

Heavy Rotation



A New Generation of Hydraulic Excavators —
Better, Stronger, Faster

By Nick Zubko

To a contractor, flexibility is important – weather can be unpredictable, the scenery is always changing and jobsites themselves present a different set of challenges nearly every morning. Flexibility is just as important for the operators inside the cab of whatever machine is digging the pit, shaft or trench to get your next project started off on the right foot. And, it's at least part of the reason that hydraulic excavators have become one of the most useful tools on nearly every type of construction site today.

The world's first excavator was introduced as far back as the early 1940s, but it was a distant cry from the machines contractors have come to know and love today. For the most part, we didn't start seeing the look and design of today's hydraulic excavator until the 1960s. Over the years, the market has grown into a multi-billion dollar industry led by a long list of global powerhouses such as John Deere/Hitachi, Caterpillar, Volvo, Case, Kobelco, Terex, JCB and Komatsu, in addition to Korean manufacturers like Hyundai, Doosan (formerly Daewoo) and others.

That said, it's no surprise that the market is now more diverse than ever. Everywhere you look, an excavator can be found working in residential construction, commercial construction, site preparation, quarry work, water and sewer, roads and bridges, farms and everywhere in between. They also have one of the most expansive size ranges of any piece of construction equipment produced today. Some of the smallest excavators can fit in the bed of a large pickup or trailer, while the largest ones look like something straight out of "Jurassic Park." Most of the compact models float on feather-light rubber tracks that barely leave a blade of grass out of place, while the larger ones either ride on a set of mammoth tires, or crawl across the earth on huge steel girders that leave an impression you can see from a mile away.

Every year, manufacturers produce new machines and incorporate new features into every excavator size class. Improvements in hydraulic systems, for example, have given operators the ability to achieve lightning-fast digging times that result in higher productivity, while improvements in machine uptime slash daily operating cost to all-time lows. In the end, all any of this really means is that you can be sure that there's an excavator perfectly suited to your exact needs. It's the right size, the right shape and does everything you need to adapt to any application or environment imaginable.

Class Description

Excavators are broken down into several different categories, but first and foremost it's by size. The compact or "mini" excavators usually weigh less than about 20,000 lbs, and are primarily used for landscaping and light utility work. With an increasingly common feature called "zero-tail swing," these machines allow operators to easily maneuver in some pretty small workspaces. Above the 20,000-lb mark, heavy-duty excavators are identified as either small (25,000 to 50,000 lbs), medium (50,000 to 80,000 lbs) or large (80,000 lbs and bigger).

"The smaller midsize machines are typically used for digging house foundations and light utility work, while the bigger midsize machines are used for site preparation and pipeline digging," explains Russell Jerome, supervisor of excavator engineering for John Deere Construction & Forestry. "Traditionally, the largest excavators are used for mass excavation, often digging from a ledge and filling large articulated dump trucks. But the type of project often determines the size of machine required. Ask yourself: how deep must the machine be able to dig? How much weight can it crane? Are there space limitations? How quickly must the job be done? These are all questions that need to be asked when assigning an excavator to a jobsite."

Typically, the excavators that see the most utility work are at the large-end of the compact class up to the 35-metric ton size class (around 77,000 lbs). However, larger machines are sometimes used in the bigger-scale projects, where heavy craning is required



Configurations such as an offset boom, minimum-swing radius and zero-tail-swing allow excavators of all different sizes to work in tight quarters, such as residential backyards or crowded city streets.

or heavy trench boxes need to be pulled into place. In the end, the type of project typically determines the size of machine required. But one of the most important aspects of this issue for most contractors is ease of transportation.

“The size that you can typically transport relatively easily is the 16- to 20-metric ton (35,000- to 44,000-lb) range,” explains Dave Wolf, marketing manager for Case Construction Equipment, which entered the excavator market with the acquisition of Drott Excavators in 1981. “Those are fairly easily transported from location to location. But at the same time, it gives contractors the power and dig depth that they need for utilities. Some machines are designed with a narrower undercarriage specifically for this purpose — so you don't have to worry about being oversized for transporting.”

Moving Parts

Apart from size, the main components of a hydraulic excavator are relatively universal throughout the industry. You have the boom, the arm (sometimes referred to as a stick), the cab and a set of tracks or wheels. The engine powers a hydraulic system that supplies linear and rotational motion. Add a selection of attachments and you have yourself an excavator.

One of the most noticeable differences between excavators is probably the boom. The size of the boom affects everything from reach, dig depth, breakout force and lift capability. But the configuration of the boom is also a big consideration. Most large excavators are configured with the boom pinned to the platform, which means that the boom swings with the house (cab).

Some machines have what is called a “swing boom,” which means that the boom extends from a pivot point or tower set in front of the machine. The house itself can still be rotated a full 360 degrees (as on standard configuration machines), but the boom swings side to side 180 degrees, allowing excavation perpendicular to the machine for easy digging next to buildings. Other configurations, such as offset booms, minimum-swing radius and zero-tail-swing, allow the machines to work in tight quarters, such as residential backyards or crowded city streets.

“A smaller swing radius allows an operator to work in a variety of different environments,” says Wolf. “In confined spaces, they don't have to worry about the counterweight interfering with any kind of fence or tree lines when they rotate the house. Minimum-swing-radius excavators have a tail that swings a little beyond the edge of the tracks, but it's typically still tight enough. You see a lot of those working alongside roads, putting in sewer and water pipes. Those configurations can swing within one lane of traffic, as opposed to the



Tracked excavators are much more common than wheeled units, but wheels can be very effective when you need a little extra mobility on the job.

longer tail swing machines, which can stick out and obstruct two lanes.”

Some sort of tracked undercarriage seems to be the preferred mode of transportation for every size class. It's a set of rubber tracks on compact models, and steel on everything above. While tracked excavators are much more common than wheeled units, wheeled excavators can be very effective when you need a little extra mobility on the job. The market is still relatively split on this one, evidenced by the fact that a handful of leading manufacturers (including Case, Komatsu, JCB and Terex) don't even offer wheeled models in their product lines.

“An excavator is a digging machine. And while the wheeled excavator can enhance mobility, it somewhat limits the digging efficiency of the excavator,” notes Jerome. “The tracked undercarriage is also much more reliable and effective in rocky and muddy soil conditions. A wheeled excavator is useful when craning jersey barriers off and on trucks during road construction projects. Government agencies also use them to drive out to a jobsite that requires only a little bit of digging, such as cleaning up a ditch near a culvert.”

Inner Workings

Inside an excavator, there are really just a few primary parts. There is an engine, a hydraulic pump, control valves and cylinders. The engine supplies power to the pump, which provides oil flow and pressure. Pumps are typically axial piston designs, which have features that regulate the flow rate and pressure output. The control valve distributes the oil to cylinders that perform the digging of the soil.

According to manufacturers, the control valve is the component that really allows customers to distinguish between different makes and models of excavators. It's what gives the operator the "feel" he needs to perform the digging operation. In the early days, excavators used levers and linkages to control hydraulic functions; they have now evolved to use primarily pilot controls and manufacturers have continued to make small, but significant, improvements.

"Hydraulic pressure is a major point for excavators," says Tony den Hoed, marketing communications and product launch specialist of excavators for Volvo Construction Equipment, which launched its first hydraulic excavators in 1999. "Many manufacturers have an approved pressure that they increase as much as possible. Higher pressure makes the machine perform better. However, if it is increased too much, the machine runs the risk of significant damage and invalidated warranty. The engine is the heart of the machine and it affects both hydraulic performance and fuel consumption. And with gas prices escalating, fuel consumption is becoming a very hot subject."

In reality, many of the significant changes in excavators have been in relation to the operator controls. Old linkages have been eliminated in favor of electronic controls and pilot-operated hydraulics, joystick controls and throttle-type rpm control for the engine. Those areas all have been tightened up so that wasted hydraulic effort is a thing of the past. The efficiency of the hydraulic systems has advanced to the point where the operator can be more productive. These developments have also made

excavators much more efficient for the use of a variety of attachments — offering utility contractors an increasingly versatile machine.

"The hydraulic excavator has become more efficient and more attachments have been developed to make it a more versatile machine," says Jerome. "And attachments are often an important factor for the utility contractor. One machine may be required for several tasks, the ability to adapt it to each task is important. Recently, some manufacturers have developed electro-hydraulic controls for larger machines. The hydraulic excavator has become more efficient and more attachments have been developed to make it a more versatile machine, similar to the skid steer."

The New Generation

In the past five years, manufacturers have made several important improvements to excavator design, including engine performance, operator interface and comfort, ergonomics, component life and styling. Service intervals have been improved on many machines by using better oils and filtration methods. According to manufacturers, there are several more improvements emerging on the horizon such as attachment identification and the use of hybrid engine technology.

"As far as attachment identification, today when an operator changes an attachment on a machine, he has to reset the hydraulic pressure and flow," explains den Hoed. "In the future, the attachment may have a radio chip (RFID) that sends a code to the machine and it automatically recognizes the attachment. In addition, hybrid engines will be developed that maintain machine performance at a significantly

reduced fuel consumption and emission expulsion."

Just in the last year or two, several manufacturers have introduced new additions to their existing excavator lines. Caterpillar, for example, introduced three new midsize excavators to launch its new D-Series line in 2006, replacing its already successful C-Series. Komatsu's most recent addition to its excavator line was the new PC138USLC-8 short tail swing excavator, which boasts 92-net hp with an operating weight ranging between 31,000 and 33,000 lbs.

Terex also redesigned its LC-2 large excavators this year, upgrading to a new pattern change control, which allows operators to change the control pattern to best



Attachments are an important factor for a utility contractor. Improvements in excavators' hydraulic systems have made a variety of attachments more efficient and easier to use.

suit their particular operation style. The LC-2 now features a new Tier-3 emission-compliant engine, using a common rail injection system combined with a new electronic management system (e-EPOS) that increases productivity and fuel efficiency.

Adding to its successful D-Series line, John Deere will be introducing three new excavators later this year. The 160D LC, 200D LC and 225D LC will retain many of the industry-leading features of their predecessors, but offer faster hydraulics, a redesigned cab, undercarriage enhancements and a new cooling system.

“John Deere’s new D-series excavators offer several new features — Tier 3 emission engines, larger cabs, heated/air-ride seats, hydraulic variable speed fans with optional reverse, increased power and drawbar pull, and lower noise levels are a few of the new additions,” explains Jerome. “All of this is added to our already established dealer support, machine productivity and exceptional resale value of our machines.”

On the heels of the introduction of its new CX700 excavator in April 2006, Case introduced the first models in its CX B Series line of full-sized excavators earlier this year, which includes the CX160B, CX210B, CX240B and CX290B, as well as long-reach configurations of the CX210B and CX240B and a narrow version of the CX210B. The CX B Series machines delivered significant increases in fuel efficiency over their predecessors (about 20 percent), plus up to a 17-percent increase in horsepower.

“These new CX excavators are delivering increased fuel efficiency and horsepower, but they are also providing a substantial increase in productivity,” says Wolf. “In our testing, they easily moved 25 percent more cubic yards of material per gallon of fuel. In addition, while they always used regenerative hydraulics on the boom and arm, we’ve added it to the bucket curl, which speeds the cycle time required to get a bucket of dirt.”

Volvo CE introduced a new C-series generation of its popular EW range of wheeled excavators earlier this year. The EW160C and EW180C have all the benefits of Volvo CE’s new C-series crawler excavators. The C-series offers more powerful Volvo Tier-3 compliant engines with V-ACT (Volvo

Advanced Combustion Technology), balancing engine performance with operation requirements – all while minimizing fuel consumption.

“In addition to engine performance, we have spent tons of time analyzing control placement,” notes den Hoed. “Many ergonomic studies have been performed to best improve the environment for the widest range of operators. So with our new C-Series machines, we believe we have established a new standard benchmark for an operator environment. Volvo CE has also maximized the durability of the undercarriage and all of its components.”

Nick Zubko is associate editor of *Utility Contractor*.

HOW MUCH IS THIS CONVERSATION COSTING YOU?



WHY DEAL WITH THIS?

Employee Time Card						
Name: DAVID B.		Date: 11-15				
Day	Start	Launch	End	Jobsite	Activity	Hours
Monday	7	1/2	3:30	Brentwood	Gen	8
Tuesday	7	1/2	4	"	"	8
Wednesday	7	1/2	4	"	"	8 1/2
Thursday	7	1/2	4	Crestview	"	8 1/2
Friday	7	1/2	4	"	"	8 1/2

Employee Signature: *David B.* Total Hours: 41 1/2

WHEN YOU CAN HAVE THIS.

Employee Report							
Burns, David		Date Range: 6/11/2007 through 6/15/2007					
Day	Date	Jobsite	Start	Stop	Cost Code	Hours	Total
Mon	6/11	Brentwood	7:08 AM	12:05 PM	Excavation	4:57	7:38 hours
			12:41 PM	3:22 PM	Excavation	2:41	
Tue	6/12	Brentwood	7:12 AM	12:07 PM	Excavation	4:55	7:35 hours
			12:43 PM	3:23 PM	Excavation	2:40	
Wed	6/13	Brentwood	7:12 AM	12:02 PM	Excavation	4:50	7:53 hours
			12:46 PM	3:49 PM	Excavation	3:03	
Thu	6/14	Crestview	7:17 AM	12:19 PM	Pipe Installation	5:02	7:58 hours
			12:50 PM	3:46 PM	Pipe Installation	2:56	
Fri	6/15	Crestview	7:13 AM	12:07 PM	Pipe Installation	4:54	7:49 hours
			12:44 PM	3:39 PM	Pipe Installation	2:55	

Signature: *David B.* Burns, David **Total 38:53 hours**

> TRACKING service work?
> DOZENS of cost codes?
> Crews on the MOVE?

More than 350,000 workers
clocked in today with
The JobClock System.
Find out why!

Ask About **PocketClock™**



THE JOBLOCK® THE CONTRACTOR'S TIMECLOCK.™
 Call today: (888) 788-8463 • www.jobclock.com

