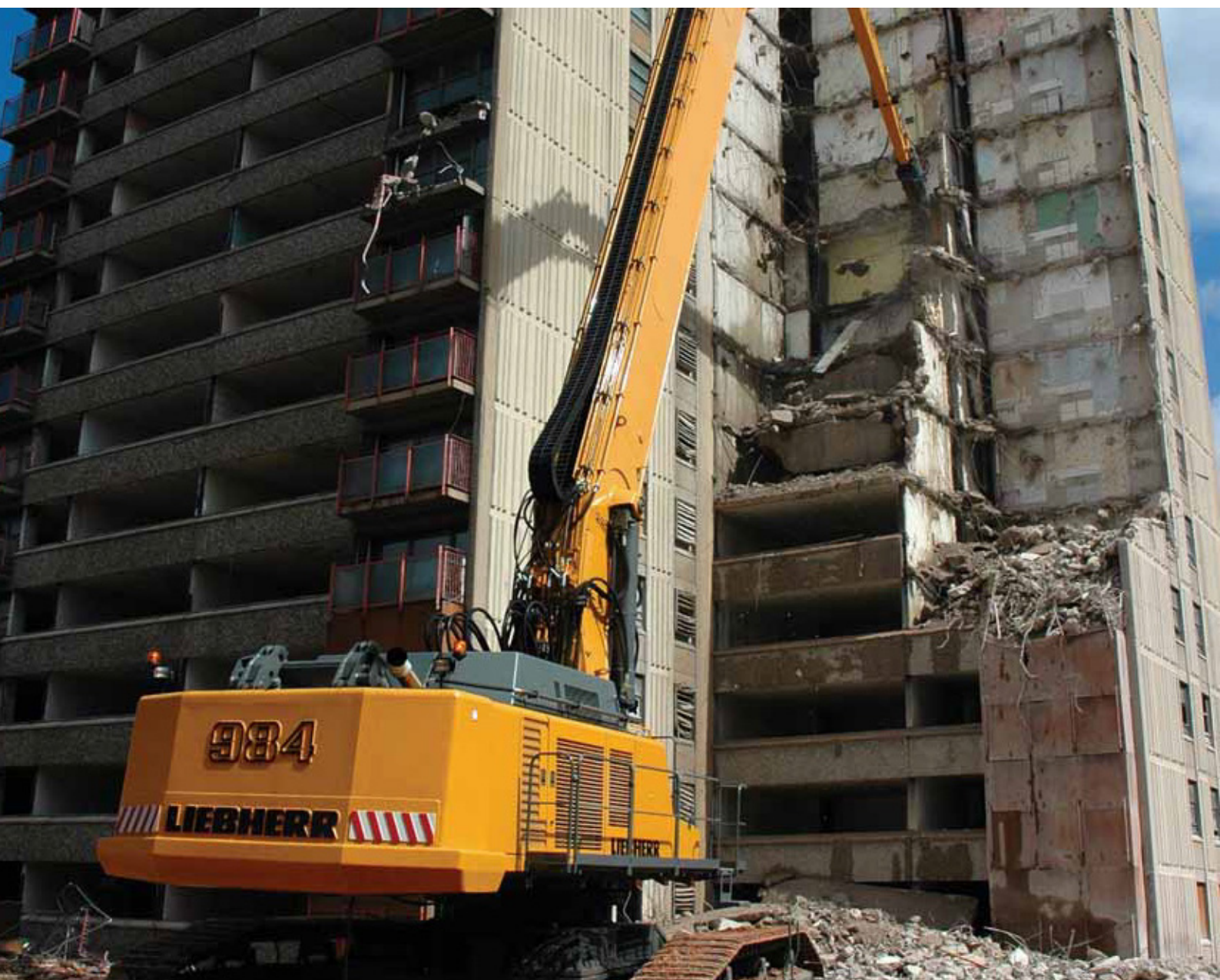




National Federation of Demolition Contractors
Voice of the Global Demolition Industry

High Reach Demolition Rig **GUIDANCE NOTES**

For demolition machines of 15 metres working height and above



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DRG101:2019

INTRODUCTION

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

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

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

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

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1 GENERAL

1.1 TEMPORARY WORKS IN DEMOLITION

- Definitions
- Nature, applicability and status of guidance
- Limitations of good practice guidance

The scope of this guidance is to define the roles, safe working practices and acceptable levels of control needed to use a high or ultra high-reach machine in a demolition environment.

For the purposes of this guidance, a high or ultra high reach demolition machine is defined as a 360° bespoke excavator base equipped with a purpose-built, multi-boom or telescopic boom that has a working height of 15 metres or more. Most multi-boom or telescopic boom machines are capable of safe operation without the use of stabilising outriggers, although these may be fitted dependant on the manufacturer's specification. This type of equipment is typically mounted on a tracked machine base that has undergone modifications including strengthening, widening and lengthening to allow it to work in a safe manner when the front end equipment is fully extended.

These machines must be fitted with a Falling Object Protective Structure (FOPS) and a Falling Object Guard Screen (FOGS) cab to conform to BS 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.

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.

A detailed method statement and task specific risk assessments should be produced for all work involving high or ultra high-reach machines.



1.2 OBJECTIVES OF THE GUIDANCE

- Principal objective is to promote safety and status of guidance

The principal objective of this guide is to ensure optimum site safety during the deployment and use of a high or ultra high-reach demolition machine on a top-down demolition and dismantling project.

Whilst the primary objective of the guide is safety, a secondary objective is that this should be achieved without unnecessary, excessive or prohibitive expenditure. This is certainly not a minor issue since the hire, purchase, transportation and use of a high or ultra high-reach demolition machine is often a significant proportion of the total cost of the demolition process. In addition, the use of a high or ultra high-reach machine can make a significant contribution to demolition site safety by eliminating the necessity for manual operations or work at height.

It is anticipated that this guidance will form the basis of further discussions between all stakeholders involved in the specification of working practices, not only for the use and monitoring of safe working practices but in addition, the manufacture and supply of such equipment.



1.3 RESPONSIBILITIES

- Stakeholders involved in the specification, installation and use of a high or ultra high-reach machine
- Responsibilities to be defined
- Use of appropriately trained, and qualified personnel

A number of stakeholders will be involved in the specification, selection, supply, use and maintenance of a high or ultra high-reach demolition machine. Amongst those with specific duties within the workplace Acts and Regulations are the client, the principal contractor, the machine hirer or manufacturer, and the demolition contractor.

This guidance has been prepared to assist specifiers and principal contractors in selecting and imposing safe working methods and to provide them with an understanding of the many variables faced when using these specialised machines.

Contractual and operational arrangements should ensure that the equipment is adequately operated, inspected, maintained and as necessary, repaired during its time on site.

The respective roles of the various parties should be clearly understood and the responsibilities and liabilities of all stakeholders should be defined and recorded in the relevant site specific documentation. This guide does not extend or affect any such responsibilities and or liabilities.



1.4 SAFETY LEGISLATION

- CDM Regulations
- PUWER Regulations
- Current British Standards
- Health and Safety Procedures

The Workplace Acts and Regulations, particularly the Health and Safety at Work etc Act, 1974, current British Standards and codes of practice, apply to all aspects of construction and demolition works. The Construction (Design and Management) Regulations are aimed at improving the management of health and safety throughout construction and demolition projects and place duties upon clients, CDM co-ordinators, designers and contractors.

There is a statutory requirement under the CDM regulations, in all work places, for risk assessments to be carried out. These risk assessments should be read and understood by all persons who are required to carry out work on site.

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

The risk assessment process will also determine whether a fully-enclosed scaffold will be required to a section of the building – i.e. the façade – or the extent to which exclusion zones should be established.

Under CDM the client is required to make available all information on ground conditions (normally a desktop survey is carried out). The operator of the machine must ascertain that any such information is suitable and adequate prior to access and maneuver on site. Where necessary, further surveys should be carried out. Key items to be covered, in any survey of ground conditions, will include soil condition beneath existing slabs; sewers; basements; cellars; service runs, air raid shelters; culverts; wells; underground tunnels; historical voids; “made-up” ground, and even the possibility of unexploded bombs.

The planning and preparation stage should also determine factors such as how the structure has been constructed, i.e. steel or concrete frame, timber or concrete floors, the system of cladding used and the possible presence of post tensioned concrete elements.

At the planning stage, the height of the structure to be demolished will determine the type of machine to be employed and its maximum safe working envelope. Consideration will need to be given as to whether ramps or raised working platforms will be required.

Safe Working Height

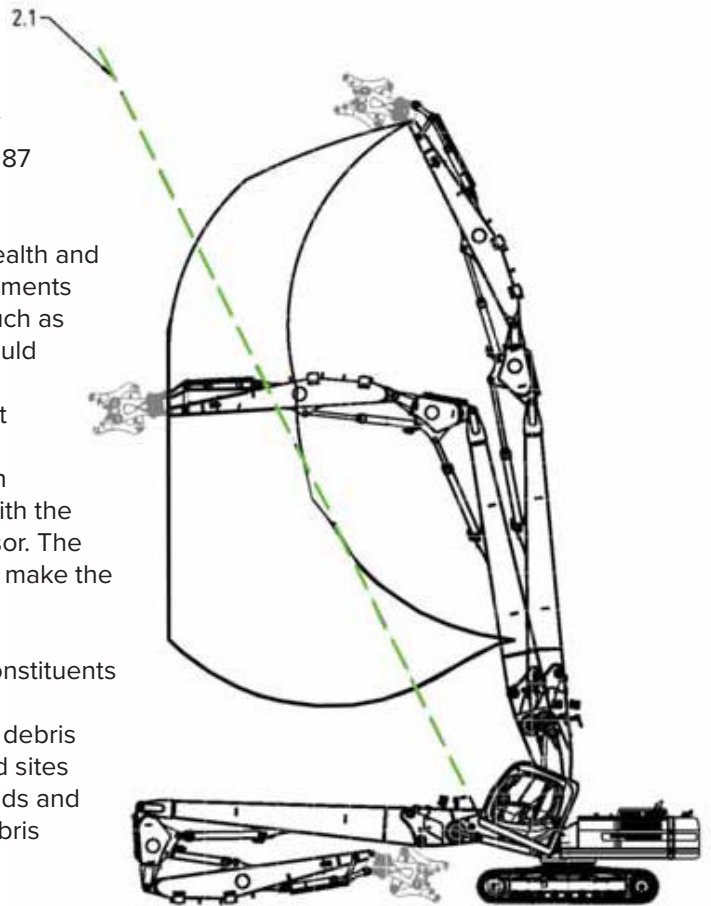
Although manufactures state a machine height within their sales brochures, this is not necessarily the safe working height (ratio 2-1) and contractors should always calculate (with schematic drawings) if a machine is suitable in size and working height.

Exclusion Zones

Safe working spaces and exclusion zones should be in place within and around the site. The extent of the exclusion zone should be varied according to the type of demolition activity and the rate of progress (refer to BS6187 for a detailed description).

Exclusion zones should be part of an overall managed health and safety regime and should be included in all method statements and risk assessments. The use of plant and machinery such as high reach and ultra high reach demolition machines should be planned so that their operation does not present a risk to those nearby. It may be necessary for a competent banksman to enter the exclusion zone to assist the high reach operator as detailed within section 4.2. Entry within the exclusion zone, under these circumstances, will be with the full knowledge of the machine operator and site supervisor. The machine operator shall signal his intent to stop work and make the machine safe prior to such access arrangement.

Exclusion zones should be designed with a number of constituents in place, i.e. the structures 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.



Protective Systems

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:

- Scaffold
- Scaffold screen
- Crane hung screens
- Container bunding



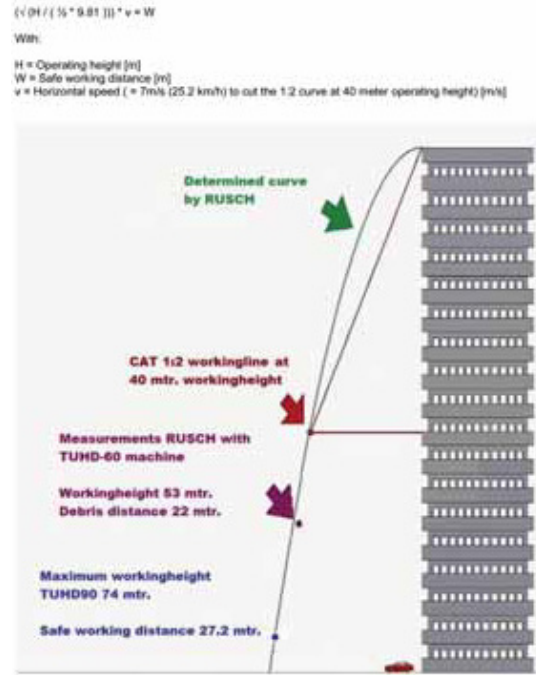
1.5 MANAGEMENT PROCEDURES

- Operating requirements
- Confirmation of machine specification
- Insurance

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

2 to 1 ratio is measured from front of cab at lower level (at fixed, un-raised cab position).

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



Simplified rule:
 From an operating height of 40 meter and thus a working distance of 20 meter, 0.25 meter need to be added to the safe working distance for every meter of operating height increase.



2 EQUIPMENT AND OPERATOR

2.1 EQUIPMENT REQUIREMENTS

- Safety equipment
- Visibility
- Boom angle indicator
- Working envelope/range monitor or indicator
- Attachments
- Maintenance
- CE Marking

The machines described within this guidance should feature a wide array of equipment to protect the machine operator, his fellow workers, and the general public.

All high or ultra high-reach machines must be fitted with a FOPS and FOGS protective cab that will generally feature strengthened, impactresistant glass. To ensure that the operator is fully protected during reduction operations, it is recommended that the cab door is kept closed.

All high and ultra-high reach demolition machines should have good all-round visibility through the cab windows. Windows that are cracked or damaged will impair operator visibility and are a hazard which should be replaced immediately.

All round visibility is a legal requirement that demands the operator be able to see a minimum of 1m out by 1m above ground around the full circumference of his machine. This is generally accomplished by fitting a rear or side camera and mirrors mounted on the cab and machine upperstructure. Mirrors that are cracked, damaged or missing and therefore will impair operator visibility, are to be replaced immediately.

In some ultra high-reach machines operator visibility may be enhanced by the use of a CCTV system. The camera is generally mounted on the arm close to the attachment and in conjunction with the side and rear cameras, can be viewed via a monitor in the operator's cab. Such systems should be tested as part of the machine's daily maintenance routine.



All machines should be fitted with a boom angle indicator (boom position alarm) that provides a visible and/or audible indication that the boom is in a safe working position. The operator must ensure that the machine remains within the prescribed safe working radius at all times.

Every high or ultra high-reach demolition machine will utilise a variety of attachments to perform breaking, cutting, crushing and pulverising duties.

These will include:

- Combi-cutter crusher
- Hydraulic Pulverisers
- Steel Shear
- Hydraulic Hammers (subject to consultation with the machine and tool manufacturer).
- Selecta grab

It is important that the right tool is used for the work in hand as detailed within the site safety plan and method statement.

All attachments must be maintained and regularly inspected, excessive tool wear will lead to unnecessary strain being placed on the machine. Particular attention should be paid to the hydraulic hoses feeding the attachment to ensure they are tight; undamaged; and not rubbing or fouling.

Dust suppression sprays should also be checked daily to ensure they are fully operational.

Attachments that place undue strain and exceed the safe working load of the machine should never be used. If the high or ultra high-reach demolition machine is equipped with a quick-change device, the weight of the device and carrying cradle must also be taken into account.

The safe working load of the machine should be clearly displayed within the operator's cab. If this information becomes lost or illegible, it is to be replaced immediately. All attachments and quickchange devices should be clearly marked with their gross weight. If this information becomes lost through wear or damage to the attachment, it is to be replaced immediately.

It is a legal requirement that a competent person carry out a weekly inspection of the machine and its attachments. However, good practice and common sense call for daily inspections of the machine and its attachments. This should involve a visual inspection before the start of each working shift with checks that include: all pin cross bolts and the safety locking plates on the lock pins; hydraulic hoses and cylinders; debris in pivot areas; attachment linkage; boom position alarm; pivot points and cylinder locating points. Signs of wear or damage that could impair the safe working condition of the machine or the attachment should be recorded and the fault corrected or repaired. Operation, maintenance and repair of the machine should be conducted in strict accordance with the requirements stipulated in the owner and operator manual provided by the machine's manufacturer. All other daily and regular maintenance checks to be carried out in accordance with manufacturer's instructions.







2.2 OPERATOR REQUIREMENTS

- Training standards to CPCS and NDTG competency levels
- Safety summary

All machine operators should have access to the site specific method statement, risk assessments, job specification, ground conditions survey and any other relevant information necessary for them to operate the machine in a safe and efficient manner.

Operators should operate all controls in a smooth, steady manner and avoid any sharp or sudden movements that might affect the safe operation and stability of the machine. The machine should be operated in line with the tracks and over the front idlers (drive sprockets to the rear) for maximum stability, allowing the machine to be reversed quickly and safely in the event that falling debris may strike the machine.

Operators should ensure that they do not operate the attachment in line with the boom as loose debris may roll down the boom and onto the cab of the machine. Good practice will dictate that the operator should be able to see the jaws of the attachment and to accomplish this, the attachment should be angled downwards when cutting or shearing.

Operators should never allow the working attachment to become entangled in debris that could lead to an overload or loss of stability. It is recommended that operators of high and ultra high-reach excavators receive regular (annual) eye tests to ensure good vision.

High and ultra high-reach machines should be operated in strict accordance with the manufacturer's commendations and in accordance with the following key guidance:

- ALWAYS seek further training in machine operation if necessary.
- ALWAYS plan your work programme with site management.
- ALWAYS check the ground conditions before operating
- ALWAYS remove boom extension whenever possible.
- ALWAYS report safety issues to site management.
- ALWAYS operate the attachment in the manner it was designed to function. Never use it to push or pull against a structure.
- ALWAYS ensure that machines with retractable undercarriage that it is set and locked in the fully extended position whilst working.
- NEVER cause any side load to the machine.
- NEVER overload the machine.
- NEVER strike the work with the attachment.
- NEVER assist the machine to turn by lifting the tracks with the equipment.
- NEVER crane or pull with the machine.
- NEVER move about the site with the equipment fully raised.
- NEVER approach a high voltage wire
- NEVER undercut the building as debris may roll back onto the machine.



3 SITE CONDITIONS

3.1 SITE INVESTIGATION

- Importance of site appraisal
- Ground investigation/survey
- Investigation of building/structure to be demolished
- Risk assessment of ground conditions and working environment

In addition to any desk top survey conducted for ground conditions it is important that a thorough appraisal of the entire site, prior to the commencement of work, is carried out by the machine operator and site manager. An inspection of the site should identify the location of any weak and variable areas, the presence of overhead hazards, and details of the type of building/structure to be demolished. 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.

Appropriate and sufficient ground investigation, in the selection of a suitable area to operate the machine, is vital to ensure that the provision of an adequate and safe working surface is constructed. Localised weaker zones in the sub-grade, including inadequately backfilled and compacted excavations, existing or abandoned services and hard spots, such as old basement walls, can be just as hazardous as weak zones.

It is particularly important that any sub-structures (below ground) in an around the building/structure are identified and are 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 especially important when working in towns and city's known to contain underground tunnels.



3.2 SITE PREPARATION

- Excavation of weaker zones, old foundations and services
- Backfilling of voids
- Deterioration of sub-grade
- Inspection of sub-grade before placement of platform

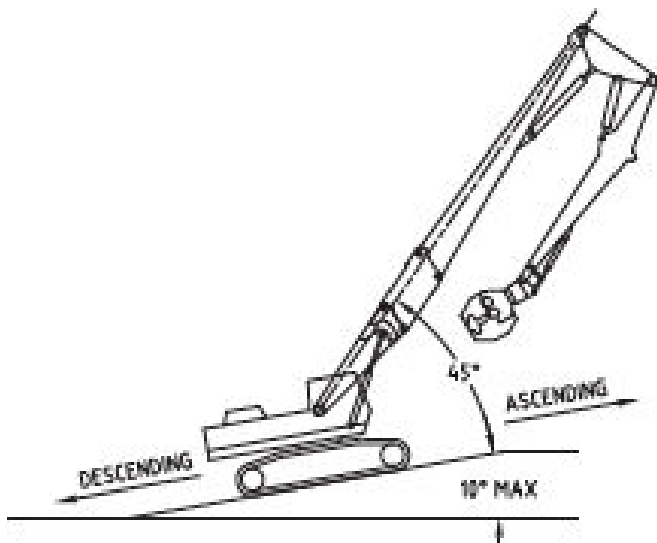
Works to prepare a site for the placement of heavy machines may necessitate the excavation of weak zones, old foundations and abandoned services. Such excavations should be backfilled with suitable material that has been adequately compacted. Whilst it may be sufficient to excavate localised small areas of weak ground, larger areas will require more detailed consideration. Such problems could include the presence of inadequately backfilled trenches or service tunnels. It may be necessary to zone the site in terms of bearing resistance or to specify a minimum distance from a pit or trench at which the machine can be used safely.

Natural or man-made voids such as cavities in weak rock, shafts, wells, tunnels, culverts and basements, also require special consideration.

Measures such as backfilling may be required. Where this is not practicable or possible, voids should be clearly marked and isolated from site activity by barriers or other means which should be carefully maintained throughout the course of the works. Voids or weak spots can be concealed beneath surface crusts or paved areas.

Deterioration of the sub-grade should be prevented by ensuring adequate drainage is installed or by minimising exposure to wet and frosty weather. Erosion or deterioration caused by water from dust suppression systems should also be taken into account. Where deterioration does occur, the affected material should be removed and replaced with suitably compacted materials before placement of the platform.

Inspection and recording of the sub-grade by a competent person immediately before placing the platform is essential.



4 AT WORK

4.1 SETTING UP SAFELY

- Protecting personnel and the public
- Placing/aligning the machine
- Creating a raised platform

A safe working place and an exclusion zone for operation of the high reach machine must always be in place and maintained at all times. Non-essential personnel and members of the public should be excluded from the area.

In instances 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.

The design of a working platform must be suitable and sufficient for the machine that is to be used all design work and back up calculation 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/specification of the fill material to be used.

It is important to note that the majority of accidents involving high or ultra high reach excavators can be attributed directly to inadequate ground conditions, poorly designed and/or constructed working platforms.



The working platform should be constructed using 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. An allowance should be made for the deadweight of the machine and any point loading that may occur.

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. The working platform must be inspected on a daily basis for signs of erosion or degradation caused by weather conditions, water run-off (including that from water suppression systems) and general wear.

Access to the working platform should be with the boom in the lowered or retracted position, the machine boom should be floated to maintain the correct position whilst accessing and egressing the ramp. However, in some instances it may be necessary to raise the boom to a semivertical position as the machine approaches the building face. Egress from the work platform should be in reverse, with the boom lowered towards the face of the building. Prior to reversing, the operator should ensure that the exit route is completely clear and that the site supervisor is aware of the machine route to maintain the exclusion zone.

When operating from a working platform, it is good practice to maintain a sufficiently large debris pit between the platform and face of the building/structure to allow debris to fall without encroaching towards the track frame of the machine. It is advisable to have a conventionally rigged demolition machine, working in support of the high reach machine, to enable debris to be cleared from the pit and the platform top.

The machine should never be put to work whilst positioned on a slope. A few degrees out of plane will significantly shift the central axis of the machine creating stresses in the boom and base section which in turn can cause instability. Using a shear, for example, whilst working out of plane by more than 1° causes severe stresses in the turning point, which are created by the turning moment of the shear. Continued use in such circumstances will significantly reduce the life of the machine and its component parts. Travelling on slopes should be avoided but, when unavoidable, the machine should travel with the slope, not across it.

4.2 WORKING SAFELY

- Banksman
- Changing attachments
- Lifting and lowering the boom
- Dust emissions

In certain working environments, a trained and competent banksman may be required. The banksman should never be allowed inside the drop zone while work is in progress. Where necessary, two-way radio communications may be required between the banksman, machine operator and site supervisor to maintain safe operation of the machine and site.

To avoid the risk of injury during a change of attachment or front-end equipment, it is recommended that changeovers involve a competent assistant and are conducted in strict accordance with the manufacturer's instructions, ensuring that the original manufacturer's pins and pin retainment systems are located and secured with the manufacturer's recommended locking devices. An area with firm and level ground should be selected for the changeover and any equipment not being used should be stowed in accordance with the manufacturer's instructions.

The attachment - ie, shear, grab, pulveriser - should only be used and maintained in accordance with the manufacturer's instructions. Attachments should never be used to bludgeon, push or pull a structure to weaken it. In addition to the obvious damage which could occur to the attachment, the kinetic energy built up by the movement of the boom or dipper arms towards the structure, will increase with every centimeter travelled ($\text{Mass} \times \text{Acceleration}$). If the attachment strikes an object that does not give way, the deceleration \times the mass of the attachment will impact on the boom, boom mountings and base and may impose bending stresses in the cylinders and boom.



An operator of a high or ultra high reach machine should always be aware of the difficulty in gauging distances between the attachment and the structure, particularly where water sprays or dust may obscure the operator's sightline. Adverse weather conditions may not directly affect the machines stability, but high winds, direct sunlight, poor visibility and fog may affect the safe operation of the machine in extreme conditions.

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. This will allow the machines counterweight to function and compensate for the change in any degree of plane. It is also important to recognise that the load capacity of the machine will vary on the quadrant position of the boom in relation to the machines undercarriage. In the case of a crawler machine (tracked) the three quadrants that should be considered are:

1. Over the side of the tracks
2. Over the idler end of the tracks
3. Over the drive sprocket end of the tracks

The stability of the machine when lifting and lowering the boom will also be affected if the machine is not placed on firm and level ground. Machines fitted with a gyroscope/inclometer instrument coupled to a warning indicator will alert the operator that the machine is operating outside of the angle of inclination and over the predetermined threshold for safe operation. In such instances the operator should not attempt to continue lifting or operating.

Having successfully raised the boom to the optimum position required to work, the operator should ensure that all the machines warning devices and operational instruments are fully functioning before starting work. As with all such equipment, test functions are built into the machine controls. These may include inclometer warning sensors (telescopic boom only), cameras, fuel and oil levels, wind speed anemometers, engine temperature etc. In addition, a physical pre-start check of the rudimentary machine components must be undertaken to include track and frame, mirrors, boom and arm hinge points, attachments etc. If in doubt, the operator should refer to his 'operator manual' and the manufacturers instructions for best practice principles. All daily checks should be made with the equipment fully retracted and lowered to the ground as shown within the machine operating manual.

Every effort should be made to minimise the dust created by the reduction process. This may be undertaken in a number of ways, i.e. by utilising the machines bespoke and in-built dust suppression systems, employing a 'water cannon' 'fog cannon' etc atomized water sprays or even a simple hand held hose or other specially designed dust suppression system. Where the water supply is insufficient to manage such systems, a suitable engineered alternative should be sought.

4.3 SHUTTING DOWN

- Shutting down the equipment
- Locking the cab

It is an important safety aspect that the machine is stowed in a safe manner at the end of each working day. The main and intermediate dippers should be fully lowered; any telescoping sections are fully retracted; and the main boom is lowered until the attachment is on the ground in accordance with procedure detailed within the operating manual.

The ignition key should be removed, the operator's cab should be locked and any additional security functions such as battery isolator, alarms or cab protection systems should be activated.

4.4 TRANSPORT TO & FROM SITE

- Loading onto low-loader
- Securing on low loader
- Stowing equipment

It is possible to transport most high reach machines with the boom attached to the base. However, for many ultra high reach machines it may be necessary to detach the demolition boom from the base machine and transport separately (manufacturers transport recommendations to be followed). Where counterweights are demountable, these should NEVER be removed before the demolition boom is removed. Extreme care must be taken whilst moving machines with counterweights removed, avoid travel over uneven ground use low angle approach ramps and keep within manufacturers guidelines.

Retractable undercarriage must be operated in strict accordance with manufactures operating manual procedures.

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.

The boom need only be raised to sufficient height for ground clearance and should never be slewed across the trailer. Running boards should be folded and secured in the upright position to compensate for track overhang. They should be deployed with suitable marker boards displayed.

The boom should be chocked and chained to prevent any bouncing or rocking that might lead to damage to the boom. In addition, the machine should be chained to the trailer in accordance with good industry practice and current legal requirements.

Pre-start checks on all equipment (including stowed away equipment awaiting deployment) should be carried out prior to redeployment.



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