structure to be demolished

B

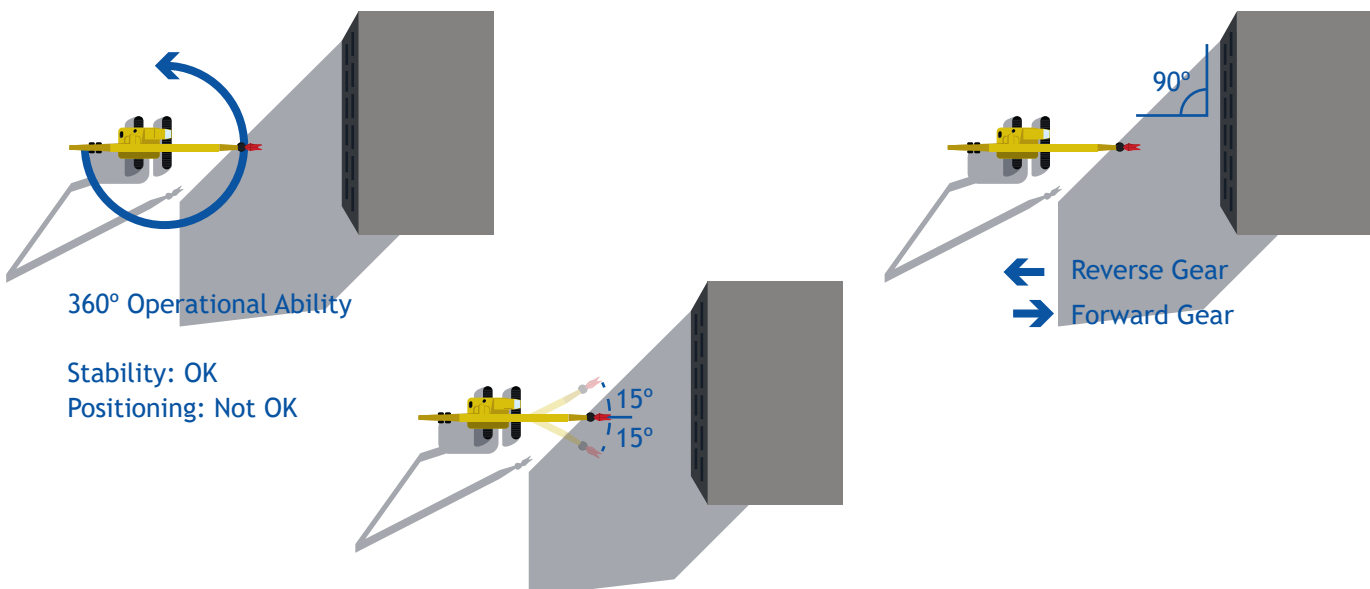
The proper positioning of the machine in relation to the structure to be demolished is essential in order to ensure operability and the safety of the demolition. The positioning of the machine influences the stability and therefore the necessary safety. It is forbidden to operate high reach machines on uneven or not properly compacted/stabilised ground. For this purpose, a preliminary investigation of the site is essential in order to identify any areas which are particularly vulnerable and susceptible to failure. Ground conditions and the existence of basements and services must be investigated.

Technical recommendations

Situations that may lead to the failure of the operation of the machine must be resolved by stabilising/compacting the ground. If this is not possible, the area must be restricted to prevent the transit of the machine. To ensure stability, the operation angle of the arm should be limited.

The experience of leading demolition companies has determined that the recommended maximum angle of work does not exceed 15° on either side of the track frame centre line. These limits should be considered good practice except when differently specified by the manufacturer.

The possible EMERGENCY EXPULSION of the machine from the building is carried out by positioning the tracks orthogonally to the front of the demolition with the direction coherent with the commands (“ahead” to move towards the building, “back” to move backward). Some manufacturers claim full 360° operational stability, such configuration is to guarantee the stability of the machine. However, it is good practice to position the machine correctly to the face of the building. If the machine has extending tracks it is needed to ensure that they are locked off when extended and in use. Although it must be mentioned, some manufactures include in their machine a mechanism that fulfils this automatically, without the need of going out the cabin to check.



Positioning of the arm with respect to the building to be demolished

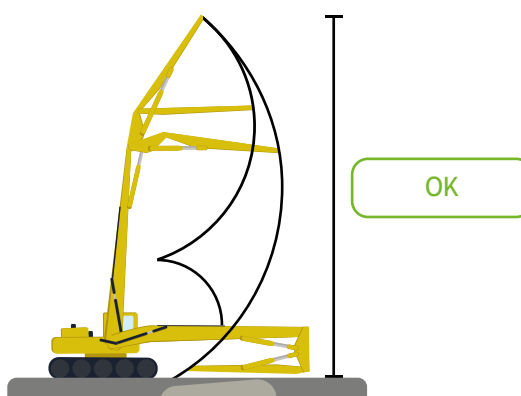


The positioning of the arm is also a fundamental element to achieve safety.

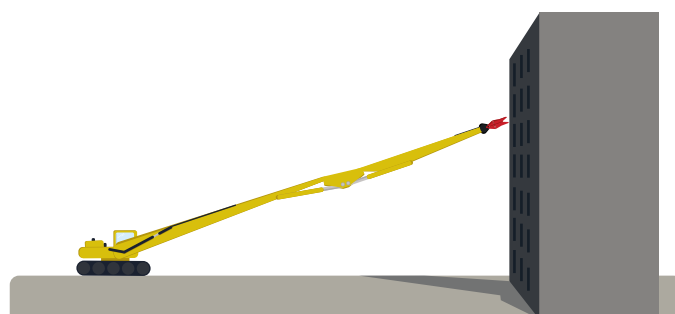
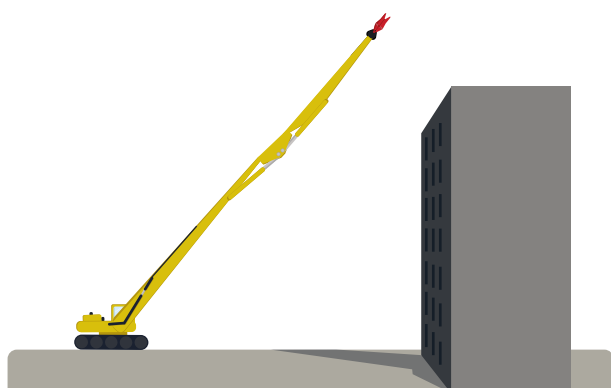
Technical recommendations

It is recommended that the indications of the builder concerning the correct preparation and positioning of the arm are meticulously followed.

The demolition high arms are considered extensions of the base machine, although more fragile in comparison to the excavation arms; their structure makes them particularly sensitive to torsion and traction/compression loading. Due to this fact, it is necessary to avoid pushing or pulling manoeuvres of traction, for instance, thrusts or lifting on the parts of the building in demolition.



Not OK



Working platforms

D

When the working height of the machine is not sufficient to reach the top of the structure to be demolished, it may be necessary to create a raised working platform upon which to station the machine. This platform must be level, flat, and without gradients and be constructed from suitable, well-compacted hard debris.

The overall size and height of the raised platform will typically be dictated by the working requirements of the specific application.

Technical recommendations

The design of a working platform must be suitable and sufficient for the machine that is to be used all design work and backup calculations must be carried out by a competent person. The designer should have full access to any pre-determined ground condition survey, site inspection records and details/specifications of the fill material to be used.

The construction of these ramps is subjected to certain specifications, as listed below:

1. The maximum height of the platform should not exceed 10m from the base of the building to be demolished.
2. The dimension of the platform must exceed at least 4 metres wider than the machine and 8 metres longer than it.
3. An access ramp to the working platform should be constructed of similar compacted materials with a recommended gradient of 10 degrees as determined within a risk assessment.
4. The working platform should be constructed using a material with a maximum particle size of 150 mm containing sufficient smaller particles to allow good compaction levels to be attained in accordance with the design specification. Hardcore, crushed concrete, compacted demolition rubble, crushed aggregate, masonry, chalk or fully compacted earth are all considered suitable materials.
5. The high reach machine must be placed on the top, flat part of the embankment at the end of the platform. It is not possible to work on surfaces of different levels.
6. The mounting of the platform should be performed in forwarding gear while the descent should be performed in reverse gear.
7. It is possible to continue using the ramp even after removing the high arm, using standard demolition arms.

Logical progress of the demolition phase on multi-storey buildings

E

Technical recommendations

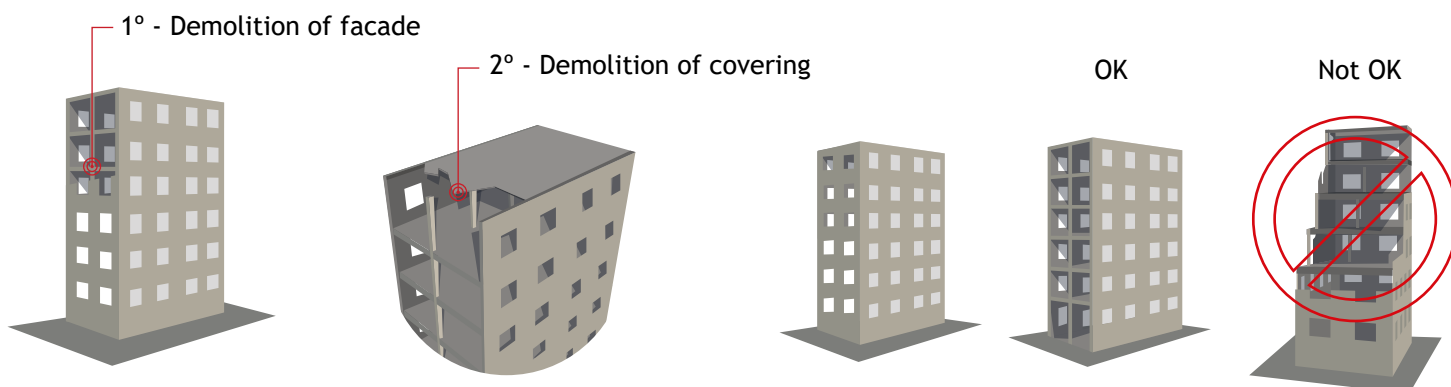
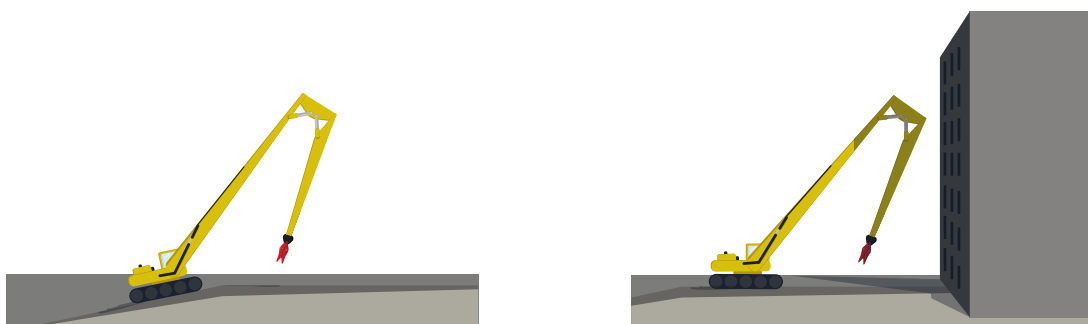
The basic rule for approaching the demolition of a multi-storey concrete building is to start demolishing the structure perpendicular to the floor joists (see image).

The demolition process begins from the highest floor and proceeds down to the ground floor by spans marked by two pillars.

Typically, multi-storey structures are created with multi-level elements and therefore every floor located between pillars is structurally stable; this allows the demolition of every section while guaranteeing the stability conditions of the adjacent section.

In this sequence of vertical demolition, it is necessary to pay a lot of attention to the overload on the joists due to the accumulation of debris. It is therefore fundamental in avoiding untimely collapses. The attics involved in the demolition must be kept clear from debris.

The sequence of demolition for any given structure should be detailed in a site method statement.



Systems of containing dust and debris

F

Using high reach machines, the development of dust is a common matter. Due to the high altitude of the demolition area, the risk of falling debris is also significant.

Technical recommendations

To overcome these drawbacks the ordinary dust systems and debris containment used in demolition standard operations are allowed. Such systems are usually:

- Spraying water through water jets
- Pressure lances operating from elevated platforms
- Fog cannons
- Spray systems attached to demolition arms

Containment of the rubble

G

Due to the elevated height of the demolition area in comparison to the ground, the consequential risk from falling rubble to the ground is substantial.

Technical recommendations

To avoid this risk, the following drawback systems are used:

- Flexible containment systems realised in highly resistant plastic material held up by temporary works (scaffoldings) or cranes
- Rigid metal containment systems held up by provisional works or cranes
- Protective scaffoldings, valances, modular elements tunnel, etc.

Also of great importance to restrict the demolition area are the operational area of the excavator and the area of protrusion of the building; keeping in mind the possible collapses and the fall of rubble, such areas must be delimited and restricted to personnel.

It is important to keep the demolition area clear of the high reach demolition machine. For this, it is advisable to have support available such as a shovel/excavator in order to remove the rubble from this area. The rubble can be accumulated in the deposit and/or treatment areas if provided for, or promptly removed from the site.

5.5. How should the job site and operation areas be organized?

The use of high reach machines on site requires a specific site organisation that ensures that the area is secure and in the desired conditions, which must be maintained at all times for the safe development of demolition activities. The site organisation must take into account the following aspects:

- **Provide pathways and accesses** allowing safe loading and unloading of the machinery along with reassembling and general maintenance on site.
- **The operation area for the machine** must be sufficiently spacious to provide the correct relation between building height and the distance of the machine.
- **If it is necessary to build platforms and access ramps**, ensure that adequate space is available.
- **A parking place for the machine must be provided**, where is it safe to lower the arm to the ground in order to attach the tool.
- **When surveying the site and operational areas**, take into account that physical obstacles and utilities must be safeguarded (e.g. overhead power lines, other buildings which are not subject to demolition, sewages, gas lines, etc.).
- **Exclusion zones and safe zones must be settled up**. Their extent should be varied according to the type of demolition activity and the rate of progress. Exclusion zones should be designed with a number of constituents in place, i.e. the structure's height and construction, the surrounding topography and environment, the predicted debris area and the potential for 'fly' material, etc. On constricted sites containment measures, such as barriers, scaffolding, bunds and pits, etc., may be incorporated to enable the predicted debris area size to be reduced.
- **The need for protective, environmental and debris enclosures should be assessed**. These could take many forms and may include reinforced plastic sheeting, debris netting or even temporary structures. Further examples include but are not limited to: scaffolds, scaffold screens, crane-hung, screens or container bunding.
- **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. A bund formed out of soil/hardcore to reduce splash back of falling debris toward UHR Rig.
- **Throughout the demolition**, materials arising must be progressively cleared to ensure the work area around the base machine is kept clear and tidy.



6. Working with high reach equipment

6.1. What good operative procedures should be followed?

Following the project and always keeping in mind the risk assessment elaborated specifically for the project is essential in order to minimise the risks during the job performance and carry out the operation safely. It is possible, however, to apply some general guidelines in almost all cases. Those good operative procedures are compiled in the following table:

Good operative procedures working with high reach demolition equipment		
1	Exclusion zone	The exclusion zone should be kept at all times as a safe working area for operating the high reach machine. Personnel and the general public should be excluded from the area except for essential personnel.
2	Use of support personnel	<p>A banksman can be used for demolition activities with high arms in reduced or limited visibility conditions, even with additional CCTV systems. This banksman is a highly qualified person with training and competence who is positioned in strategic points with better visibility than the operator. During demolition operations, he provides information and orders.</p> <p>When work is in progress, the banksman should never be allowed inside the drop zone. To ensure the safe operation of the machine and site, two-way radio communications may be required between the banksman, machine operator, and site supervisor. However, in some cases, such as lifting operations, sign language can be used for communication.</p>
3	Replacement of attachments and maintenance operations on site	<p>Safety must be ensured during the execution of maintenance operations and attachment replacement activities. In this sense, it is not advisable to carry out these operations while the excavator is in the demolition area. Instead, a flat area of approximately 20m x 6m of space - which equals 120 square meters - must be allocated in the jobsite for the performance of these operations, which can also be used to park the machine after the shift is done.</p> <p>Maintenance operations and attachment replacement activities must be carried out by qualified and properly trained personnel. The manufacturer's instructions should be strictly followed during any change of attachment or front-end equipment, as well as in maintenance operations in general, to avoid injuries and other accidents. Furthermore, these activities require appropriate equipment that complies with national laws.</p>



4	Lifting and lowering the boom	<p>When lifting or lowering the boom it must be fully retracted, in the case of telescopic booms and tucked in for multi-piece booms and dipper arms. By doing so, the machine’s counterweight will be able to compensate for changes in planes of any degree. Additionally, it is important to note that the load capacity of the machine will vary depending on where the boom is positioned relative to the undercarriage.</p> <p>The machine’s stability when lifting and lowering the boom will also be affected if it’s not placed on level, firm ground.</p>
5	Dust emissions	<p>Every effort should be made to minimise the dust created by the demolition activities in order to avoid health and safety risks. This may be undertaken in several ways (see section 5.4).</p>
6	Working platform	<p>When using a working platform, it must be inspected daily for signs of erosion or degradation caused by weather conditions, water run-off and general wear.</p> <p>The boom should be lowered or retracted before accessing the working platform, and it should be floated in order to maintain the correct position whilst accessing and egressing the ramp. Occasionally, the boom may need to be raised to a semi-vertical position as the machine approaches the building face. Work platform egress should be reversed, with the boom lowering toward the building face.</p> <p>Moreover, the debris pit should be sufficiently large between the platform and the face of the building or structure for debris to fall without encroaching on the track frame. To clear debris from the pit and the top of the platform, a conventionally rigged demolition machine should be used in support of the high reach machine.</p>
7	Storage operations at the end of the work shift	<p>The high reach machines must be parked safely after the work shift is over in a specific plant area for that purpose. The attachment should be grounded and the arm should be closed or retracted (for telescopic machines).</p> <p>The ignition key must be removed from the command, the machine must be completely locked, and, if present, the cabin alarm and protection must be turned on.</p>

6.2. What are the site requirements that must be met to work with high reach equipment?

In order to construct a safe and suitable working surface for the machine to operate, the selection of a suitable area for that purpose must be based on an appropriate and sufficient ground investigation (see section 5.2).

Weak zones in the sub-grade, inadequately backfilled and compacted excavations, existing or abandoned services and hard spots, such as old basement walls, must be localised as they are potentially hazardous areas.

It is particularly important that any sub-structures (below ground) around the building/structure are identified and documented within a risk assessment and safety plan, as these could have the



potential to collapse beneath the machine causing it to overturn. This last point is particularly crucial when working in cities and towns with underground tunnels.

To prepare a site for the placement of heavy machines, weak zones, old foundations, and abandoned services may need to be excavated. Backfilling such excavations with suitable compacted material is essential. The excavation of small localised areas with weak ground may suffice, but larger areas require more detailed attention. The presence of inadequately backfilled trenches or service tunnels could cause such problems.

It is also important to consider natural or man-made voids, such as cavities in weak rock, shafts, wells, tunnels, culverts, and basements. It may be necessary to take measures such as backfilling.

For instance, where this is not practicable or possible to improve the ground as required the site may need to be zoned, voids or weak zones should be clearly marked and isolated from site activity by barriers or other means and or the machine may have to be kept at a minimum distance from pits or trenches in order to be used safely.

Experience shows that besides the study of the technical documentation (plans and sketches available) it is advisable to carry out some surveys with standard excavators to exclude the presence of underground places or basements. The consequences of an unexpected yielding of the ground, already difficult for a standard excavator, become dramatic when high reach demolition excavators are involved for the followings reasons:

- Small yielding in ground levels at the base machine can cause significant and uncontrolled movements at the working height.
- In the event of a high reach machine rollover, the extent of the damage may spread over a considerable area.

6.3. What safety controls should be carried out on demolition high reach equipment?

The maintenance procedures and periodic inspections are necessary elements in guaranteeing the efficiency and security of high reach demolition equipment.

Such procedures, as applied by national regulations for safety at work, also play an important role for this type of equipment where safety is not only guaranteed by the professionalism of the operator but also by the efficiency of active and passive protection systems which have been installed.

Manufacturers set inspections and scheduled maintenance activities according to the specific characteristics of each machine. These inspections and their frequency are described in the use and maintenance manuals, as issued by law. To ensure that the machine meets minimum efficiency levels whilst in operation, the operator or any suitably qualified person should carry out some simple visual checks before using it:

Safety controls to carry on demolition high reach equipment		
Type of control	Checklist	Schedule
Visual inspection concerning the general state of the machine	General state of the machine; the presence of cracks or fissures in the arm, in the connecting pins; oil or liquid leakage from the engine.	Daily
Visual inspection of plates and locking systems	Verify all the bolts tightening, presence of cracks or fissures, presence of elements with inaccurate coupling and locking plates.	Daily
Hydraulic links check	Check hydraulic tube links, hydraulic cylinders, hydraulic connections and hoses for leaks	Daily
Control of active safety systems (alarm beepers, video camera)	Verify functionality, incolmeter warning sensors if fitted, and boom position alarms, when carrying out scheduled manoeuvres.	Daily
Control of the efficiency of glass surfaces and mirrors of the cabin.	Verify the integrity of the glass surfaces and mirrors ensuring proper cleaning to have the necessary visibility.	Daily
Monitor signs and icons on the machine	Check the reliability and legibility of the icons and signs installed on the machine.	Daily
Control of the efficiency and the functionality of the utensil	Verify the presence of cracks, oil leakage, the efficiency of the blades, points and teeth; effectively run tests of rotation before using the utensil.	Daily

In case, during the visual inspection, elements of failure or malfunctioning are found, the use of the machine is prohibited and the Site Manager must be immediately advised. Any maintenance must be undertaken in line with the operating manual.

6.4. How high reach demolition equipment should be stowed?

It is an important safety aspect that the machine is stowed in a safe manner at the end of each working day, taking into account the following aspects:



The main and intermediate dippers should be fully lowered



Any telescoping sections have to be fully retracted



The main boom should be lowered until the attachment is on the ground in accordance with the procedure detailed in the operating manual



The ignition key should be removed



The operator's cab should be locked



Any additional security functions such as battery isolator, alarms or cab protection systems should be activated.



6.5. Which are the most common procedures for transporting, loading and unloading high reach demolition equipment?

High reach machines, like most machinery, are likely to be moved around frequently in order to operate on different jobsites. In this regard, transportation from site to site should always be managed following good technical specifications so that all operations are carried out safely.

The specific procedures for transporting, loading and unloading the machines will vary depending on various factors. However, as high reach machines are characterised by their dimensions, which in some cases are significantly larger than standard ones, some general rules can be stated taking this into account. They are compiled in the following table.

General rules for transporting, loading and unloading high reach demolition equipment	
Transporting	
1	In most cases, this type of machine cannot be transported fully assembled but can be further disassembled by removing the track frame assemblies and counterweights from the upper works.
2	Usually, the machines are transported in two or three sections: base machine, demolition arm, and tools and counterweights (if requested)
3	All components and assemblies, such as pipes and hydraulic lines capped off must be securely anchored to the vehicle used for the transportation, in order to avoid any movement of the load in such transportation.
4	If it is possible to transport the fully assembled excavator, it is forbidden to perform any rotation manoeuvres on the transport platform.
Loading	
1	Assembly/ disassembly of the sections should be performed on an adequate and flat area with enough space for manoeuvring.
2	For transporting the arm, the attached supports provided by the manufacturer should be used.
3	Due to particular constraints of weight or size during transportation, the base machine of large machines can also be disassembled in the turret with the fifth wheel and individual tracks.
4	Appropriate cranes and lifting systems, as well as slinging points specified by the manufacturer in the owner's use and maintenance manual, should be used, in order to perform manoeuvres correctly and estimate adequate safety margins, preventing this way rollovers or instability of the load.
5	The arm must be removed before removing the counterweights.
6	When loading a fully rigged high reach machine onto the low loader the machine should be reversed onto the trailer with the boom in line with the trailer.
7	Retractable undercarriage must be operated in strict accordance with manufacturers operating manual procedures.
8	The boom need only be raised to sufficient height for ground clearance and should never be slewed across the trailer.
9	Running boards should be folded and secured in the upright position to compensate for the track overhang. They should be deployed with suitable marker boards displayed.
Unloading	
1	Appropriate cranes and lifting systems, as well as slinging points specified by the manufacturer in the owner's use and maintenance manual, should be used, in order to perform manoeuvres correctly and estimate adequate safety margins, preventing this way rollovers or instability of the load.
2	Performs assembly/ disassembly of the sections on an adequate and flat area with enough space for manoeuvring.
3	Pre-start checks on all equipment (including stowed away equipment awaiting deployment) should be carried out prior to redeployment.



7. Training of personnel

7.1. Which are the operator's professional requirements?

Highly qualified staff are required to operate the high reach machines. The procedure for the qualification of personnel has not yet been ruled in many European countries.

However, it is highly recommended that appropriate training and assistance on site is provided to operators to gradually improve the necessary skills to use this particular type of machine.

Manufacturers provide basic training courses, upon delivery of the machine, for operators as well as ordinary maintenance personnel.

Through evaluations of their professional experience and the physical and psychological abilities of their operators, employers can determine those who are skilled enough to use a high reach demolition machine.

7.2. What aspects of safety should be considered by the operator when using high reach equipment?

High and ultra-high reach machines should be operated in strict accordance with the manufacturer’s recommendations and in accordance with the key guidance compiled in the following table:

Safety aspects to be considered by high reach demolition operators	
YES	NO
Seek further training in machine operation if necessary	Cause any side load to the machine
Plan your work programme with site management	Overload the machine
Check the ground conditions before operating	Strike the work with the attachment
Remove boom extension whenever possible	Assist the machine to turn by lifting the tracks with the equipment
Report safety issues to site management	Crane or pull with the machine
Operate the attachment in the manner it was designed to function. Never use it to push or pull against a structure	Move about the site with the equipment fully raised
Ensure that in machines with a retractable undercarriage it is set and locked in the fully extended position whilst working	Approach a high voltage wire
	Undercut the building as debris may roll back onto the machine

8. Regulatory framework

The construction of new machines is regulated by the following European Directives and standards. However, it must be noted that they are general standards as the current European legal system does not take into account demolition high reach excavators specifically.

- Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC
- EN 474-1:2007, Earth-moving machinery - Safety - Part 1: General requirements
- EN 474-3:2007, Earth-moving machinery - Safety - Part 3: Requirements for loaders
- EN 474-4:2008, Earth-moving machinery - Safety - Part 4: Requirements for backhoe loaders
- EN 474-5:2006, Earth-moving machinery - Safety - Part 5: Requirements for hydraulic excavators
- EN ISO 3449, Earth-moving machinery - Falling-object protective structures - Laboratory tests and performance requirements (ISO 3449:2005)
- EN ISO 3471, Earth-moving machinery - Roll-over protective structures - Laboratory tests and performance requirements (ISO 3471:2008)

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The European Demolition Association, **EDA**, was founded in 1978. Our community brings together the main stakeholders of the demolition, decontamination and recycling industries. Among our members there are national associations, contractors, suppliers, engineering and consulting companies.

There are several reasons for being part of the **EDA**:



»» To look after the interests of the demolition, decontamination and recycling activities in Europe.

»» To exchange information, reference documentation, best practice, training, challenges and solutions.

»» To set and promote European standards.

»» To build a wide and reliable network of contacts in Europe with the most important stakeholders.

»» To maintain contacts with similar organizations in other parts of the world: America, Asia, Africa and Oceania.



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