Demolition with Brokk
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Introduction

Demolishing a building or parts of it, is very often much more complicated and considerably more expensive than erecting it in the first place.

Everybody working in the demolition business today is aware of this and the endeavour to find new working methods, tools and machines to facilitate the work of demolition is a constantly ongoing process. This handbook starts off by describing demolition in general terms but it is mainly about demolition using Brokk - the remote controlled, electrically powered demolition machine that gives contractors new opportunities to demolish profitably. The book is meant to be an inspiration for present and future Brokk users. It is also intended as specialized reading for major customers who procure demolition contracts.

Since the 1970s Brokk AB has been developing, manufacturing and marketing Brokk machines. This is the company’s sole product line, one that has of course been developed over the years and now comprises a complete model programme with a large range of attachments.

Attention is being increasingly focused on the environmental aspects of demolition work and new demands are consequently being made of demolition contractors. Opting for the Brokk method of demolition not only greatly improves the chances of meeting the requirements that apply to the individual operator’s work situation and the general environment of the work place, it also makes it possible to satisfy requirements for noise reduction, recycling etc.

In a nutshell - Brokk is a machine that enables contractors to demolish cost effectively in accordance with their customers’ requirements and for the successful development of their own companies.

»Demolition with Brokk« is based on a previous publication, »Demolition Handbook«, published by Atlas Copco in the mid 1980s. A work group at Brokk AB has been responsible for this and a number of customers have contributed their experience and opinions.

We would naturally like to extend our warmest thanks to all those who have participated. The rapid development of demolition methods and our products would be impossible without the close cooperation of our customers, the Brokk users.

Martin Johansson, Managing Director of Brokk AB
Skellefteå, March 2000
Demolition volumes

Reasons for the substantial increases in demolition volumes are:

- existing land within built-up areas must be utilized;
- demands for modernization and improved comfort;
- redevelopment of inner city areas;
- rapid technological changes within industry require ever more efficient plant premises and this necessitates at least partial demolition;
- technological equipment is being renewed even more rapidly to maintain highly competitive levels and premises must be adapted.

The consequences of the above will be increased demands for the further technological development of demolition methods and equipment and their levels of efficiency.
General factors influencing method selection

A range of different factors influence the choice of demolition method or combination of methods:
- the location of the premises to be demolished
- the surrounding area
- the foundations or ground conditions
- the amount of work space available
- the existence of local statutes and restrictions
- existing environmental requirements

Description of the premises
- structural characteristics of the building - special stress factors
- construction materials used
- condition of the building - age, wear and tear, etc.
- specific accident risks

Demolition volume
- What type of equipment will result in the lowest total cost?
- What is the time allocated for completion?

1) High capacity equipment - high hourly cost
2) Lower capacity equipment - lower hourly cost

If the conditions of contract for demolition are clearly specified, this often results in certain restrictions in the selection of methods.

In the case of less specified demolition work, where various methods are allowed, it is more difficult to carry out cost comparisons.
Preparing for demolition

General
Thoroughly inspect the premises, site, surroundings, structural characteristics and neighbouring buildings that could be affected by the intended demolition work. Investigate the environmental requirements/restrictions that apply and whether there is any potential risk to life and property.

Roofed and framed structures
Check the stability of roofs and framed structures. Load bearing sections must be identified for reasons of safety.

Walls
Check the thickness of all walls and identify those that are load bearing.

Balconies etc.
Check their system of support.

Concrete structures
Check the type of concrete that has been used, its quality and the extent of any damage.

Pre-stressed concrete and pre-cast structures
These must be inspected with great care and attention. You will require:
- the necessary data from the manufacturer,
- the necessary data from the building contractor,
- the necessary data from the Local Authority
- inspection by a Chartered Engineer
- identification of the type of pre-stressing to be used

Cellars, wells, etc
Inspect these thoroughly and pay particular attention to the possible presence of chemical fluids or gases.

Building materials
If asbestos has been used special measures must be taken.
Mains and services to be cut off:
- electricity lines
- gas pipes
- telephone cables
- fuel lines
- water mains
- heating lines

The demolition contractor shall always use separate service lines. When carrying out demolition work with Brokk check that the electricity supply has sufficient amperage.
Waste

If residual waste on the site incurs a risk of infection contact the appropriate Local Authority department.

Previous function of condemned premises

If you suspect the presence of dangerous gases or chemicals contact the Local Authority. This applies particularly to radioactive waste.

Materials and equipment

Check all materials and equipment to be used.

Scaffolding and shores

Comply with all existing regulations. Scaffolding should be dismantled as demolition progresses and should not be allowed to reach above the working level. All scaffolding shall be inspected.

Prohibited or restricted access

This is the responsibility of the Local Authority.

Administrative aspects

A demolition project involves a large number of local and central government authorities (laws and statutes, etc).

Safety rules and precautions

Since all demolition work incurs a certain element of risk, a large number of regulations apply concerning:

- the work site itself,
- the equipment in use,
- work site personnel,
- safeguards against uncontrolled collapse,
- safeguards against fire, explosion and flooding etc.

Third party protection

- right of access - cordoned-off areas,
- local statutes and restrictions

Protection of private property

Vibration disturbance to neighbouring buildings.

Insurance liability

All the necessary insurance coverage must be arranged.
Demolition methods and equipment

General
The advances in technology within the area of demolition have increased the need for more sophisticated tools and equipment.

The use of such equipment and tools and the level of safety for those using them is highly dependent on effective cooperation between manufacturers, contractors and operators. Incorrect use of a tool or equipment is potentially dangerous. Manufacturers cannot be held responsible when the tool or equipment is used for a purpose it was not designed or intended for.

The contractor is responsible for ensuring that:
- the tool or equipment is solely used for the type of work it was designed for,
- the tool or equipment is maintained in compliance with the manufacturer’s stipulations and recommendations,
- the operator is properly trained in the use of the particular tool or equipment,
- the tool or equipment is inspected and tested at regular intervals by qualified personnel.

Demolition methods
A. Demolition using hand-held tools
B. Demolition using rig-mounted breakers
C. Demolition using rig-mounted crushers
D. Demolition by blasting
E. Demolition by splitting
F. Demolition by sawing and drilling

Mechanical demolition is the process of creating torque or shearing stress through static or dynamic loads on the demolition material. Concrete can withstand high compressive stress whereas its resistance to tensile stress is low (less than 10% of its compressive strength). Concrete should therefore be demolished by exploiting this characteristic. This is not the case when chipping or sawing but it is the case when blasting and splitting.

Reinforcement bars are embedded in concrete structures where tensile force occurs in order to increase the strength of the concrete. By subjecting structures to bending forces through the use of grabs, for example, the low resistance to tensile stress can be exploited.

Demolition using hand-held tools
Demolition is usually carried out by chipping and tearing down layers horizontally as well as vertically. A building is usually demolished in the reverse order to that in which it was built. This method is usually used for small demolition volumes and often as preparatory work for other demolition methods. It is highly labour intensive, slow and expensive. Great care must be shown as regards falling rubble.

If the distance to the nearest street or building etc. is less than that prescribed, then free fall of the material demolished is forbidden and a suitable building hoist, chute or the like must be used.

When sections of a building are demolished, remaining sections must be checked to ensure that they are sufficiently stable. If this is not the case they must be reinforced or shored. The hand-held
breakers can either be compressed air, electrically or hydraulically powered. Different kinds of chisels are used depending on the material they are to be used on. The result of the work and the service life of chisels depends on such factors as the working pressure, the weight of the breaker, the cutting edge of the chisel and the bending stress the chisel is subjected to. Chisel edges should be regrinded in good time in order to achieve best results.

The most common type of hand-held equipment used is usually compressed air powered. The reasons for this are their robust design, their reliability and their easy handling. Also, compressors are to be found at most building sites. For minor jobs or short-term work, electrically powered tools are commonly used.

Demolition using hand-held tools is expensive because of the high labour costs involved. The problems that the use of hand-held tools gives rise to in the work environment have also been the focus of a great deal of attention. These mainly occur in the form of musculo-skeletal damage ("white fingers") and neurological disorders such as loss of feeling and numbness.

Due to the complexity of the problem there are no prescribed norms and regulations specifying the maximum extent to which the method is safe to use. However it is not at all unusual for individual contractors themselves to draw up their own rules and regulations to safeguard their employees. As a rule therefore, hand-held tools are only used when alternative methods have proved themselves unsuitable, or when there is insufficient space on site for rig-mounted equipment or when the coverage area of the latter is inadequate.

Nowadays rig-mounted equipment is available that is specially designed, compact and easy to operate and ideal for use in cramped narrow spaces (See Brokk 40 further on).

Demolition using rig-mounted breakers

The use of hand-held equipment for demolishing large volumes of concrete is simply uneconomic. Hydraulic breakers from 30-600 kg are available for mounting on different types of carriers. When compared to hand-held alternatives, these units have the great advantage of delivering much more powerful impact and feed forces and they are also much more effective. It is common to make use of the carrier’s hydraulic system and it is often necessary to carry out a swift change of tools between the breaker and other attachments (e.g. bucket).
This is facilitated through the use of a quick-hitch and hydraulic quick couplings.

Hydraulic breakers demand the use of carriers with sufficient stability (weight ratio). The crucial factor here is that the surface the carrier is being used on is capable of bearing the load. If the method is used for sideways demolition of high vertical walls or columns, then great care should be taken to avoid collapse on the carrier or operator.

Demolition using rig-mounted crushers.

The use of rig-mounted crushers for demolition has become an extremely interesting alternative when requirements stipulate low noise levels whilst demolition work is being carried out. The crushers grip the demolition material and crush it and the only sound to be heard is that of the material being crushed and of rubble falling. Compared with using a rig-mounted breaker this method often makes it possible to have much longer working shifts per day when conditions and restrictions limit the length of time a breaker can be used.

Demolition by blasting

Blasting is sometimes an extremely effective demolition method for which Brokk can be an excellent complement. By weakening the structure of the building at different points it is possible to blast different sections in a controlled manner. This can be achieved by using the Brokk demolition machine to create a number of “weakened points” in accordance with the calculations of blasting experts. Brokk can also be used afterwards to chip or cut down any sections, parts of walls, floors etc. not completely demolished by the blasting.

IMPORTANT! All blasting requires an extremely high level of professional expertise. A thorough blasting programme must be drawn up first and approved by the respective authority (Local Building Committee). The police should also be informed so that they can cordon off the area in question.
Demolition by splitting

When large sections of concrete must be demolished or when large openings are to be made, and where the use of explosives is impossible, suitable splitting equipment can be used. This method has a negligible effect on the surrounding environment, does not create shock waves and generates hardly any dust, noise or flying fragments. The use of splitting equipment requires the predrilling of holes for insertion of the splitting cylinder or wedge. Even in the case of demolition by splitting, Brokk can be used to advantage in combination with other equipment in the preparatory and finishing stages of the work. With the bucket attached, Brokk can also be used for removing demolition materials.

Demolition by sawing and drilling

These methods are used either for total removal of sections or as a preparatory measure for clearing an area for demolition and often occur in combination with other demolition methods. Sawing produces accurate cuts and smooth edges and requires less secondary work than chipping. Circular saws cut through concrete both vertically and horizontally to a depth of 40 cm.

An ever increasing number of contractors using these methods now use Brokk as a complement so that they can select the best possible demolition method for each individual object to be demolished.
The previous chapter dealt with the manner in which different technical circumstances affect the selection of method. Other important factors are the costs and the time required for each of the various methods. These must be compared in order to calculate and submit a tender for a demolition project. Tenders within the demolition business often vary substantially.

The more highly specified and detailed preliminary enquiries and specifications are, the more confidently the contractor can submit a tender. Of equal importance is a thorough inspection of the object to be demolished. Factors that often underlie large variations in tenders are:

- lack of cost assessment experience
- inaccurate analogical conclusions
- incorrect assessment of the degree of reinforcement
- unforeseen mechanical adjustments
- change of method
- unforeseen breakdowns
- sorting of demolition materials, transport to environmental station etc.

Some rules of thumb concerning costs may be of interest here:

- demolishing a concrete building is at least twice as expensive as demolishing an older brick building of the same size;
- for reconstruction purposes it is 5-10 times more expensive to demolish concrete than to cast it calculated per m³.

**Costs**

In the following cost analysis, the figures quoted should be regarded as guidelines as they are dependent on a number of factors that can vary considerably.

The figures referring to demolition relate to the cost per solid m³ and those sawing per m² of sawn area. Regarding capacity, the figures quoted refer to an average capacity (fm³/h) during an 8 hour shift. This is estimated to be 50-60% of the maximum hourly capacity. The costs specified are based on the cost level for 1999.

When demolishing reinforced concrete with hand-held tools a capacity of ca 0,1-0,3 fm³/h is attained at a cost of 5600-1440 SEK m³. Equivalent costs using a 250kg rig-mounted breaker are ca 800-400 SEK fm³. This clearly shows the economic advantages of using rig-mounted breakers, space permitting, instead of hand-held ones.

Apart from the lower cost aspects of rig-mounted breakers, substantial time-saving is important too. This decreases total demolition time and allows other kinds of work to be started earlier, thereby achieving capital rationalization.
Demolition using rig-mounted breakers

The diagram below shows the capacity and costs for different size breakers and carriers. The trend is to avoid the use of excessively heavy breakers because the costs incurred by the large excavators required for their use are very high.

The values in the diagram are intended as comparison between different size breakers and different types of demolition materials. The values should be regarded as a guideline since they are affected by a range of different factors such as the thickness of the concrete, its location, etc.

From the diagram we can see that when work is being carried out in heavily reinforced concrete using a 400 kg hammer, a capacity of about 1.5-2.5 m³/h can be reached at a demolition cost of about 640-400 SEK/m³. This applies to horizontal demolition.
Demolition with Brokk using breaker or crusher

Capacity

<table>
<thead>
<tr>
<th>Capacity/h</th>
<th>Length of wall (2200 mm high, 150 mm thick)</th>
<th>Length of wall (2200 mm high, 300 mm thick)</th>
<th>Length of wall (2200 mm high, 500 mm thick)</th>
<th>Floor 150 mm/ increased capacity in %</th>
<th>Double reinforced reduced capacity in %</th>
<th>With crushers reduced capacity in %</th>
<th>Foundation 2x2x1 m time required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brokk 40</td>
<td>0,5 - 1,5</td>
<td>-</td>
<td>-</td>
<td>+ 20</td>
<td>- 50</td>
<td>- 10-50</td>
<td>-</td>
</tr>
<tr>
<td>Brokk 110</td>
<td>1,5 - 2,0</td>
<td>1,0 - 1,5</td>
<td>-</td>
<td>+ 30</td>
<td>- 30</td>
<td>- 10-50</td>
<td>20 h</td>
</tr>
<tr>
<td>Brokk 150</td>
<td>2,5 - 3,5</td>
<td>1,5 - 2,5</td>
<td>-</td>
<td>+ 20</td>
<td>- 20</td>
<td>- 10-50</td>
<td>14 h</td>
</tr>
<tr>
<td>Brokk 250</td>
<td>4,0 - 6,0</td>
<td>3,0 - 4,0</td>
<td>0,5 - 1,5</td>
<td>+ 30</td>
<td>- 15</td>
<td>- 10-50</td>
<td>8 h</td>
</tr>
<tr>
<td>Brokk 330</td>
<td>8,0 - 11,0</td>
<td>4,0 - 5,0</td>
<td>2,0</td>
<td>+ 30</td>
<td>- 5</td>
<td>- 10-50</td>
<td>4 h</td>
</tr>
</tbody>
</table>

The table above shows the average capacity figures for demolition of concrete structures using Brokk.

Blasting

The following factors affect capacity and cost:
• the dimensions of the building’s structures,
• the type of construction material,
• the type of explosives to be used,
• the amount of blasting to be carried out etc.

The holes drilled are usually spaced at a distance similar to the thickness of the material, and with a hole depth 2/3rds of its thickness. This will result in suitable fragmentation of the material and eliminate the need to subsequently break it up for loading or transportation. Consequently, the less thick the material the greater the number of drill metres necessary per solid m³ material. See diagram.

The arcs in the diagram clearly show that with concrete of a specific thickness, it will be substantially cheaper to blast than chip with breakers. The thicker the concrete the greater the difference. In the case of heavily reinforced concrete, the breaking point lies somewhere between concrete 1 and 1.5m thick. For non-reinforced concrete the corresponding limit is 1.5 metres and upwards. For total demolition of high-rise buildings blasting is always a better alternative from the cost aspect than the use of other methods, irrespective of the strength of the material to be demolished. On the other hand, blasting is not always appropriate. The cost relationship between blasting and chipping is illustrated below.

The diagram shows the cost relationship between blasting and chipping. Chipping is the most economical alternative for concrete structures of thin or normal thickness.
Sawing

The capacity obtained when sawing depends on the depth of the cut and the feed rate which in turn is dependent on the strength of the material and the positioning of the reinforcement bars. Capacity is also affected by:

- the manner in which the guide rails and attachment devices are arranged;
- resetting of sawing positions
- water flushing

Average cutting capacity (m$^2$/h) using diamond-edged saw blades and a sawing depth of up to 0.4m in floors are presented in the adjacent diagram.

For wall sawing the capacity will be substantially lower; only 40-50% of the floor cutting capacity. Costs are greatly influenced by the quality of the blades, the stability of the unit and the setup arrangement of the saw. Blade service life and costs are influenced by the strength of the material being cut, the feed rate, peripheral speed and feed force applied. The feed rate will lie within the region of 0.5-1.2m/min with a feed force of 2-3 kN and a peripheral speed of 30-60 m/s.

There are different kinds of blades for different kinds of material.

When cutting through standard reinforced concrete floors, the total cost lies between 960-1150 SEK/m$^2$ cut. When sawing walls this figure can increase up to 2700 SEK/m$^2$ cut.
Core drilling

Capacity in this case depends on the qualities of the material being core drilled, the rotation speed, feed force and cooling efficiency. The relationship between the rotation speed and the feed force applied is particularly important for obtaining minimal wear of the core bit.

A sufficient supply of water must be available for the cooling of the core drill and flushing away drill cuttings. Core bit diameters of up to 600 mm are used and the peripheral speed of the bit varies between 2-5 m/s. A bit with a diameter of 200 mm requires a feed force of about 10kN and a power source of about 10 kW. The following operating capacities apply:

<table>
<thead>
<tr>
<th>Material</th>
<th>35 mm</th>
<th>400 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavily reinforced concrete</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Lightly reinforced concrete</td>
<td>3.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Non-reinforced concrete</td>
<td>4.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Masonry</td>
<td>6.0</td>
<td>2.0-3.0</td>
</tr>
</tbody>
</table>

Core drilling is the method usually used to drill the holes for insertion of splitting cylinders. This therefore is a combination-method for splitting a series of holes drilled along the contour of an opening and subsequently splitting between the holes. The openings along the contour will be rather uneven so secondary work will be necessary.

The method does not impact negatively on the environment. Core drills are also used for smaller holes for service lines or cable penetrations.
Partial demolition and demolition for reconstruction.

During the 1960s there was a substantial boom in new construction. This large volume is now in need of repair, reconstruction and development. Therefore, demand in this sector is likely to be high for some time to come. Even the re-use of buildings of historical and cultural value demands careful partial demolition, thereby safeguarding their internal and external features and increasing their value. Renovations of this type are often very expensive and involve environmental problems for the work crew, neighbours and surroundings.

As a rule, changes in the concrete structures of a building have to be carried out by creating openings etc. A large number of factors influence the choice of method for concrete demolition and the one that is best varies from case to case. The most common methods for partial demolition and opening up holes are:

- chipping with hand-held equipment
- rig-mounted hydraulic breakers
- diamond sawing
- core drilling
- splitting
- cautious blasting

The principles for the above-mentioned methods have already been dealt with. However, in reconstruction work it is particularly important to take precautions to minimize disturbance to the surroundings, and limit damage to other sections of the building. Work in the vicinity of the site must also be allowed to continue. Reconstruction demolition primarily involves the removal of walls and the creation of holes. The latter can vary substantially in size, ranging from large holes down to holes for service lines or cable penetrations.

Using the different methods

The choice of method often depends on the available transport facilities for the equipment and the transport equipment that is available for removal of the demolished material. When demolishing with rig-mounted breakers care must be taken to prevent cracks forming in remaining structures.

In many cases the formation of dust on site may require control through water flushing and then it is imperative that the water is removed. When creating holes the contour edges will be jagged and uneven, which in turn necessitates secondary work.

Traditional rig-mounted breakers require considerable space. Brokk demolition machines can work in confined spaces and can be transported through areas of a building or demolition site that are cramped. They are also very environmentally friendly for the operator to use. Using Brokk means that operators are no longer subjected to the hazards involved in manual demolition.

Mechanisation of this type of work can make it more economically viable to repair and renovate old buildings rather than to simply demolish them totally and build new ones. The great risks sometimes involved in manual demolition due to unknown factors relating to the building and the construction materials, are reduced thanks to Brokk.

Cutting methods (sawing and core drilling) require water cooling and devices for removing used flushing water. Sawing entails cutting through the reinforcement bars so that the existing reinforcement cannot be re-used. Sawing offers low capacity but high precision. The risks of damage to existing structures are minimal and vibration is
slight. As the sawn surfaces will be even and cut with precision, the amount of secondary work required will be minimal.

Core drilling is used for smaller holes intended for cable penetrations etc. and for holes in conjunction with splitting.

The combination of core drilling/splitting is used for opening up larger diameters and where holes are predrilled along the contours of a structure prior to splitting. This is a relatively quiet method which does not impact negatively on the immediate environment. Care must be taken however, to ensure that the powerful forces transmitted from the splitting equipment do not damage neighbouring structures.

Splitting involves poor control of the size of the opening and results in rough surface edges, which in turn necessitates secondary work. When considering controlled blasting for partial demolition, licensed personell must be contacted. (For further information about this method, please see Chapter 4).

**Costs and capacities for partial demolition**

Guidelines have already been given relating to costs and capacities for the different methods presented. For partial demolition these values are further affected by other factors such as the number of holes to be opened, the size of the holes, the thickness of the structure, whether it’s a case of vertical or horizontal demolition, and last but not least the space available.

For those methods that require secondary work, this cost also should be taken into account and included in the final cost assessment. The cost of secondary work varies considerably, depending on the skill of the operator and whether the work is to be done horizontally or vertically. This cost after sawing is, however, negligible.
Demolition with Brokk

Below is a list of the current Brokk models and the type of demolition work they are generally used for.

Method and machine selection can vary from case to case depending on machine availability, operator skills and the requirements/regulations that apply to each individual demolition assignment. Please make a special note of the following points:

- the thickness of the material
- the hardness of the material (e.g. special reinforced concrete)
- the total volume of the demolition
- the bearing capacity of the surface (floor structure etc.)
- the possibility of transporting the machine at the demolition site (capacity of lifts etc.)
- requirements regarding removal, environmental source-sorting and recycling of materials

<table>
<thead>
<tr>
<th>Model</th>
<th>Characteristics</th>
<th>General</th>
<th>Materials</th>
<th>Special areas of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brokk 40</td>
<td>Small and handy. Can pass through narrow openings easily. Ideal for sensitive surfaces</td>
<td>For small scale work indoors instead of using hand-held equipment. Ideal for use in confined spaces.</td>
<td>Concrete, tiles, clinker</td>
<td>Flats, bathrooms, thin walls and floors, (max.200mm), balconies (from scaffolding), changing piped, roof and chimney work, demolition of stairs, minor digging, in connection with sensitive bridge work, variety of service work</td>
</tr>
<tr>
<td>Brokk 110</td>
<td>Compact machine, light in relation to its capacity</td>
<td>For general demolition work</td>
<td>Concrete, brickwork</td>
<td>For general demolition on normal floor structures, pile driving, demolition of piping, lightwells, staircases, cement roofs</td>
</tr>
<tr>
<td>Brokk 150</td>
<td>Compact machine with a slightly higher capacity than the Brokk 110.</td>
<td>For general demolition work that is somewhat heavier.</td>
<td>Concrete, brickwork</td>
<td>For complete demolition or heavier demolition work, brick lining in ovens, demolition at industrial buildings, bridges and multi-storey car parks</td>
</tr>
<tr>
<td>Brokk 250</td>
<td>Compact machine with reach and capacity</td>
<td>Heavier demolition work</td>
<td>Concrete etc.</td>
<td>Foundations, beams, pillars, walls, floor structures up to 500mm thick, demolition of cellars, digging, renovating tunnels, where the actual work may require the capacity of a Brokk 330 but the floor is too sensitive for it (e.g. marble floors)</td>
</tr>
<tr>
<td>Brokk 330</td>
<td>Compact machine with extra reach and power for the heaviest of demolition assignments</td>
<td>Heavy demolition</td>
<td>Concrete etc.</td>
<td>Heavy structures, heavily reinforced objects (e.g. bank vaults), demolition of balconies, demolition of beams, scaling, demolition of shafts</td>
</tr>
</tbody>
</table>
Compact capacity

External dimensions

As has been previously stated, Brokk is a demolition machine with great capacity. Its capacity should be seen in direct relation to the smallness of its dimensions and the lightness of its weight. The advantage of its smallness becomes particularly apparent when the demolition area is cramped and confined.

For example, the Brokk 40 can pass through openings as narrow as 60 cm. Its low height can be useful when demolition areas are restricted vertically.

Remote control

Remote control of Brokk machines via cable/radio is one of the advantages that are the main features of the Brokk concept. Remote control of the machines impacts extremely positively on the work environment (please see section on environment). Conversely, it is possible for the operator to stand very close and have an excellent view of any work requiring great precision.

Creative demolition

No matter how strange it may sound, the demolition business is actually extremely creative. By investing in Brokk demolition machines each individual contractor gains great freedom of choice as regards demolition methods and innovative solutions for increasing efficiency and profitability. The machines can also be used with each other and with other demolition methods in a variety of combinations.

One example comes from balcony demolition. For work of this nature, a Brokk 40 that has been lifted by crane or is on a scaffolding can be extremely effective. Another alternative is to allow a Brokk 330, fitted with crusher, to make use of the full length of its reach to demolish balconies from its secure position on the ground below.
Transport/accessibility

Between work sites

Due to its light weight, Brokk can be transported between work sites easily. A Brokk 40 can be transported in a normal trailer. The larger models are transported either on trailer, by lorry or using a hired vehicle (e.g. a carrier). The machines are loaded onto these by means of ramps and are simply driven on. Other alternatives are to lift the machines using a truck or something similar.

At the work site

Usually Brokk machines are transported within the work site "under their own steam". Please ensure that the electricity supply has sufficient amperage (depending on the model) and that the electric cables are long enough.

Staircases

Brokk 40, the smallest model, can be moved in normal staircases. Depending on the staircase design (length, steepness and material) blocks can be laid out and the larger Brokk models can be maneuvered up or down them.

Lifts

Brokk 40 can be transported in an ordinary lift (provided that the prescribed weight restrictions are complied with). Larger models require a hoist with sufficient capacity.

Cranes

Cranes can naturally be used to lift machines at the actual work site itself. Certain demolition tasks can be performed by simply lifting the Brokk with a crane and carrying out the work with it suspended.
Costs for demolition with Brokk

The following table provides a rough indication of the cost ratio incurred when using Brokk for demolition. The cost is linked to the respective model and the capacity of each machine.

The larger the model, the higher the cost per hour worked.

<table>
<thead>
<tr>
<th>Model</th>
<th>Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brokk 40</td>
<td>1,9</td>
</tr>
<tr>
<td>Brokk 110</td>
<td>1,8</td>
</tr>
<tr>
<td>Brokk 150</td>
<td>1,7</td>
</tr>
<tr>
<td>Brokk 250</td>
<td>1,6</td>
</tr>
<tr>
<td>Brokk 330</td>
<td>1,5</td>
</tr>
</tbody>
</table>

The hourly cost for Brokk 330 is ca 70 percent above the hourly cost for Brokk 40. If the hourly cost for Brokk 40 (including operator) is 500 SEK then the cost for Brokk 330 is 850 SEK.

As far as tenders are concerned, estimating the scope of an assignment and the number of working hours required plays a vital role in deciding a total price.

Operator expertise

The operator’s experience and expertise is absolutely crucial as regards capacity and efficiency. An experienced skilful operator can demolish twice as much as one that is inexperienced. Know-how and previous experience gained from similar demolition projects are needed to handle these machines. Brokk AB and various associates offer continuous operator training.

Tools

Brokk is usually fitted with a chipping breaker which makes it an effective and all-round demolition machine.

Today there are several other ways of utilizing the total capacity of the Brokk machine. Use of the attachments increases the range of application for Brokk and creates more opportunities for profitable working methods. In the case of large scale demolition work for which a particular attachment is ideal, the investment involved can sometimes pay for itself after just one single assignment.

The design makes it possible to quickly change between different attachments. Below is a description of the various attachments that can be used. This area is developing very rapidly indeed and new tools are being developed all the time.

Breakers

Hydraulic breakers from all leading suppliers can be attached to Brokk.

 Crushers

Crushers have become an exciting alternative to chipping breakers especially in places where "silent demolition" is required e.g. built-up areas or reconstruction-demolitions where regular daily activities are in progress at the same time as the demolition. There are several examples of this e.g. the reconstruction of department stores and indoor shopping malls where, as far as noise is concerned, crushers make it possible to carry out demolition work for longer periods per day.

Capacity-wise the use of crushers results in a somewhat reduced volume of demolition (compared with chipping breakers). However, if cir-
cumstances are as described above, their use results in a higher daily volume of demolition.

Crushers crush the demolition material by means of hydraulic pressure. What is of crucial importance as regards the use of crushers is the hardness of the material, the speed of the crushers and the thickness of the material (which must not exceed the cutting width of the crushers). Reinforcement bars can be cut using a special pinch-function integrated in the crushers (does not apply to Brokk CC260).

**Grapples**

Grapples are used in special circumstances where it is necessary to grab hold of materials such as cable racks, ventilation drums, pipes etc. to tear, pull or lift them.

**Buckets**

Brokk can be fitted with a bucket to enhance flexibility and extend its range of use. This is ideal when the space where the demolition is to be carried out is confined. Brokk also facilitates the removal of materials because, thanks to its compact size, it can be used for this purpose too.

There are also times when Brokk is used solely for digging, e.g. when restrictions require only electrically powered machines.
Scabblers
Scabblers are used when a surface layer needs removing e.g. in renovation work when the body or frame of the object is intact but the area of wear is damaged. There are different scabblers models for different kinds of use, depending on the material that is to be removed.

Brokk and the environment
The environmental aspects of demolition work are coming under the spotlight to an ever increasing degree. Brokk AB work continuously on these issues in a serious manner. This applies not only to the production at Brokk AB but also to how the whole concept of demolition machines impacts on the environment at the general and individual level.

Work environment, operator
The general ergonomic work situation of the individual operator has become the focus of interest. When hand-held tools are used there is a great risk of repetitive strain injuries occurring due to the vibration e.g. so-called "white fingers". The operator is also exposed to a range of dangers when carrying out demolition work at the site: sudden collapses, falling rubble etc. To these can be added the risks of dust and exhaust fumes.

Using the remote-controlled electrically powered Brokk eliminates these risks or reduces them significantly. This means that the drawbacks of working with hand-held tools do not apply to Brokk.

Work environment, general
It is in this area that special attention can be focused on the fact that Brokk is electrically powered. This means the elimination of exhaust fumes - a demand that is being made by an increasing number of clients both in industry and in the demolition business. A further advantage is that Brokk produces a very low level of noise.

Sorting at source, recycling
Sorting at source for the purpose of recycling building materials is to an ever increasing degree becoming part of the demolition contractor’s assignment. Experience gained from carrying out demolitions with Brokk has been very positive indeed in this respect. In particular as regards work where concrete crushers are used, since the material can be separated and cut into suitably sized lumps for quick efficient sorting.

Concrete crushers can also be used for pulling window and door frames loose so as to separate material of this kind from e.g. concrete.
For further information, please call us at +46 910 711 800