

# US&R Heavy Equipment & Rigging Specialist Training

## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

May08

National Urban Search & Rescue Response System  
Heavy Equipment & Rigging Specialist Training



### Heavy Equipment & Rigging Specialist Training



**Module 3 Unit 3:  
Demolition Equip  
and Methods +  
Helicopter Ops**

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### Unit Objective

**You will be able to explain how demolition contractors and their equipment may be effectively used during US&R operations**

**Also, you should understand the advantages and disadvantages of using Helicopters in US&R**

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### Enabling Objectives

- Define tasks that demolition contractors perform
- Identify demolition equipment types and attributes useful during US&R operations
- Identify range and uses of attachments
- Identify usefulness of cranes and explosives
- Discuss reasoning behind use of demolition equipment during US&R operations
- Discuss the use of Helicopters in US&R

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# US&R Heavy Equipment & Rigging Specialist Training

## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

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### Basic Demolition Tasks

- Break structure with care not to damage adjacent structures
- Crush material and separate in special, safe area
- Load and haul off

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### Basic US&R Tasks

- Break structure with care so as not to harm victims
- Move material
  - To access victim
  - Only as far as necessary
- Load and haul off
  - Only if necessary
  - Explosion crime detection

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### Demolition Equipment

- Rated in metric tons (2,200 lb)
- Has relatively short life
  - Rarely find 10-year old excavator
  - Contrast to 30- to 50-year old cranes
- New equipment
  - Precise and computer-controlled
  - Comfortable cab with joysticks
  - Robots, mini-excavators

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## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

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### Demolition Equipment (continued)

- Need to trailer to site
  - Need space to unload and store
- Maximum size excavator on one trailer is 30 tons
  - Many are available up to 30 tons
  - Move around site at 3 mph

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### Demolition Equipment & Methods

- Loaders: wheel and track
- Excavators: mini to 200 tons
  - Robots: recent addition
- Cranes: ball and cutters
- Explosives: mini to full building

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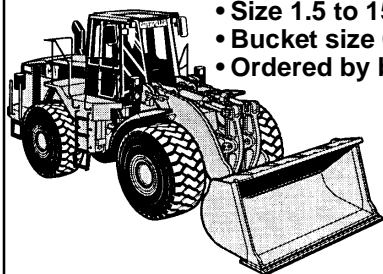
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### Wheel Loaders



- Size 1.5 to 150 tons
- Bucket size 0.2 to 40 cy
- Ordered by bucket size in cy

Skid steer and backhoe are variations

- Can travel on site up to 25 mph
- Can attach to bucket for emergency lifting

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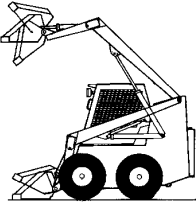
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**Skid Steer Loaders**

- Size 1.5 to 3 tons
- Bucket size 0.2 to .75 cy
- 4-ft wide and up



- Can be placed inside building
- Need relatively level surface
- Can be fit with attachments
- Have been very useful in US&R

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**Skid Steer Loader at OKC**



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**Skid Steer Loader at OKC**



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**Skid Steer Loader at OKC**



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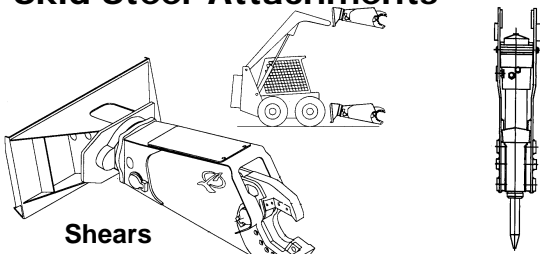
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**Skid Steer Attachments**



**Shears**  
Can only work directly in front of unit—shear rotates

**Hydraulic breakers**

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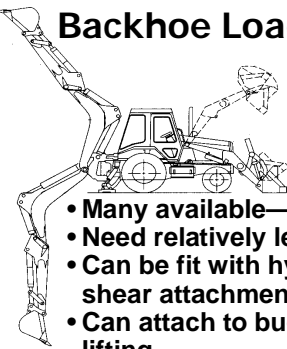
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**Backhoe Loader/Excavator**



- Size: 3 to 8 tons
- Bucket size: 1 to 1.5cy
- Width: 6 to 8 ft
- Many available—many operators
- Need relatively level surface
- Can be fit with hydraulic breaker or shear attachments
- Can attach to bucket for emergency lifting

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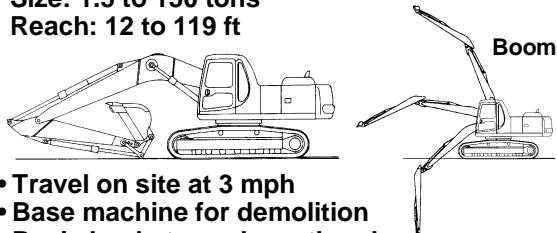
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## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops May08

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**Excavators**  
Size: 1.5 to 150 tons  
Reach: 12 to 119 ft



- Travel on site at 3 mph
- Base machine for demolition
- Basic bucket may have thumb
- Fit with many types attachments
- Have been used in US&R for Lifting

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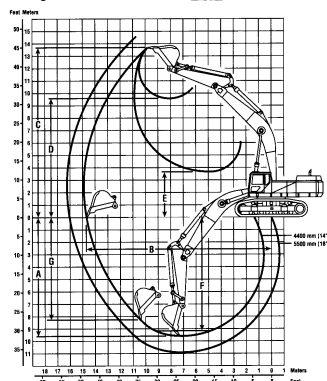
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**Excavator range diagram**

Also have load capacity charts



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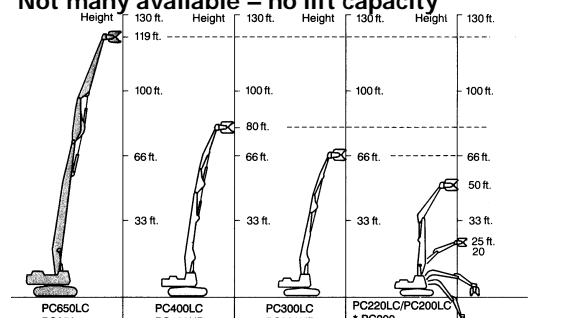
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**Long-Reach Excavators**  
Not many available – no lift capacity



Model	Height (ft)	Reach (ft)
PC650LC / PC650	119	130
PC400LC / PC400HD	80	130
PC300LC / PC300HD	66	130
PC220LC / PC200LC * PC200	50	130

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### CAT 345 Long Reach

- See Addendum Demo 1 at end of unit
  - Shows that max tool weight is 3,000 lb with 70-foot long front
  - Lift capacity with normal stick varies from 30,000 lb to about 10,000 lb
    - ◆ Based on 10- to 30-foot reach

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### Excavator Attachments

- Designed to efficiently do specific tasks
- Need skilled operator
- May be changed rapidly with quick change couplers
- Are very expensive

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### Excavator Attachments (continued)

- Basic bucket with thumb
- Hydraulic breaker (ramhoe)
  - Sized for 1.5 tons to very large
- Shear: concrete, steel, wood
- Crusher/smasher
- Grapple
- Universal processor

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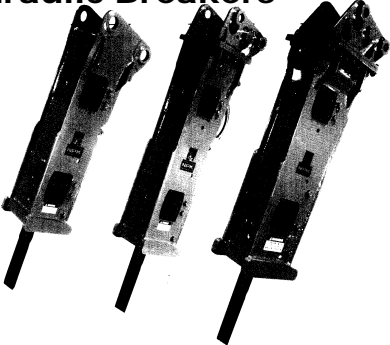
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### Hydraulic Breakers



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### Excavator with Hydraulic Hammer at I-880 Collapse



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### Excavator with Hydraulic Hammer I-880 Collapse



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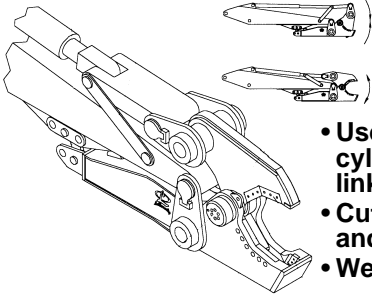


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**Bucket Linkage Shear**

- Uses excavator cylinder and linkage
- Cuts concrete and steel
- Weighs 3,000 lb

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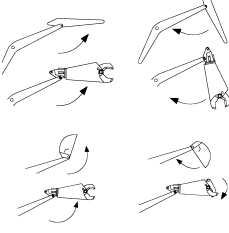
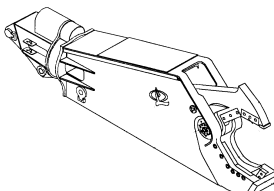
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**Mobile Shear**

- Rotates 360 degrees
- Replaces stick or bucket
- Weight is 500 to 58,000 lb
- For skid steer to largest excavator

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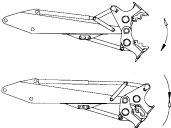
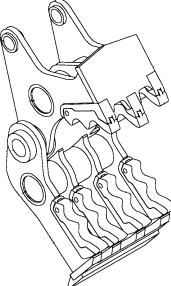
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**Concrete Crusher**

- Uses excavator hydraulics
- Replaceable teeth
- For 10-ton and larger excavators

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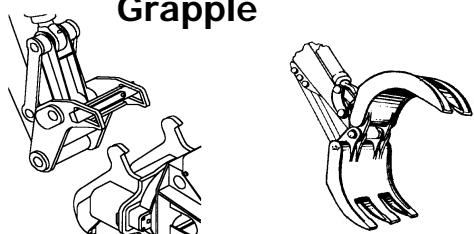
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### Grapple



- Uses excavator hydraulics
- For 10-ton and larger excavators
- Optional quick coupling system

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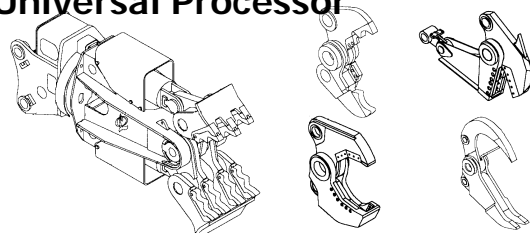
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### Universal Processor



- Rotates 360 degrees
- Replaces stick or bucket
- Weight is 500 to 58,000 lb
- For skid steer to largest excavator

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### Mini-Excavators

- Weigh as little as 3,500 lb
  - Can operate inside buildings
- Minimum of 40 inches wide
- Full 360-degree swing
- Need relatively level surface
- Gas or diesel
- Attachments
  - Bucket
  - Hydraulic hammer
  - Shear and crusher

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CAT 301.5 Mini-Excavator



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CAT 301.5 Mini-Excavator



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CAT 301.5 Mini-Excavator



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### Robot Excavators

- **Brokk**
  - Weighs 800 to 9,000 lb
  - Powered by electric generator
  - Hammer, shear, and bucket
  - 400 available in U.S.
  - 24- to 60-inches wide
- **Caterpillar mini-excavator**
  - In development

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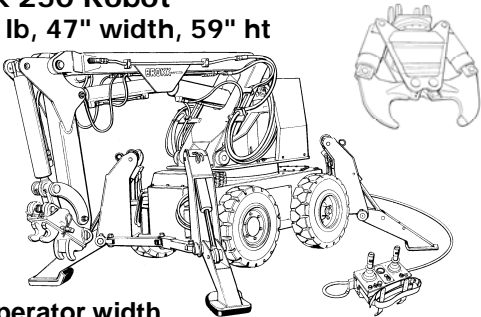
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### Brokk 250 Robot

6,750 lb, 47" width, 59" ht



97" operator width

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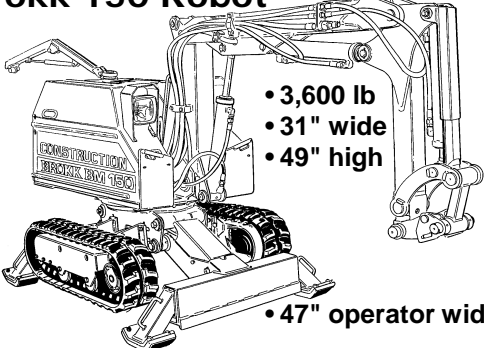
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### Brokk 150 Robot



- 3,600 lb
- 31" wide
- 49" high

• 47" operator width

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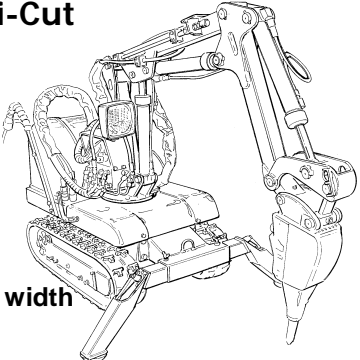
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**Brokk Mini-Cut**



- 794 lb
- 24" wide
- 37" high
- 41" operator width

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**Cranes Used in Demolition**

- Wrecking ball
  - Not so good any more
  - Noise & safety considerations
- Clamshell bucket
  - Used in NYC to remove URM wall hazards
- Hand cut and drop or lift off
  - Used extensively in OKC
- Suspended shear
  - Used to demolish tall steel frame in conjunction with small excavators placed in structure

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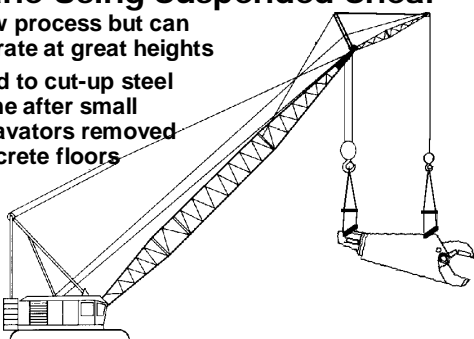
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**Crane Using Suspended Shear**

Slow process but can operate at great heights

Used to cut-up steel frame after small excavators removed concrete floors



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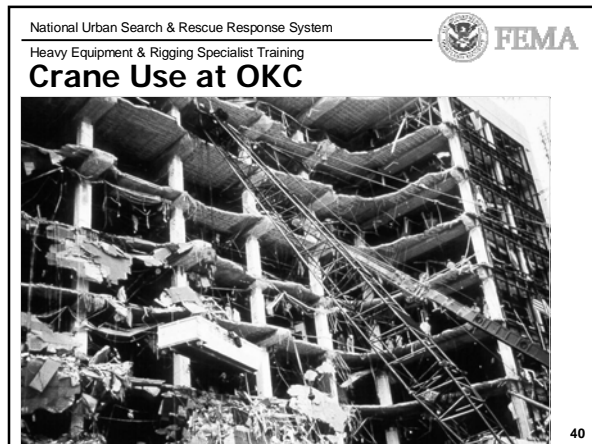
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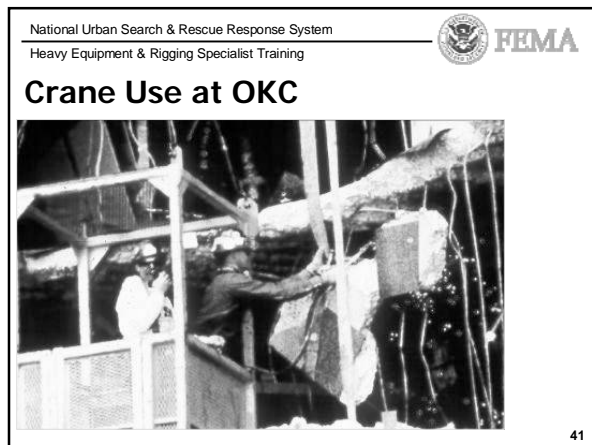
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**Crane Use at OKC**

Sometimes required complicated rigging



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**Explosives Used in Demolition**

- Entire buildings have been demolished by controlled explosions
  - Minimum use of explosives and maximum use of gravity
  - Not useful to US&R

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**Explosives Used in Demolition**  
(continued)

- Mini-blasting used to carefully remove damaged concrete
  - Rebar may remain and be reused
  - Small charges in bore holes
  - Section to be blasted covered with blanket to restrain fragments and dust
  - Time consuming, but said to be faster than pneumatic hammer

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### Equipment Choices for US&R

- Plan to use most available equipment
  - Excavators to 30 tons with 30- to 45-ft reach
  - Skid steers (inside structure)
  - Mini-excavators (inside also)
  - Backhoe (many available)
- Need operator experienced with equipment and attachments
  - Should give short trail problem
  - Should train task force HERS

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### Equipment Choices for US&R (continued)

- Specialty equipment may be available after 2- or 3-day delay
  - Long-reach excavators
    - ◆ Longest reach is on largest excavators
    - ◆ May need special trailer and permits
  - Robots (new on market)
    - ◆ Only 350 Brokk in U.S., adding 50 per year
    - ◆ Mini-excavator robot is very new

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### Excavator Use in US&R

- Mostly used in recovery mode
- Hazardous environment for rescue workers
- Most operators have no US&R experience
- Can rapidly move, crush, and/or cut concrete
- Can cut moderately sized steel sections
- Can move properly sized steel sections
- Excavators may work in concert with grapples or other demolition equipment

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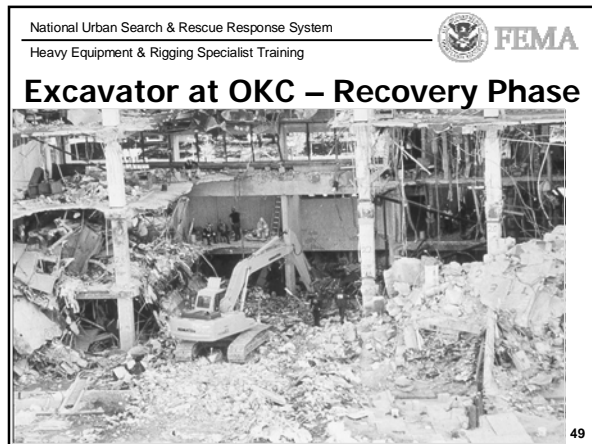
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# US&R Heavy Equipment & Rigging Specialist Training

## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

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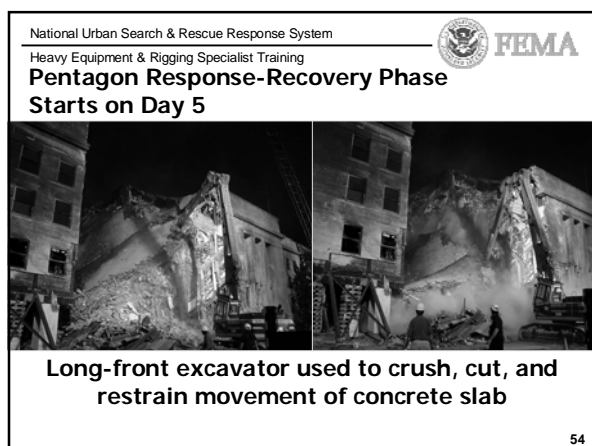
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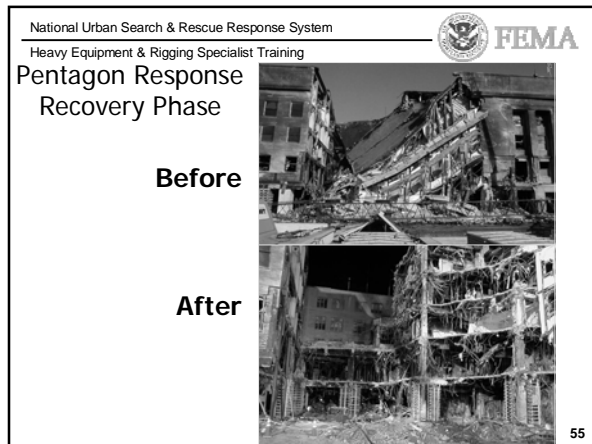
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# US&R Heavy Equipment & Rigging Specialist Training

## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

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# US&R Heavy Equipment & Rigging Specialist Training

## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

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### Summary – Demolition Equipment

- As with most US&R, KISS
- Plan to use most commonly available equipment
  - HERS should be trained to use and operate
    - ◆ Skid steer
    - ◆ Mini-excavator
    - ◆ Backhoe
- Plan simple test problem for demolition equipment operator
  - Long reach may be available—days

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### Mill Valley,CA - Feb06 Mudslide Recovery

- Victim buried by Mud-Slide
- Use of Clam Bucket with Crane
- Very difficult and tight Site
- Close interaction between Marin Co Rescue & Crane Operator

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### Mill Va. Crane Setup Very Tight Site



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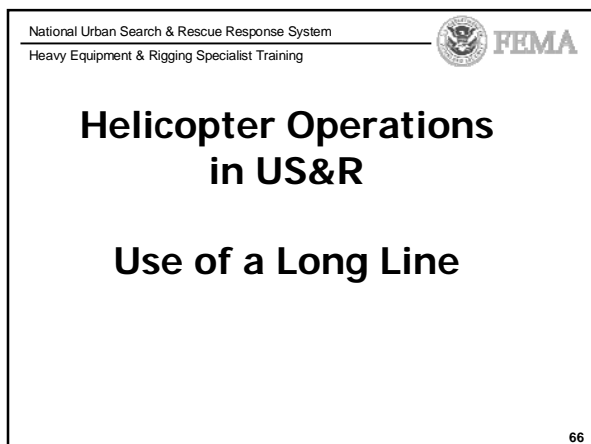
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### Basic Helicopter Operation

- Long-line with rescuer in harness
  - Deploy to secure/extricate a single victim
  - Deploy to rig/assist riggers in attaching to a load
- Long-line with hook
  - Pick capacity based on limits of the ship
    - ◆ Must allow for amount of fuel
      - May need fuel truck on site – to re-fuel
      - May need to dump fuel – to increase capacity

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### Rigging on a very long line

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### Basic Helicopter Operation

- Examples of Pick Capacity (Military Type, approx. values)
  - Rescue Type - 1,000lb
  - Huey Type - 4,000lb
  - Black Hawk - 8,000lb
  - Chinook - 19,500lb
  - Sikorski CH-53E - 24,000lb

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# US&R Heavy Equipment & Rigging Specialist Training

## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

May08

National Urban Search & Rescue Response System  
Heavy Equipment & Rigging Specialist Training



### Basic Helicopter Operation

#### More Examples of Pick Capacity (approx. values)

- Bell 206-L-4 - 2,000lb
- Bell UH-1B - 4,500lb
- Bell 214B-1 - 8,000lb
- Sky-Crane - 25,000lb (Air-Crane)

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### Sikorski 158AC



### Erickson Air Crane

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### Sikorski Fire Hawk - 1000 gal water



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# US&R Heavy Equipment & Rigging Specialist Training

## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

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**Sikorski CH-53E**



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**Bell Commercial Helicopter**



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**Basic Helicopter Operation**

- **Safety Issues**
  - Weather Conditions
  - Clearance Issues
  - Prop wash
  - Noise
  - Static Electricity
  - Ground Positioning

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National Urban Search & Rescue Response System  
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### Basic Helicopter Operation

- **Communications**
  - **Radio**
    - ◆ Direct Communication to Pilot from HERS
    - ◆ HERS Communication to Pilot's ground man
  - **Hand Signals**
    - ◆ Universal Crane Hand Signals
    - ◆ Hand Signals specific to Helicopters
      - Landing Target
      - Up
      - Down
      - Level Off
      - Direction

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National Urban Search & Rescue Response System  
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### Using Flag Signals



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National Urban Search & Rescue Response System  
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### Basic Helicopter Operation

- **Hoisting**
  - **Length of Long-line**
  - **Hook type**
    - ◆ Quick disconnect
    - ◆ Rigid
  - **Rigging**
  - **Buckets, Grapple, etc**

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# US&R Heavy Equipment & Rigging Specialist Training


## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

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### Receiving Rigging from Helicopter



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### Helicopters Delivering pipe



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### Helicopter Rigging



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# US&R Heavy Equipment & Rigging Specialist Training

## Module 3 Unit 3: Demolition Contractor Equip & Helicopter Ops

May08

National Urban Search & Rescue Response System  
Heavy Equipment & Rigging Specialist Training



### Summary – Helicopter Operations

- **Very Special Tool**
  - Need special safety and operating procedures
    - ◆ Special signaling
    - ◆ Special Rigging
  - Can provide lift capacity to otherwise inaccessible areas
    - ◆ Everglades
    - ◆ Bay Area Wetlands
- **HERS needs to know when and where to suggest use of this tool**

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National Urban Search & Rescue Response System  
Heavy Equipment & Rigging Specialist Training



### Evaluation

**Please complete the evaluation form for  
Module 3 Unit 3: Demolition Equipment  
and Methods + Helicopter Operations**

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## STUDENT MANUAL

### HEAVY EQUIPMENT AND ADVANCED RIGGING COURSE

#### MODULE 3

#### UNIT 3: DEMOLITION CONTRACTOR'S EQUIPMENT & METHODS PLUS HELICOPTER OPERATIONS

##### Unit Objective

Upon completion of this unit, you will be able to explain how demolition contractors and their equipment may be effectively used during US&R operations.

##### Enabling Objectives

You will:

- Define what tasks demolition contractors perform,
- Identify demolition equipment types and attributes that are useful during US&R operations,
- Identify the range and uses of attachments,
- Identify the usefulness of cranes and explosives, and
- Discuss the reasoning behind the use of demolition equipment during US&R operations.
- Discuss the use of Helicopters as a special tool for US&R Operations

##### Acknowledgement

National Association of Demolition Contractors





### I. Overview

In this section, we will discuss how demolition contractors and their equipment can be used to aid US&R operations with some of the tasks that operations need to perform.

The **basic tasks** normally performed during structure demolition are as follows.

- **Break the structure** under some sort of restrictions so that adjacent structures and people will not be adversely affected.
  - ◆ In remote or restricted locations, where the public and adjacent structures are a sufficient distance from the demolition site, the major safety focus is on protecting the demolition workers, while efficiently breaking the structure.
  - ◆ In congested urban settings, detailed plans must be developed and followed in order to protect the public and adjacent structures.
- **Crush and separate** the material during and after the breaking process.
  - ◆ Most of the structural materials are crushed and separated for recycling.
- **Loading and hauling off** debris complete the demolition process.
  - ◆ Many demolition sites remain very tidy because some of the material may be completely processed in as little as one day.

In comparison, **the basic US&R tasks** that are performed in the process of reaching a confined victim are as follows.

- **Carefully break the structure** without harming victims and without creating any new victims.
- **Move material** only as required to access a victim and all adjacent victims.
  - ◆ Material needs to be moved both quickly and carefully since careful moving alone may not be sufficient to rescue an injured victim.
- **Loading and hauling off** debris may or may not be necessary to US&R.
  - ◆ In incidents with few victims, the building material may remain on site until after the rescue phase of US&R has been completed. In this case, the material will be removed when the structure is finally demolished.
  - ◆ In incidents with many victims and/or that are also crime scenes, the careful loading and hauling off of material may be required.



## **II. Demolition Equipment Types and Attributes**

### **General Information**

Demolition equipment is usually rated in metric tons (2,200 lb), which represents the approximate operating weight of the vehicle.

These mostly tracked vehicles are built to withstand heavy use in the demolition environment.

- It is therefore common to find relatively new equipment being used on the typical demolition site.
- In contrast, many cranes up to 50 years in age may still be productively being used to lift all sorts of material and perform other construction tasks.

Older equipment is being discarded as newer, more efficient vehicles are developed.

- Modern equipment has computer-aided controls that are housed in very comfortable cabs.
- Joystick controls allow efficient and careful positioning of very powerful tools.
- Robotic tools have been introduced within the past few years that further reduce the stresses on operators due to vibration and proximity to the possibility of inadvertent falling objects.

Most demolition vehicles need to be brought by trailer to the job site.

- Therefore, space needs to be provided for unloading and storage.
- The maximum vehicle weight that can normally be carried on one trailer is 30 tons.
  - ◆ Larger vehicles can travel to a specific site but probably require special trailering, permits, and sufficient time.
- Tracked vehicles, such as excavators and track loaders, can move around the site at about 3 mph.

Demolition vehicles are rated to carry specific loads. Either a load capacity chart or a maximum load capacity should be provided.

### **Wheel Loaders**

These very common vehicles are used for loading all types of materials. They are available in sizes from 1.5 tons to over 150 tons. Their front-loading buckets may be as small as 0.2 cubic yards to as large as 40 cubic yards. The maximum load to be carried is normally specified. They may be brought by trailer to the site but can travel at 25 mph on roads. Some may have 4-wheel steering. They are very useful at loading material but need enough room to maneuver their buckets into the load.

- They cannot rotate like an excavator.
- They may be fit with attachments, but are mostly used with a toothed bucket.





The smaller loaders (1.5 to 3 tons) are called *skid steers* (also known as Bobcats, a common brand name).

- These very useful vehicles may be placed inside structures on relatively lightly designed office building or parking structure floors.
- They may also travel on roads, just as can other loaders.
- Their front-end buckets may be replaced by shear or hydraulic hammers, as well as other attachments.
- The bucket may be made more useful by adding forks or a thumb.
- Bobcats were very helpful in removing concrete and other debris from the first and second floors of the Murrah Building, Oklahoma City, after the bombing incident.
  - ◆ They traveled across the adjacent parking structure floors to access the debris without any damage to the parking structure.
  - ◆ They were used to pull out large pieces of concrete as well as to move debris to an exterior dumpster where they were loaded using a larger loader.

Backhoes are similar to wheel loaders and are very common vehicles.

- They have the configuration of a loader in front and a small excavator in the rear.
  - ◆ The excavator boom plus stick in the rear may be able to pivot through a limited horizontal angle.
- They weigh from 3 to 8 tons, with front bucket sizes from 1 to 1.5 cubic yards and width from 6 to 8 feet.
- There are many backhoes and operators available. Many public works departments have backhoes.
- Backhoes can be fit with hydraulic breaker and shear attachments in place of their rear excavator buckets.
- Some also have extendable sticks on the excavator booms.

### **Excavators**

These tracked vehicles are the mainstays of most modern demolition operations. They were developed in the 1960s and first appeared in the current hydraulic version in the late 1960s. They replaced the old steam shovel and have developed into extremely powerful tools that may be precisely controlled using computer- controlled hydraulics. The arm action is similar to that of the human arm and is usually configured as a boom that supports the stick, which in turn is connected to a bucket that faces the operator. The cab and arm pivot 360 degrees on the track base like a crane to allow the operator to work in any direction. The size of excavators varies from the 1.5-ton mini to giants that weigh over 150 tons.

- The 30-ton excavator with 45-foot maximum reach that can be quickly trailered to a site is commonly available.



Excavators are supplied with load capacity charts and range diagrams, similar to cranes.

- Load charts are applicable throughout the full 360-degree range of operation.
- The assumptions of relatively level base, supported by firm soil or pavement, apply to excavators as they do for cranes.
- The bearing pressures exerted by the front edge of the tracks under maximum load can be similar to those imposed by crawler cranes; therefore, similar precautions need to be taken.

They can reach from 12 to 119 feet; however, the long-reach type (with a reach over 45 feet) are not readily available.

- The long-reach types are usually equipped with a 3-piece arm instead of the normal 2-piece boom and stick.
- At full reach, these machines have no lift capacity but are capable only of supporting an attachment that may weigh in the range of 5,000 lb.
- See Addendum Demo1 at the end of this unit for data and a load chart for a 70-foot long front excavator.

Excavators have relatively small motors (30-ton powered by 168 hp computer-controlled diesel engine) and travel on the site at only 3 mph.

### **Excavator Attachments**

The basic tool placed at the end of the stick is a toothed bucket that may have a thumb.

- Both thumb and bucket operate vertically and are controlled hydraulically.
- An experienced operator can place and grasp with the bucket/thumb with great precision (much like the operation of the human hand).
- Thumbs on other types of equipment are usually stationary.

Other types of attachments are the basic bucket with thumb; the hydraulic breaker (ramhoe), sized for 1.5 tons to very large; the shear for concrete, steel, and wood; the crusher/smasher; the grapple; and the universal processor.

- All are designed to efficiently perform a specific task but require operators who are experienced with both the attachment and the task at hand.
- Attachments may be changed rapidly using quick-change couplers.
- Most attachments have replaceable teeth.

**Hydraulic breakers** (hammers) are available for any size excavator or most any other piece of demolition equipment.

- They range in weight from 150 to 17,000 pounds.
- They have shock-absorbing mounts.



- They eliminate the need for direct human contact with the debilitating vibrations produced by hand-operated jackhammers.

**Shears** are available to cut concrete, structural steel, and wood members.

A **bucket linkage shear** can be placed on medium-sized excavators (20 to 45 tons) by removing the bucket and attaching the shear to the existing hydraulic cylinder and linkage.

- This type of shear weighs about 3,000 pounds and is relatively inexpensive but cannot be easily changed.
- This shear has jaws that pivot about its horizontal pin and can only cut a horizontal object.
- They can be connected using quick couplers for rapid exchange with other compatible attachments.

**Hydraulic mobile shears** are available for any sized excavator or most any other piece of demolition equipment.

- They can cut structural steel shapes and plates, concrete, and rebar, as well as brick or concrete block.
- Rotating mobile shears feature a 360-degree, continuous rotation turntable.
- They weigh from 500 to 58,000 pounds.
- They can be placed at the end of the excavator's stick or for faster operation at the end of the boom.

**Hydraulic concrete pulverizer/crushers** are used on excavators that weigh 10 tons or more.

- They use existing hydraulics and linkage; therefore, they cannot rotate.
- Their principal task is to crush concrete and separate it into concrete fragments and rebar.
- They weigh from 1,500 to 9,000 pounds and have a jaw opening as large as 54 inches.

**Grapples** are attached to excavators so that they can efficiently load crushed material into trucks.

- They are available in two different configurations.
  - ◆ One configuration uses existing bucket linkage and hydraulics but has the limitation of not being able to rotate. It may have quick coupling capability.
  - ◆ The other connects to the end of the stick and has bi-directional rotation of 360 degrees.
- Full-size grapples weigh from 1,500 to 7,700 pounds and can be used in excavators that weigh between 11 and 80 tons. (Smaller grapples are made to be used on backhoes.)
- Full-size grapples have openings as large as 12 feet.



**Universal processors** are versatile tools that have up to six different types of jaws.

- Most of the jaw types can be quickly changed.
- The tool can rotate through 360 degrees for maximum utility.
- They weigh from 525 to 18,000 pounds and can be used on excavators in the mini-class.
  - ♦ They can also be attached to skid steers.
- They can be used at the end of three-member arms that are found on long-reach excavators.
- They can chew up most any structural material and are usually compatible with quick coupling systems.

In summary, many useful attachments are available that can be used to carefully cut and crush most any material at the US&R collapsed structure site.

- Whether they can be used effectively to aid in more rapidly uncovering the victims without harm to them or to rescuers will depend on the appropriateness of the situation and the skill of the operator.
- These tools have been developed for and effectively used in demolition work and may aid US&R when large amounts of heavy debris need to be more quickly removed to save injured victims.
- As with most US&R situations, the risk/reward ratio will need to be considered in light of all the circumstances.

### **Mini-Excavators**

Mini-excavators are a recent innovation in the demolition industry. They are compact, lightweight, and can be used inside structures to aid in the structure breaking function.

They are similar in size to skid steers.

- They have the advantage of being able to pivot a full 360 degrees about their bases.
- However, they cannot move as fast as skid steers (3 mph versus 25 mph).
- They have rubber treads for better traction in tight spaces.

A wide variety of attachments is available for mini-excavators.

Because of low cost and small size, they are becoming a commonly available demolition vehicle.



### **Robot Excavators**

Brokk, a Swedish manufacturer, has pioneered (1980) in the development of robot excavators. They are being sold in limited numbers (50 per year, with 400 total at the end of 1999) in the U.S.

- There are five different sizes, varying in weight from 800 to 9,000 pounds.
- They can fit through relatively small passageways as narrow as 24 inches and as short as 37 inches.
- The most commonly sold model in the U.S. is the 150, which weighs 3,600 pounds and will pass through a 31-inch opening
- They are powered by electricity and therefore require an accompanying generator (460 volts) and electric cord.
- They have computer-controlled hydraulics that are activated using a remote console.
- The operator, therefore, may position himself or herself at an adjacent remote location, away from vibration, some dust, and the danger of inadvertent falling objects.

The Caterpillar Company is developing a robot version of its mini-excavators.

### **III. Cranes Used in Demolition**

Cranes have been used in demolition since they have been available. They have served as launchers and swingers of the wrecking ball.

- This method is still used to demolish buildings over four stories.
- It is noisy and messy, but a properly applied 5,000-pound cast iron ball can produce dramatic results.
- The crane operator must be skilled, and the site must be cleared of personnel in order to produce a safe and efficient result.
- **This method has no application during US&R operations.**

Cranes have been used at US&R incidents to carefully remove debris.

- Clamshell buckets were deployed at an incident in New York City at which URM walls were left standing for eight stories after the building's floors had pancaked.
- The clamshell was carefully used to chew off sections of the remaining masonry in order to reduce the height of a laterally unsupported wall.

The hand cut and drop (into a suspended dumpster) was used at the Oklahoma City bombing incident to remove many concrete slabs that were left hanging from the remaining building face.

- In addition, larger slabs were rigged, and then a coordinated process of cutting and lifting was employed to remove them by a crane.



At some sites in tall buildings in congested urban areas, cranes have been used to suspend large hydraulic shears that were used to cut the structure.

- In the case of a steel frame building, the floors were carefully demolished using small hydraulic hammers mounted on mini-excavators, but the steel beams were cut and removed using a crane suspended shear.

#### **IV. Explosives used in Demolition**

Controlled demolition of large structures is a spectacular method that has been used for about 50 years.

- This technique requires a great deal of planning and experience.
- The intent is to use a relatively small amount (100 to 200 lb) of explosives (usually dynamite) to completely collapse a structure.
- Columns or walls in the lower stories are cut and drilled to receive and confine the explosives.
- The plan is to use the explosives to weaken the structure in strategic locations in order to allow gravity to complete the collapse.
- The charges are usually set to explode in a timed sequence so that the structure will collapse inward on itself.
  - ♦ In some cases, the perimeter parts of the structure are cabled inward to assure their behavior.
- **This method of demolition has been used after many US&R incidents when the sites had been cleared of victims.**

Mini-blasting is used to carefully remove damaged concrete without damaging the adjacent structure.

- It has been used to remove concrete from damaged members (beams, slabs, and columns) while not damaging their reinforcing steel cages in buildings in which the members were then reconstructed with new concrete being placed around the existing reinforcing steel.
- The method requires that many small holes be drilled and filled with appropriate explosives.
- The members are then covered with special blankets to restrain fragments and dust.
- This method was considered for controlled removal of a large hanging concrete slab during the Oklahoma City bombing incident but was not done because of time restraints.



### **V. Demolition Equipment Choices for US&R**

Since we need to save victims in a very short time period, we must plan to use the most readily available equipment.

Long-reach excavators that can chew dangerous, hanging concrete slabs that menace rescue workers would be nice to have when needed, but they are not likely to be available within 12 hours.

If demolition equipment is to be considered for use on the US&R site, the most likely equipment will be long-reach excavators and robots.

- One may inquire about availability of the more specialized equipment, but we should be prepared to make the best use of the most common items.
- Large, long-reach excavators may require several days to obtain, and robots are not readily available at this time.

Since the successful removal of a critical concrete section or other material using demolition equipment is highly dependent on the equipment operator, the arriving operator should first be given a similar task to perform to demonstrate his or her skill level.

- For crane operators, the task of retrieving the thrown end of the measuring tape (used to verify the load's radius) has been used in past incidents to test the operator's skill.
- A similar test should be used for excavator operators when they arrive at the disaster site.

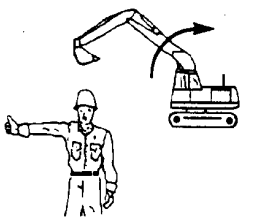
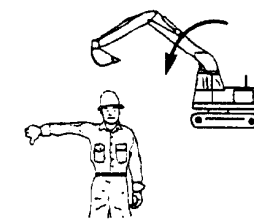
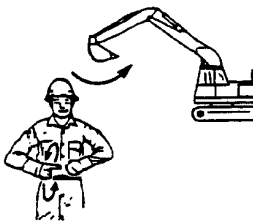
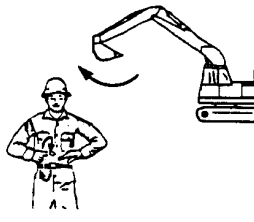
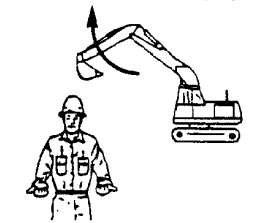
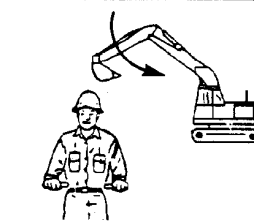
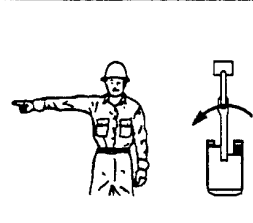
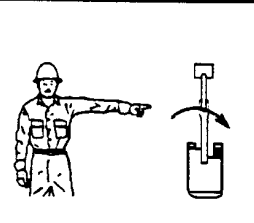
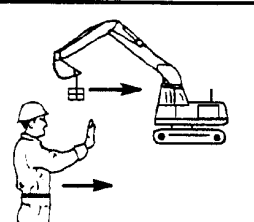
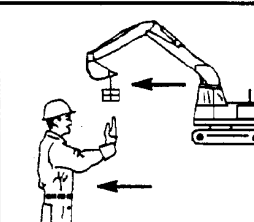
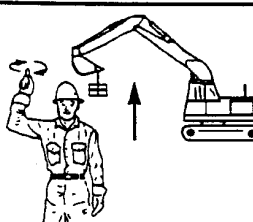
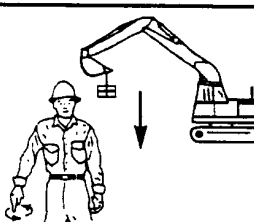


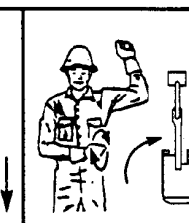
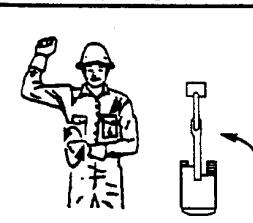
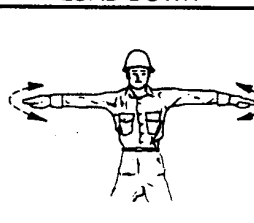


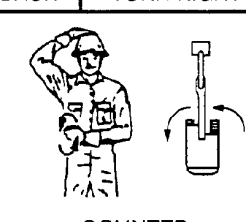
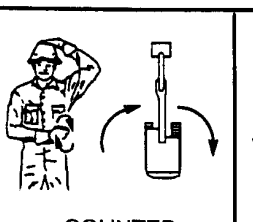


Demolition contractors and their equipment can be used successfully to reduce the time required to safely access victims.

- In order for this to happen, US&R personnel and the contractors must learn each other's needs and capabilities.
- They must then agree to develop a plan as to how the work will proceed.
- There must be well-defined communication channels maintained throughout the operation.
  - ♦ Use compatible radio frequencies.
  - ♦ Use proper hand signals.
- This understanding is essential to the successful completion of the US&R task.

**Note: A chart of hand signals for excavator operations is provided on the following page.**



## HAND SIGNALS for EXCAVATOR OPERATIONS

 BOOM UP	 BOOM DOWN	 BUCKET IN	 BUCKET OUT
 ARM OUT	 ARM IN	 SWING LEFT	 SWING RIGHT
 LOAD IN	 LOAD OUT	 LOAD UP	 LOAD DOWN
 TRAVEL AHEAD	 TRAVEL BACK	 TURN RIGHT	 TURN LEFT
 EMERGENCY STOP			
 SLOW ANY FUNCTION	 THIS FAR	 COUNTER ROTATE LEFT	 COUNTER ROTATE RIGHT
 STOP		 STOP ENGINE	





## VI. The USE of Helicopters in US&R

### Basic Helicopter Use in US&R

A helicopter provides US&R Operations with a long line for lowering and lifting objects as well as rescuers in locations that are inaccessible by normal wheeled and/or tracked vehicles.

- The line can be used to lower a rescuer to secure and/or extricate a victim or victims.
- The line can be used to lower a rescuer to assist in rigging a load
- The line can be used to lower a hook that can be rigged with a load

The capacity of a Helicopter is limited by

- Design of the ship
- Numbers and weight of the crew
- Amount of on-board fuel
  - ◆ Operation may require to have a fuel truck on-site in order to be able to increase capacity by dumping fuel (and then re-fueling)

The net lifting capacity of helicopters varies from less than 1,000 lbs to more than 24,000 lbs. Some examples are as follows:

- Military Type (approximate values depending on configuration and crew)
  - ◆ Light Rescue = 1,000lb
  - ◆ Huey Type = 4,000lb
  - ◆ Black Hawk = 8,000lb
  - ◆ Chinook = 19,500lb
  - ◆ Sikorski CH-53E = 24,000lb
- Commercial Type
  - ◆ Bell 206-L-4 = 2,000lb
  - ◆ Bell UH-1B = 4,500lb
  - ◆ Bell 214B-1 = 8,000lb
  - ◆ Sky-crane = 25,000lb



## **Helicopter Operation Safety Issues**

### **Weather Conditions**

- A helicopter can fly in poor weather conditions as long as there is some visibility
- Ice and Snow conditions are usually unacceptable flying conditions

### **Clearance Issues**

- The HERS should check the landing zone (LZ) and the lifting and set-down areas for clearance problems.
- Trees and power lines create potential clearance issues
- Loose debris that could be moved, or even blown up into the rotors may create significant problems, such as disabling the ship and/or injuring those on the ground.
- The HERS should be aware of the rotor's radius, and the pilot's competency and comfort level regarding the amount of clearance needed to operate safely

### **Prop wash**

- This is determined by the size and type of helicopter
- Prop wash is heaviest when the helicopter is setting down and lifting up
- Prop wash will be especially heavy when lifting very heavy loads
- Prop wash can be minimized by using a long line

### **Noise**

- All helicopters are noisy and ear protection should be worn by everyone near the helicopter operation

### **Static Electricity**

- This is an inherent annoyance during helicopter operations
- Static electricity can be minimized by allowing the hook, slings or other rigging touch the ground before it is handled by ground personnel

### **Ground Positioning**

- No one should approach a helicopter that is on the ground with rotor turning unless eye contact with the pilot is maintained, and a nod or other pre arranged approach signal has been given. Radio communication may also be used
  - All ground personnel should remain safely away from the revolving rotor, and if practical, stand in front of the helicopter within a clear view of the pilot.
- ♦ **Do Not Surprise the Pilot**



### **Helicopter Communications**

#### Radio

- Most helicopters arrive with extra hand-held radios that the crew prefers ground personnel to use.
  - ♦ By using these radios, the pilot can receive communications directly through their headsets
- Direct Communication to Pilot from HERS
  - ♦ This communication should be only as detailed as necessary, and to the point
- HERS Communication to Pilot's ground man
  - ♦ This communication can be direct voice when standing nearby, or by radio when at a distance
  - ♦ This could be a situation where the helicopter ground person is provided with a US&R radio, but with the scarcity of the encrypted radios, that is unlikely.
  - ♦ This communication should, again, be only as detailed as necessary, and to the point

#### Hand Signals

- Hand signals should be clear and concise with the arms held away from the body
- Most helicopter pilots that are experienced doing lifting understand universal Crane Hand Signals.
  - ♦ During any US&R incident this needs to be confirmed, prior to any lifting
- Hand Signals specific to Helicopters
  - ♦ Landing Target – designating the landing target or LZ is done by lifting both arms up high and moving them in an easy circular motion. Holding a red flag is very helpful.
  - ♦ Up – designated by holding one arm up and moving it in an easy circular motion. The speed of the up movement is indicated by the speed of the circular motion
  - ♦ Down – designated by holding one arm down and moving it in an easy circular motion. The speed of the down movement is indicated by the speed of the circular motion
  - ♦ Level Off – designated by holding both arms out straight
  - ♦ Direction – designated by holding one arm out, pointing in the desired direction



## **Helicopter Hoisting**

### Length of Long-line

- As previously mentioned a line of 50 ft or more may be used in order to minimize the effects of prop wash

### Hook types

- Quick disconnect type hook are especially helpful in helicopter operations
- Normal Rigid Hooks may be used, but operations will take longer

### Rigging

- Buckets and Grapples may be especially useful during helicopter operations
- All the types of normal rigging may be used

## **Summary of Helicopter Operations**

- Helicopter is a very special tool that can provide a long lint to lift objects in locations that cannot be accessed by wheeled and/or tracked vehicles
- They need special safety and operating procedures such as special signaling and special rigging
- They have limitations in lift capacities and operational conditions
- However they can provide lift capacity to otherwise inaccessible areas, such as wetlands like the Florida Everglades and bay area wetlands
- It would be best if US&R Task Forces make contact with Helicopter Lifting Companies and establish working relationship, prior to any US&R Incident.

## 330B L and 345B L Ultra-high Demolition

*Heavy-Duty purpose built for your demolition job.*

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### Hydraulics

Auxiliary hydraulic flow control offers 4 programmable settings to precisely match hydraulic tool requirements.

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### Undercarriage

Caterpillar<sup>®</sup> excavator undercarriage is stable, durable and low maintenance. Optional heavy-duty hydraulic variable undercarriage allows usage of heavier demolition tool.

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### Operator Station

Roomy, quiet, automatically climate controlled cab has excellent sightlines to the work tool.

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### Upper frame and counterweight

Heavy-duty upper frame handles increased loads and movements. Additional counterweight provides maximum stability throughout the recommended working range.

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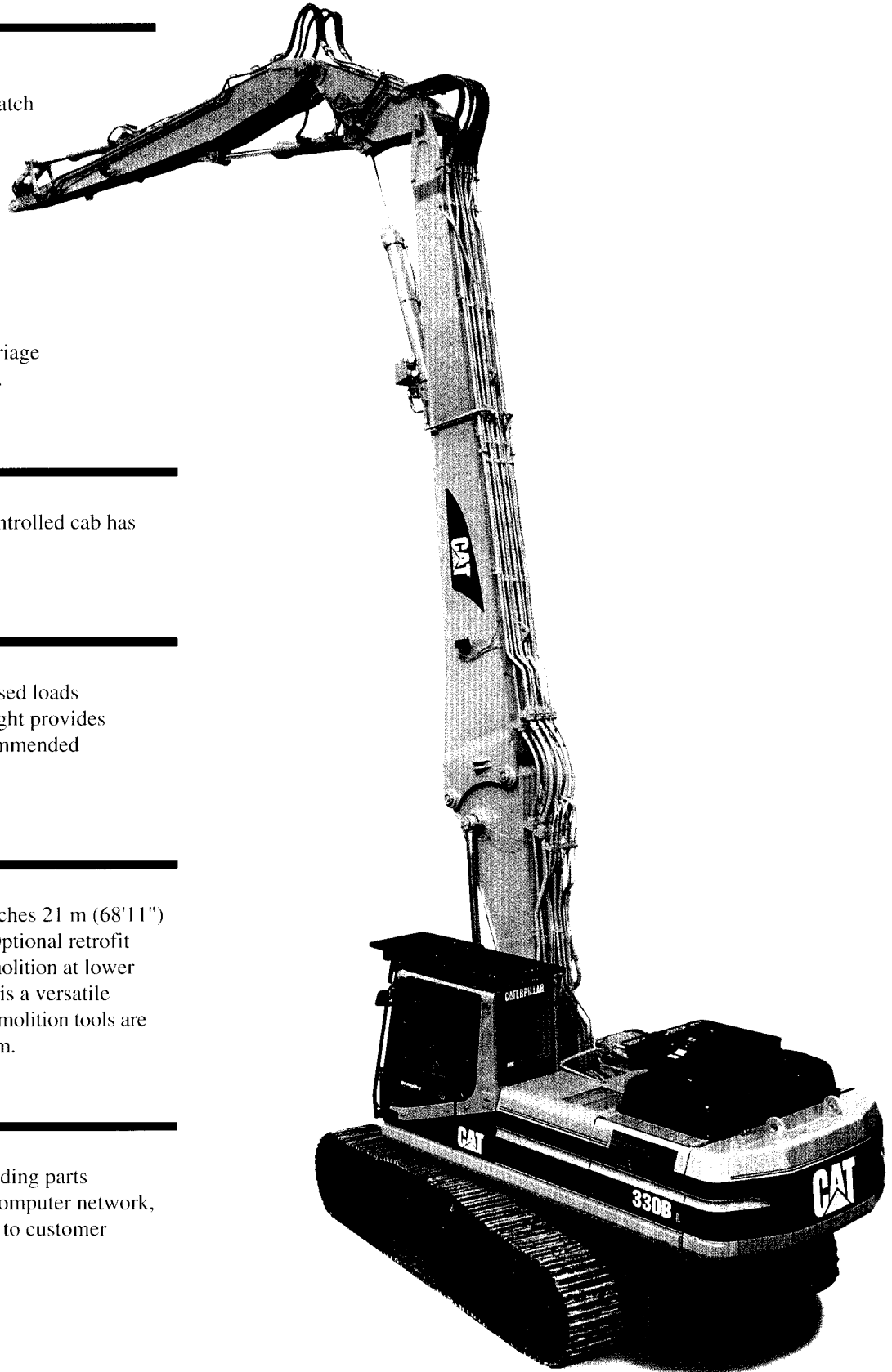
### Booms, sticks and working tools

3-piece Ultra-high Demolition front reaches 21 m (68'11") on 330B and 22.8 m (74'9") on 345B. Optional retrofit boom nose and demolition sticks for demolition at lower heights or normal digging truly make this a versatile machine for your job site. Caterpillar demolition tools are built to optimize the excavator/tool system.

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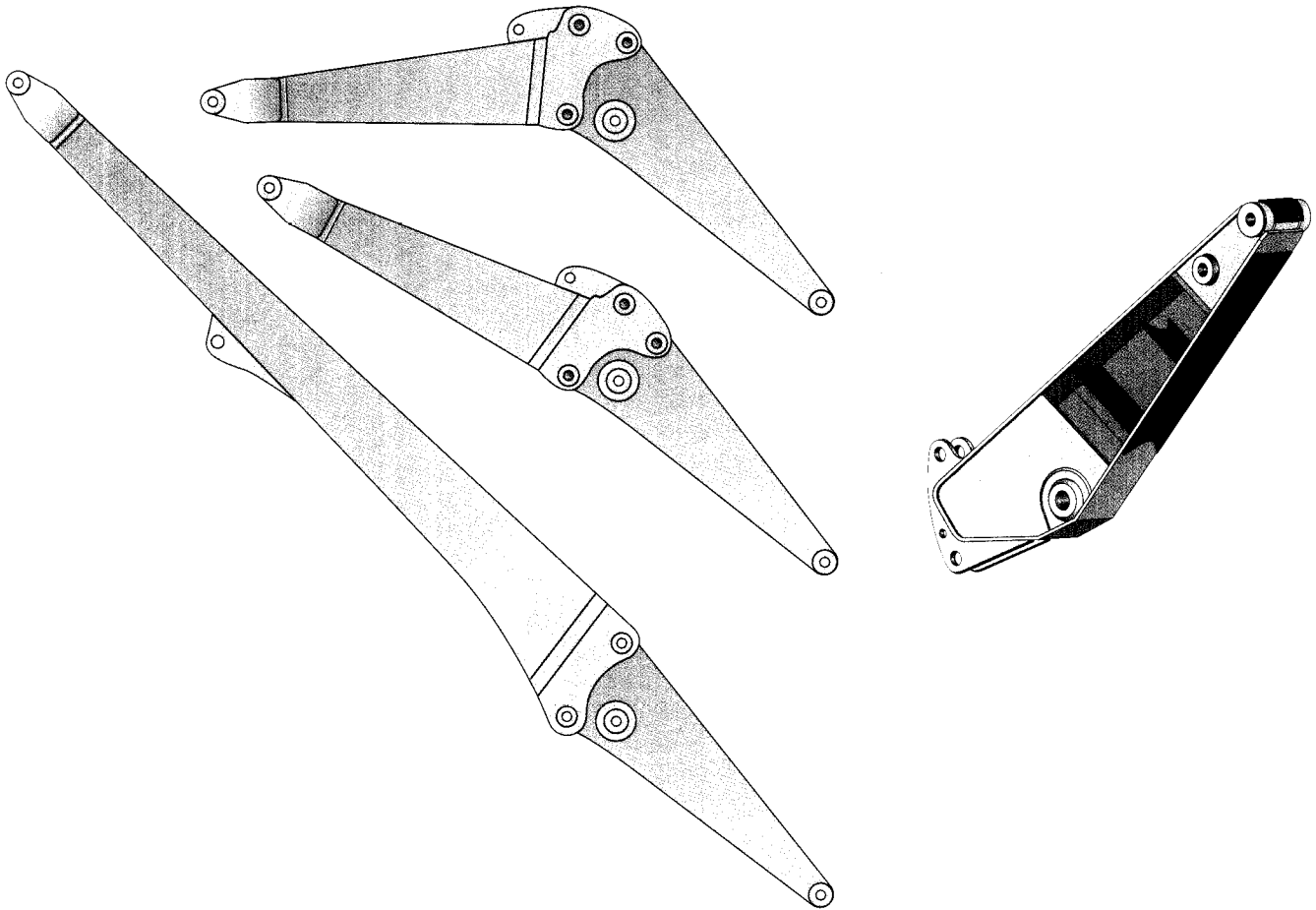
### Serviceability/Customer Support

Many convenient service features, including parts availability supported by a worldwide computer network, enhance Caterpillar's total commitment to customer support.



## Booms, Sticks and Working Tools

*Maximum versatility gets the best out of your machine.*



**2 piece main boom** with pin-mounted joint between boom foot and boom nose.

**Retrofit capability** with short 2-position boom nose on boom foot for clean-up, demolition (hammer use) and digging. This adds to the machine's extreme versatility by allowing the retrofit boom nose to be mounted in a straight (demolition) or bent (digging) position.

**Special stand** to support long boom or short retrofit boom when changing configuration.

### **Purpose built demolition sticks**

match the short boom nose

- additional internal reinforcements to support mechanical shears or thumb buckets
- heavier plates
- 12 mm (0.47") bottom wear plate
- through hardened bores

**B family** bucket linkage on 330B

**C family** bucket linkage on 345B

**Lowering control devices** are installed on all boom and stick cylinders.

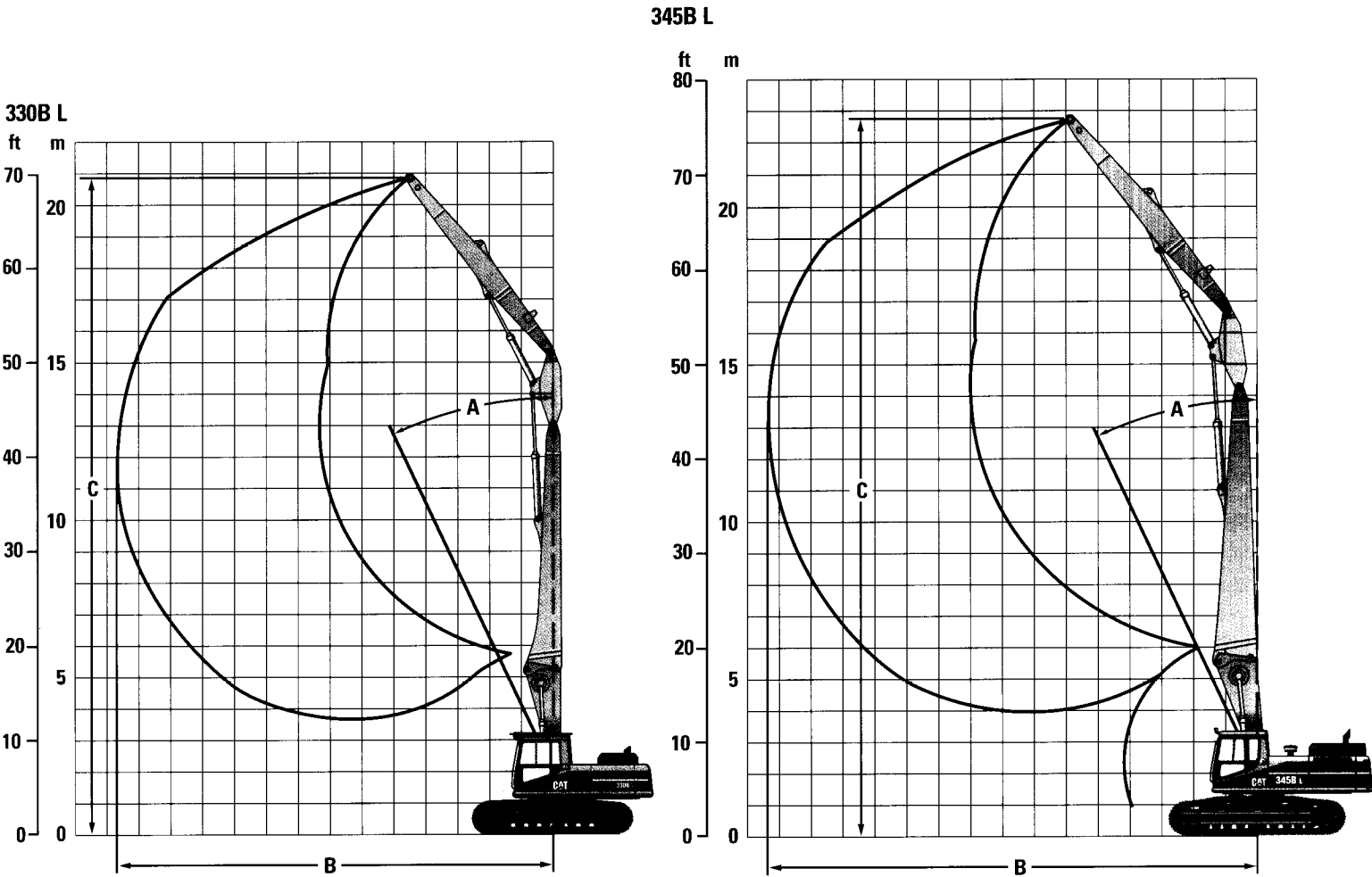
### **An electronic warning device**

signals the operator when the main boom gets out of the recommended working range.

**Choose from a variety of Caterpillar work tools** such as concrete crushers and pulverizers, steel shears, demolition grapples, hydraulic hammers and quick couplers.

# Shipping Dimensions and Recommended Working Range Ultra-high Demolition – Front Parts

All dimensions and weights are approximate.

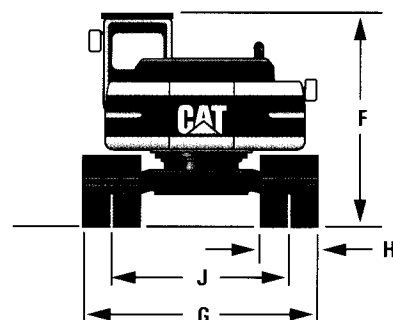
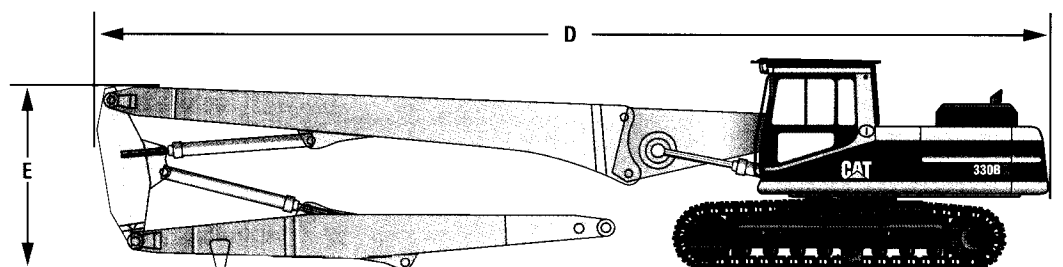


	330B	345B
<b>A</b> Maximum allowable angle from vertical	25°	25°
<b>B</b> Maximum allowable horizontal reach	13.8 m (45'3")	15.3 m (50'2")
<b>C</b> Maximum vertical pin height	20.9 m (68'7")	22.8 m (74'9")
<b>Maximum tool weight*</b>		
with L undercarriage	2300 kg (5,072 lb)	2300 kg (5,072 lb)
with hydraulic wide gauge undercarriage	3000 kg (6,615 lb)	3000 kg (6,615 lb)

\* Design of the mounting bracket is critical. Weight includes mounting bracket and Quick Coupler (if any).

Range is applicable in 360° and dependent on undercarriage choice and maximum weight of work tool.

330B L and 345B L Ultra-high Demolition specifications



	<b>330B</b>	<b>345B</b>
<b>D</b> Overall length	14.90 m (48'10")	16.25 m (53'4")
<b>E</b> Boom height	2.90 m (9'6")	3.44 m (11'3")
<b>F</b> Cab height*		
with Falling Object Guard	3.34 m (10'11")	3.67 m (12'0")
without Falling Object Guard	3.15 m (10'4")	3.48 m (11'5")
<b>G</b> Overall width	3.34 m (10'11")	3.49 m (11'5")
<b>H</b> Track shoe width	0.75 m (2'6")	0.60 m (2'0")
<b>J</b> Track gauge	2.59 m (8'6")	
Fully retracted		2.39 m (7'10")
Fully extended		2.89 m (9'6")
<b>Weight**</b>	39 570 kg (87,252 lb)	52 640 kg (116,071 lb)

\* Cab height must be increased by 0.3 m when equipped with hydraulically tiltable cab.

\*\*If equipped with super-long demolition front part, "B" linkage, "High Visibility" Eurocab, falling object guard, heavy duty long undercarriage, triple grouser track shoes and without tool.

#### **With Hydraulic Wide Undercarriage (if equipped)**

	<b>330B</b>	<b>345B</b>
<b>H</b> Track shoe width	0.75 m (2'6")	0.60 m (2'0")
<b>G</b> Overall width		
Fully retracted	3.15 m (10'4")	3.00 m (9'10")
Fully extended	3.55 m (11'8")	3.60 m (11'10")
<b>J</b> Track gauge		
Fully retracted	2.40 m (7'10")	2.40 m (7'10")
Fully extended	2.80 m (9'2")	3.00 m (9'10")
<b>Weight*</b>	45 140 kg (99,534 lb)	59 000 kg (130,095 lb)

\* If equipped with ultra-high demolition front part, corresponding linkage, "High Visibility" Eurocab, falling object guard, triple grouser track shoes, heavy duty long hydraulic wide undercarriage and without tool.

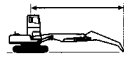
For information on specifications for configurations other than those included in the above charts, consult your Caterpillar dealer.

**330B L and 345B L Ultra-high Demolition specifications**



## 345B L Lift Capacities – Straight Position

4.0 m (13'2") stick (150-4711) with bucket (136-6242)



Load at  
Maximum Reach



Load Radius  
Over Front



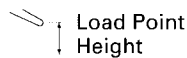
Load Radius  
Over Side

		3.0 m/10.0 ft		4.5 m/15.0 ft		6.0 m/20.0 ft		7.5 m/25.0 ft		9.0 m/30.0 ft		10.5 m/35.0 ft			
10.5 m	35.0 ft	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	m
								*7900	*7900					*4800	8.60
								*18,000	*18,000					*11,700	27.67
9.0 m	30.0 ft	kg	lb					*8400	*8400	*7400	6900			*4300	9.84
								*19,900	*19,900	*16,400	14,500			*10,400	31.95
7.5 m	25.0 ft	kg	lb			*8300	*8300	*8900	*8900	*7700	6900	*5500	4500	*4000	10.72
						*19,700	*19,700	*21,000	*21,000	*18,400	14,600			*9800	34.99
6.0 m	20.0 ft	kg	lb	*9400	*9400	*10 200	*10 200	*9600	*9600	*7800	6600	*6500	4500	*3900	11.34
				*21,700	*21,700	*23,700	*23,700	*22,600	*22,600	*18,700	14,100	*15,600	9500	*9600	37.10
4.5 m	15.0 ft	kg	lb	*17 900	*17 900	*12 800	*12 800	*9900	8900	*8000	6200	*6500	4300	*4000	11.73
				*41,800	*41,800	*30,200	28,500	*23,500	19,000	*19,000	13,200	*15,600	9100	*9600	38.44
3.0 m	10.0 ft	kg	lb			*13 300	11 600	*10 100	8000	*8000	5700	*6400	4100	*4100	11.92
						*31,600	25,000	*24,100	17,200	*19,200	12,100	*15,400	8600	*9900	39.09
1.5 m	5.0 ft	kg	lb			*13 200	10 200	*10 000	7200	*7800	5200	*6100	3800	*4300	11.91
						*31,400	22,000	*24,000	15,500	*18,800	11,200	*14,700	8100	*10,500	39.09
0.0 m	0.0 ft	kg	lb	*9200	*9200	*12 200	9400	*9500	6600	*7300	4900	*5600	3600	*3800	11.71
				*23,300	*23,300	*29,400	20,200	*22,700	14,300	*17,700	10,400	*13,400	7600	*9700	38.43
-1.5 m	-5.0 ft	kg	lb	*6200	*6200	*12 700	9100	*8300	6300	*6400	4600	*4500	3500	*3100	11.31
				*15,300	*15,300	*31,000	25,600	*20,100	13,600	*15,500	9900	*10,800	7500	*8000	37.08
-3.0 m	-10.0 ft	kg	lb			*9100	*9100	*8100	6300	*4800	4600	*2500	*2500	*2100	10.68
						*22,600	*22,600	*19,900	13,500	*11,700	9900			*5600	34.95
-4.5 m	-15.0 ft	kg	lb					*4900	*4900	*3900	*3900				
								*12,200	*12,200	*9500	*9500				

\* Indicates that the load is limited by hydraulic capacity rather than tipping capacity. Lift capacity ratings are based on SAE standard J1097. Rated loads do not exceed 87% of hydraulic lifting capacity or 75% of tipping capacity.

## 345B L Lift Capacities – Straight Position

3.4 m (11'2") stick (150-5994) with bucket (136-6242)

















Load at  
Maximum Reach



Load Radius  
Over Front



Load Radius  
Over Side

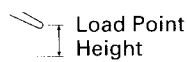
		4.5 m/15.0 ft		6.0 m/20.0 ft		7.5 m/25.0 ft		9.0 m/30.0 ft		10.5 m/35.0 ft				
														m ft
10.5 m 35.0 ft	kg lb			*10 100 *22,200	*10 100 *22,200	*7300	*7300					*6100 *13,700	*6100 *13,700	7.68 24.58
9.0 m 30.0 ft	kg lb			*9900 *22,100	*9900 *22,100	*8600 *18,800	*8600 *18,800	*5800	5600			*5300 *11,900	*5300 *11,900	9.05 29.32
7.5 m 25.0 ft	kg lb			*10 500 *23,200	*10 500 *23,200	*8700 *18,900	*8700 *18,900	*7000 *15,200	5800 12,200			*5000 *11,100	4100 9200	10.00 32.61
6.0 m 20.0 ft	kg lb	*15 200 *31,500	*15 200 *31,500	*11 500 *25,000	*11 500 *25,000	*8900 *19,300	8400 18,100	*7000 *15,300	5500 11,700	*5500	3400	*4800 *10,800	3200 7200	10.66 34.87
4.5 m 15.0 ft	kg lb			*11 900 *25,900	11 400 24,700	*9000 *19,600	7500 16,200	*7000 *15,300	5100 10,800	*5400 *11,700	3300 6900	*4800 *10,700	2700 6000	11.08 36.30
3.0 m 10.0 ft	kg lb			*11 900 *26,000	9600 20,800	*8900 *19,500	6600 14,200	*6900 *15,000	4500 9700	*5200 *11,300	3000 6400	*4200 *9500	2400 5300	11.28 36.99
1.5 m 5.0 ft	kg lb			*11 200 *24,600	8300 17,900	*8500 *18,600	5800 12,400	*6500 *14,100	4100 8700	*4800 *10,200	2800 5900	*3700 *8200	2300 5000	11.27 36.98
0.0 m 0.0 ft	kg lb			*9800 *21,600	7600 16,400	*7700 *16,700	5300 11,300	*5800 *12,500	3700 8000	*4000 *8300	2700 5600	*3000 *6700	2300 5200	11.06 36.28
-1.5 m -5.0 ft	kg lb	*8100 *18,100	*8100 *18,100	*7800 *17,100	7500 16,000	*6200 *13,600	5100 10,800	*4600 *9800	3600 7700	*2400	*2400	*2100 *4700	*2100 *4700	10.63 34.85
-3.0 m -10.0 ft	kg lb	*4500 *10,100	*4500 *10,100	*5100 *11,000	*5100 *11,000	*4100 *8800	*4100 *8800	*2600 *5200	*2600 *5200			*900 *1900	*900 *1900	9.95 32.57

\* Indicates that the load is limited by hydraulic capacity rather than tipping capacity. Lift capacity ratings are based on SAE standard J1097. Rated loads do not exceed 87% of hydraulic lifting capacity or 75% of tipping capacity.

330B L and 345B L Ultra-high Demolition specifications

## 345B L Lift Capacities – Bent Position

4.0 m (13'2") stick (150-4711) with bucket (136-6242)



Load at  
Maximum Reach



Load Radius  
Over Front



Load Radius  
Over Side

		1.5 m/5.0 ft		3.0 m/10.0 ft		4.5 m/15.0 ft		6.0 m/20.0 ft		7.5 m/25.0 ft		9.0 m/30.0 ft		10.5 m/35.0 ft				m ft
9.0 m 30.0 ft	kg lb															*4100 *9300	*4100 *9300	8.53 27.60
7.5 m 25.0 ft	kg lb											*6200 *12,200	*6200 *12,200			*4000 *8800	*4000 *8800	9.54 31.08
6.0 m 20.0 ft	kg lb											*6400 *14,000	*6400 *14,000			*4000 *8800	*4000 *8800	10.23 33.45
4.5 m 15.0 ft	kg lb									*7900 *17,200	*7900 *17,200	*6700 *14,800	6600 14,100	*5200 4500		*4100 *9100	*4100 *9100	10.66 34.93
3.0 m 10.0 ft	kg lb					*15 600	*15 600	*11 100 *24,100	*11 100 *24,100	*8700 *18,900	*8700 *18,800	*7200 *15,700	6200 13,200	*6100 *12,800	4300 9100	*4400 *9700	3900 8700	10.87 35.65
1.5 m 5.0 ft	kg lb					*17 600 *38,300	*17 600 *38,200	*12 300 *26,700	11 500 24,600	*9400 *20,400	8000 17,100	*7600 *16,500	5700 12,100	*6300 *13,600	4100 8600	*4800 *10,700	3700 8200	10.86 35.64
0.0 m 0.0 ft	kg lb			*8300 *18,900	*8300 *18,900	*18 200 *39,800	16 100 34,700	*12 900 *28,100	10 400 22,300	*9800 *21,300	7300 15,600	*7800 *16,900	5300 11,300	*6200 *13,300	3900 8600	*5500 *12,100	3700 8200	10.64 34.92
-1.5 m -5.0 ft	kg lb	*9000 *20,200	*9000 *20,200	*12 700 *28,800	*12 700 *28,800	*17 700 *38,700	15 500 33,300	*12 900 *28,000	9800 21,000	*9800 *21,300	6900 14,700	*7600 *16,600	5000 10,700			*6200 *13,700	4000 8800	10.20 33.42
-3.0 m -10.0 ft	kg lb	*13 600 *30,500	*13 600 *30,500	*18 100 *40,900	*18 100 *40,900	*16 300 *35,500	15 500 33,200	*12 100 *26,300	9600 20,600	*9200 *20,000	6700 14,400	*7000 *14,900	4900 10,600			*6200 *13,800	4500 10,000	9.49 31.04
-4.5 m -15.0 ft	kg lb			*18 700 *40,600	*18 700 *40,600	*13 800 *29,900	*13 800 *29,900	*10 400 *22,500	9800 21,000	*7800 *16,600	6800 14,700					*6100 *13,500	5700 12,700	8.46 27.55
-6.0 m -20.0 ft	kg lb					*9700 *20,500	*9700 *20,500	*7100 *14,900	*7100 *14,900							*5400 *11,800	*5400 *11,800	6.95 22.41

\* Indicates that the load is limited by hydraulic capacity rather than tipping capacity. Lift capacity ratings are based on SAE standard J1097. Rated loads do not exceed 87% of hydraulic lifting capacity or 75% of tipping capacity.

## 345B L Lift Capacities – Bent Position

3.4 m (11'2") stick (150-5994) with bucket (136-6242)



Load at  
Maximum Reach



Load Radius  
Over Front



Load Radius  
Over Side

		3.0 m/10.0 ft		4.5 m/15.0 ft		6.0 m/20.0 ft		7.5 m/25.0 ft		9.0 m/30.0 ft				m ft
9.0 m 30.0 ft	kg lb							*7300 *16,100	*7300 *16,100			*5900 *11,500	*5900 *11,500	7.73 24.93
7.5 m 25.0 ft	kg lb							*7500 *14,300	*7500 *14,300			*5600 *10,800	*5600 *10,800	8.83 28.74
6.0 m 20.0 ft	kg lb							*7900 *14,900	*7900 *14,900	*6800 *12,900	*6800 *12,500	*5600 *10,800	*5600 *10,800	9.57 31.29
4.5 m 15.0 ft	kg lb			*14 800	*14 800	*10 700 *20,300	*10 700 *20,300	*8500 *16,100	*8500 *16,100	*7000 *13,400	*7000 *11,800	*5800 *11,100	5400 9000	10.04 32.87
3.0 m 10.0 ft	kg lb			*17 300 *32,600	*17 300 *32,600	*11 900 *22,600	*11 900 *22,600	*9100 *17,300	*9100 *16,000	*7400 *14,000	6700 10,800	*6200 *11,900	4700 7900	10.25 33.63
1.5 m 5.0 ft	kg lb			*18 600 *35,200	*18 600 *31,900	*12 800 *24,300	*12 800 *20,700	*9600 *18,300	8800 14,200	*7600 *14,400	6100 9800	*6300 *12,300	4400 7300	10.25 33.63
0.0 m 0.0 ft	kg lb			*18 500 *35,100	18 200 29,400	*13 100 *24,900	11 600 18,600	*9800 *18,700	8000 12,800	*7600 *14,500	5600 9000	*6400 *12,400	4400 7300	10.01 32.86
-1.5 m -5.0 ft	kg lb	*15 400 *30,500	*15 400 *30,500	*17 300 *32,900	*17 300 *28,800	*12 700 *24,100	11 000 17,700	*9600 *18,100	7500 12,100	*7200 *13,600	5400 8600	*6400 *12,500	4800 8000	9.54 31.26
-3.0 m -10.0 ft	kg lb	*20 000 *38,100	*20 000 *38,100	*15 200 *28,900	*15 200 *28,900	*11 400 *21,700	11 000 17,700	*8600 *16,100	7500 12,100			*6300 *12,300	5800 9600	8.78 28.70
-4.5 m -15.0 ft	kg lb	*14 800 *27,900	*14 800 *27,900	*11 800 *22,300	*11 800 *22,300	*9000 *16,800	*9000 *16,800	*6200 *11,800	*6200 *11,800			*5800 *11,300	*5800 *11,300	7.65 24.87

\* Indicates that the load is limited by hydraulic capacity rather than tipping capacity. Lift capacity ratings are based on SAE standard J1097. Rated loads do not exceed 87% of hydraulic lifting capacity or 75% of tipping capacity.

330B L and 345B L Ultra-high Demolition specifications