Part 6

COMPACTION EQUIPMENT

The first Buffalo-Springfield steam rollers appeared in 1891.

1939 Ingersoll Rand 3-drum roller

4-ton Galion 'Rollamatic' tandem steel wheel roller, produced in Galion, Ohio -1943

Huber 12-ton Roller produced in Marion, Ohio – 1940s

Early Smooth Drum Rollers - **Smooth drum rollers evolved from steam powered road rollers of the 1800s. Smooth drum rollers work best for well-graded granular soils of low plasticity, gravel subbase mixtures, and A/C pavements.**

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Paul Baumann (1892-1983) supervised the design and construction of the **San Gabriel Dam** in 1935-38, for many years the highest rockfill dam in the world (355 ft) with a volume of 10,572,000 yds^3.

- **The sheepsfoot roller has evolved into a wide variety of forms. This shows the Allis Chalmers roller, designed by Paul Baumann (above left), which introduced *replaceable* "hammerhead tips" in the late 1930s, during construction of the San Gabriel Dam by the Los Angeles County Flood Control District.**

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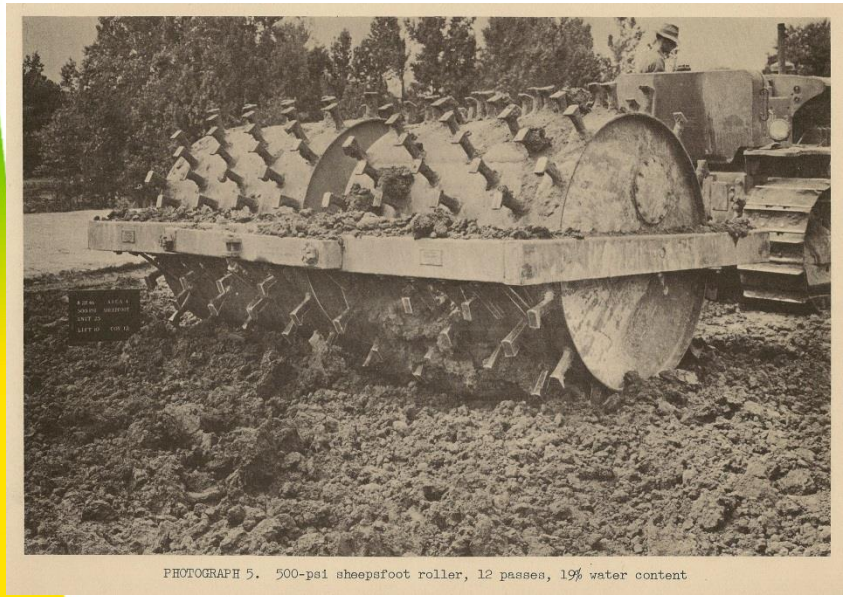
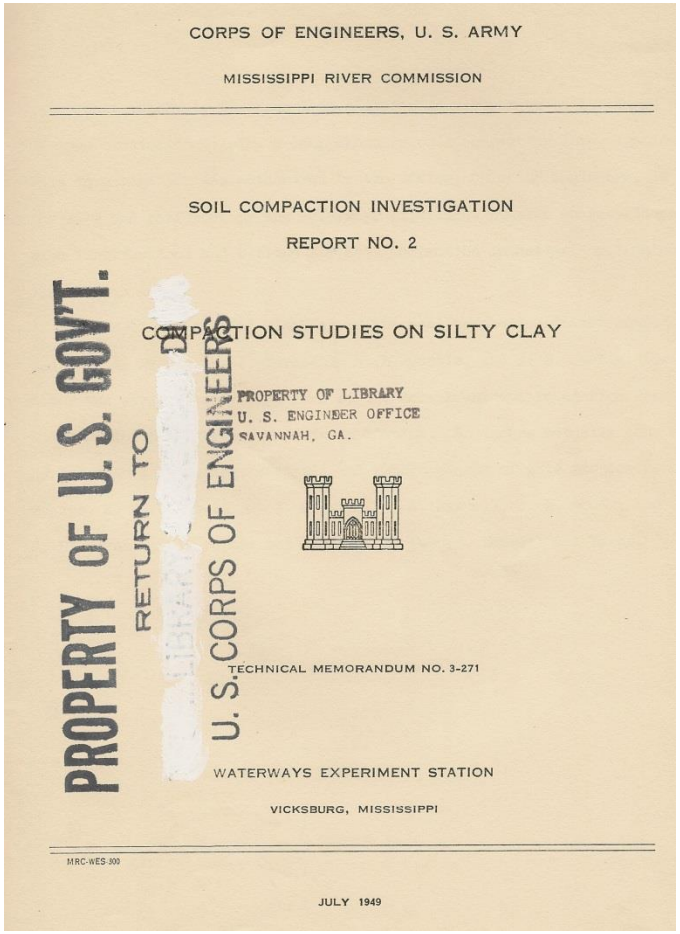
PHOTOGRAPH 8. 20,000-lb wheel load, 12 coverages, 19% water content



PHOTOGRAPH 5. 500-psi sheepsfoot roller, 12 passes, 19% water content



CORPS OF ENGINEERS, U. S. ARMY

MISSISSIPPI RIVER COMMISSION

SOIL COMPACTION INVESTIGATION

REPORT NO. 2

COMPACTION STUDIES ON SILTY CLAY

TECHNICAL MEMORANDUM NO. 3-271

WATERWAYS EXPERIMENT STATION

VICKSBURG, MISSISSIPPI

MRC-WES-300

JULY 1949

After World War II, the Army Corps of Engineers carried out a series of compaction studies on silty clay down in Vicksburg, which showed the relative import of machine design and contact pressures.

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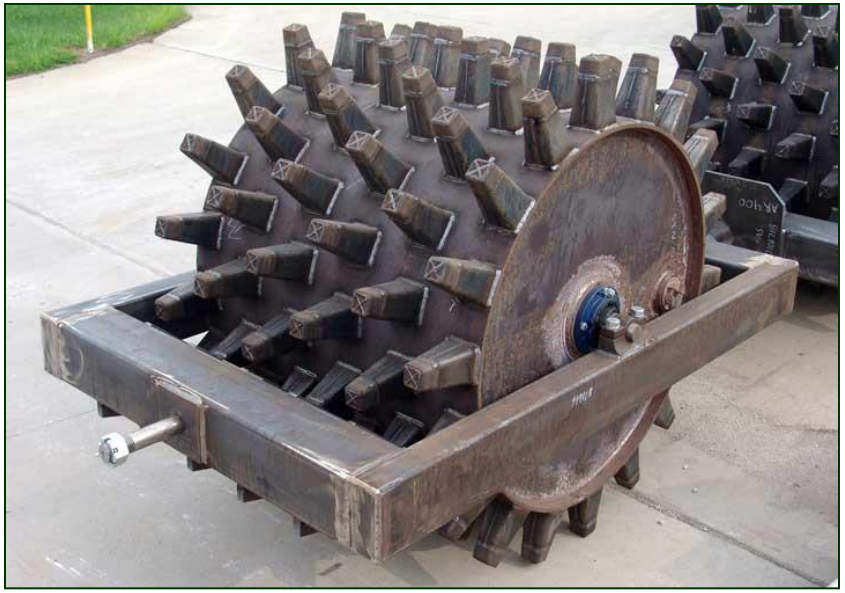

- Left: **Spike rollers** are a sheepsfoot variant that can be employed to help break up and disaggregate soft or fissile bedrock materials, increasing the bulk density of the fill mixture
- Right: A common variant is the **flat head tamping roller**, which employs tapered ‘box heads.’ This variant places *three tips* normal to the ground surface at any given time

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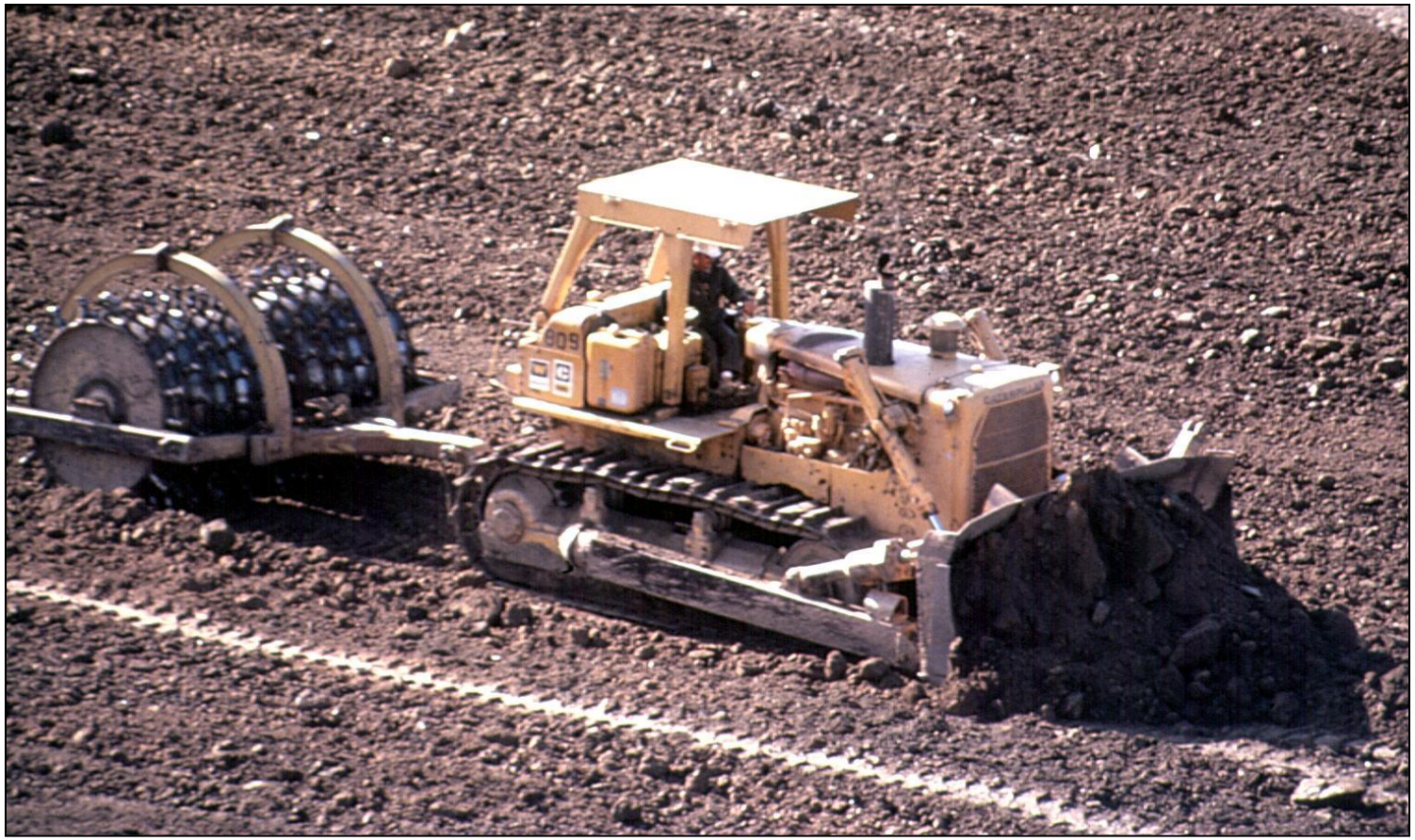
SHEEPSFOOT ROLLERS



- **Light standard sheepsfoot roller**, with 42-inch diameter drums weigh between 8000 and 16000 lbs per 8 ft width and exert contact pressures from 1000 to 300 psi, with spike contact area of 5 to 8 square inches. The spikes compact a zone 2 to 8 inches beneath their tips. This roller first appeared in California around 1930.

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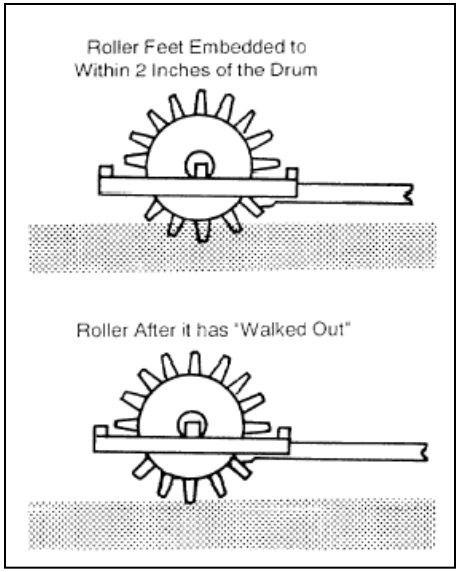
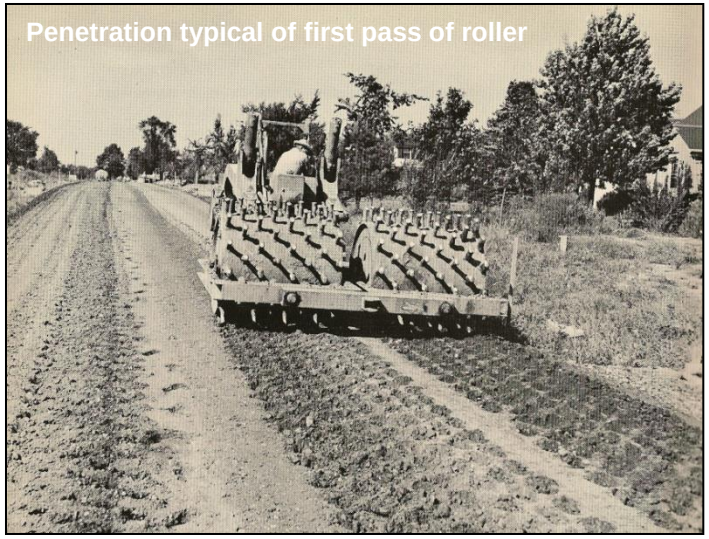
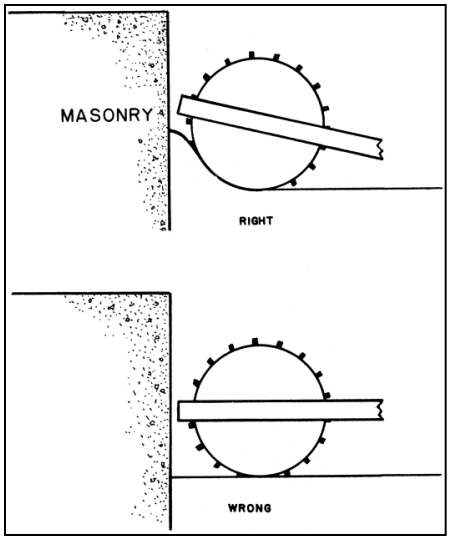




Almost idiot-proof: Any cat skinner (dozer operator) can be taught to "walk" his sheepsfoot roller out of the soil being compacted, as shown in these images.



Roller wheels cannot compact soils within ½ roller diameter of a vertical surface, such as wall or trench

- **Upper left: Sheepsfoot rollers "walk out" of the soil as it becomes densified, *leaving the uppermost 1 to 2 inches uncompacted (don't test the upper two inches – ever!)***
- **Above middle: For this reason it is important that cohesive soils be scarified prior to compaction (difficult if scrappers have been running over everything)**
- **Lower left: Roller compactors cannot compact soils adjacent to walls or near-vertical cuts. Compaction can be achieved by ramping the soil up against the wall (shown here) or inclining the backcut at 45 degrees or less.**

Letourneau Compactors

- Upper Left: In 1947 Letourneau introduced the Tournadozer, or wheel dozer, shown here. It allowed higher speeds (13.5 mph) spreading and compaction of fill lifts, using the air pressure of its enormous tires. Letourneau produced three models, all weighing approximately 25 tons, a 300 HP engine, and a 5.5 cubic yard blade capacity.
- Lower Left: The short-lived Tournapull Roller was developed for the highways market in the early 1950s to provide kneeding compaction of clayey soils with high speed and maneuverability, over long distances.

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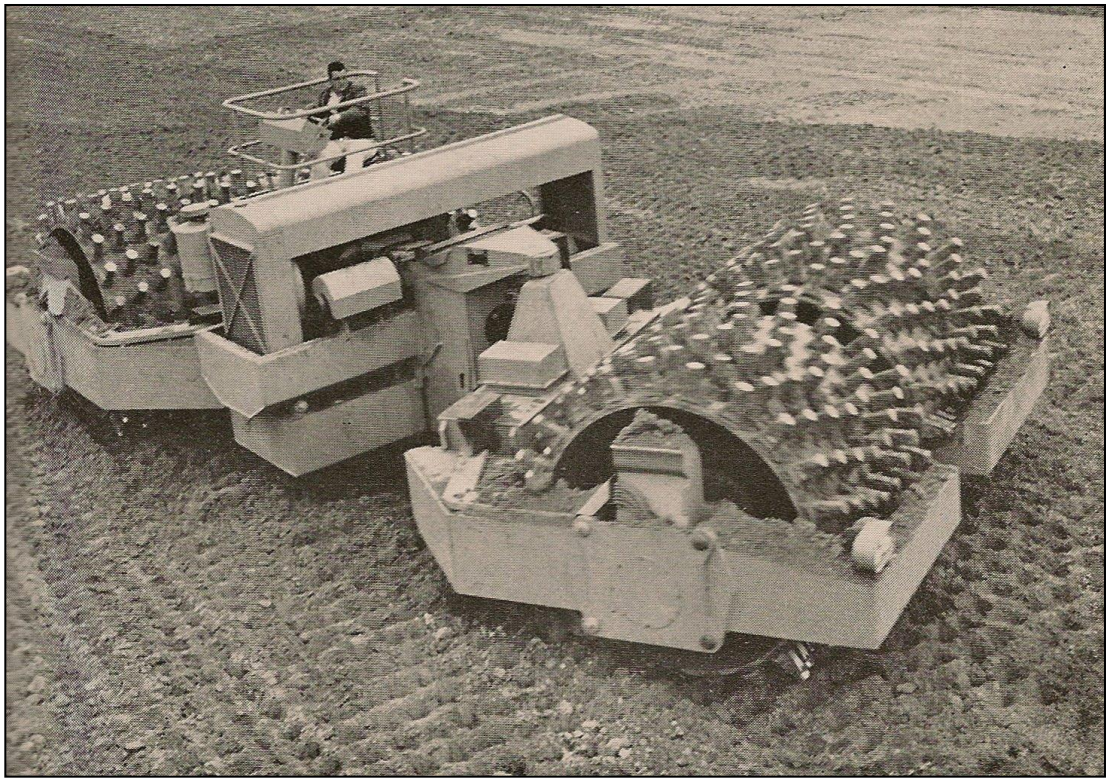
The first self-propelled compactors



- Letourneau introduced the first self-powered soil compactor in March 1959, which were improved and produced up thru 1966.
- Known as the M-50 Power Packer series, they weighed 45 tons, employed an articulated chassis, and were powered by a 420 hp Cummins V-12 engine providing current four electric motors driving the wheels. Only 35 were produced, but they influenced Caterpillar to design and fabricate something similar

RUBBER TIRED ROLLERS

- **Rubber tired (pneumatic) rollers exert a compactive effort *equal to the air pressure* in their tires (35 to 100 psi).**
- **They are generally employed on sandy soils and asphalt pavement.**

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CAT 814, 824, and 834 Series wheeled dozer-compactors

Older CAT 834B with straight blade

In 1963 CAT introduced their 824 Series wheel dozer line with a 300 hp diesel engine and the more powerful 834 Series with 400 hp engines (upper right). In 1970 they introduced the smaller 814 series wheel dozer, with 170 horsepower (shown below). The products went through multiple upgrades over the next two decades, culminating with the 814F, 824G, and 834B models in 1997. That year CAT added two more models to their line, the 844 and 854G. The CAT 834B Series (shown at left) weigh 104,000 lbs C18 diesel with 500 hp


1968 CAT 834A

CAT 834B with U-shaped blade

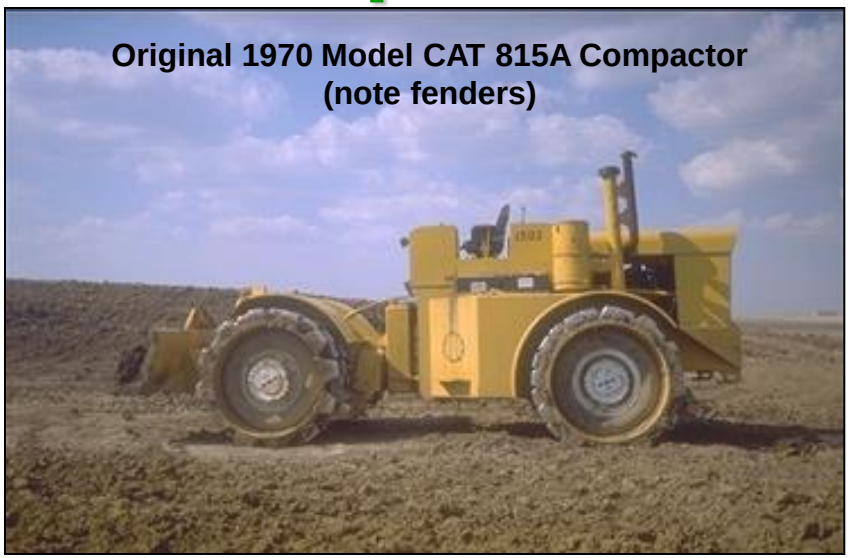

CAT 814

Though not common, the 814, 824, and 834 series wheeled dozers can be retrofitted with pad rollers, as shown at left

CAT 815 series compactors

815B with roll-over protection


Enclosed cab - Note clogged rollers


Original 1970 Model CAT 815A Compactor
(note fenders)

The Caterpillar 815 Series self-propelled compactors first appeared in 1970 and the rollover protection systems introduced in 1971. The 815 employed a D333 turbocharged engine producing 170 hp, with articulated steering and 4WD. This series is still in production with the 815F.

Always watch for clogged rollers (lower left) on the series 815s, 825s, and 835 compactors, before cleaning teeth were installed

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CAT 825 Series

Note muddy wheels

Mud teeth remove accumulated soil between roller pads


The 825C series is the most numerous, produced between 1981-95

Production began in 1969 with a D343 turbocharged 6-cylinder engine producing 300 hp.

It employs a powershift transmission and electric start and comes standard with articulated steering, and all-wheel drive on the compactor wheels.

Left: The 825H series is still in production. Its all weather cab is equipped with heating and air conditioning 15 ft wide blade and 5.5 ft diameter wheels

Notes: In 1980 CAT added headlights; in 1984 a folded core was added. 1992 saw the introduction of full suspension seats with retractable seatbelts. In 1993 the exhaust manifolds were modified with longer mounting studs and spacers. CAT offered a certified rebuild program with this model, which are widely used, world-wide. The 825 G series was produced between 1996-2002. The operating weight is 72,164 pounds.

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CAT 835 SERIES COMPACTORS

- **Above: The CAT 835 series self-propelled compactors were manufactured between 1969-73. They employed a D343 turbocharged after-cooled six-cylinder engine producing 400 hp.**
- **CAT 835s can be fitted with different kinds of rollers, a shown here. The machine at upper left has a pad roller while the one at upper right employs actual sheepsfoot roller pins.**
- **Lower Left: CAT 835 pad roller with enclosed all-weather cab**

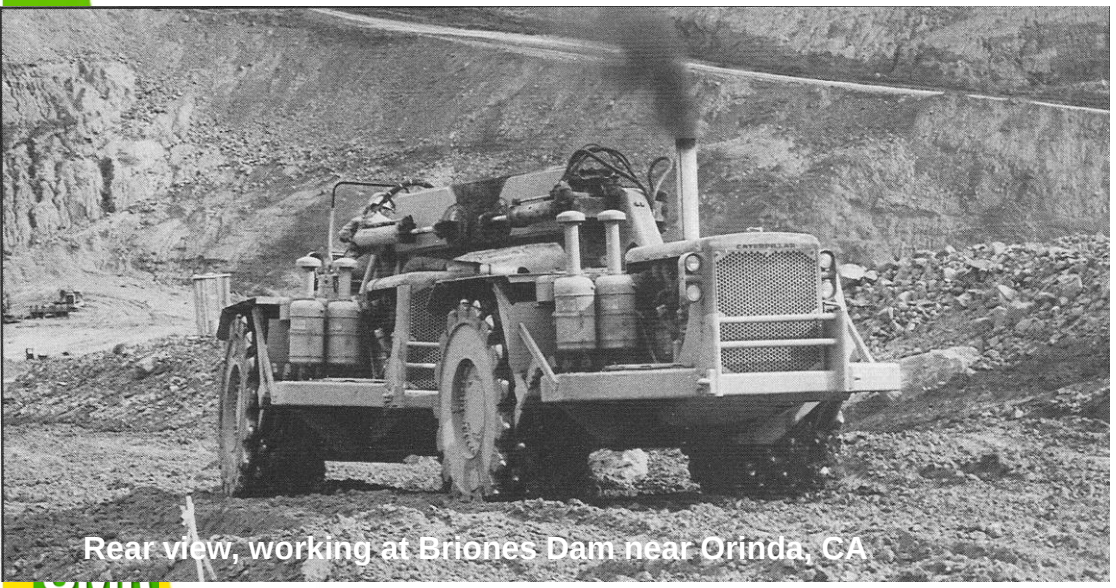
Landfill Compactors

A range of specialized landfill compactors have appeared on the market over the past 40 years, by most of the major manufacturers. These employ various types of wedges and cruciform shapes designed to disaggregate solid waste and integrate it with soil fill. These are not intended for use on engineered fill.

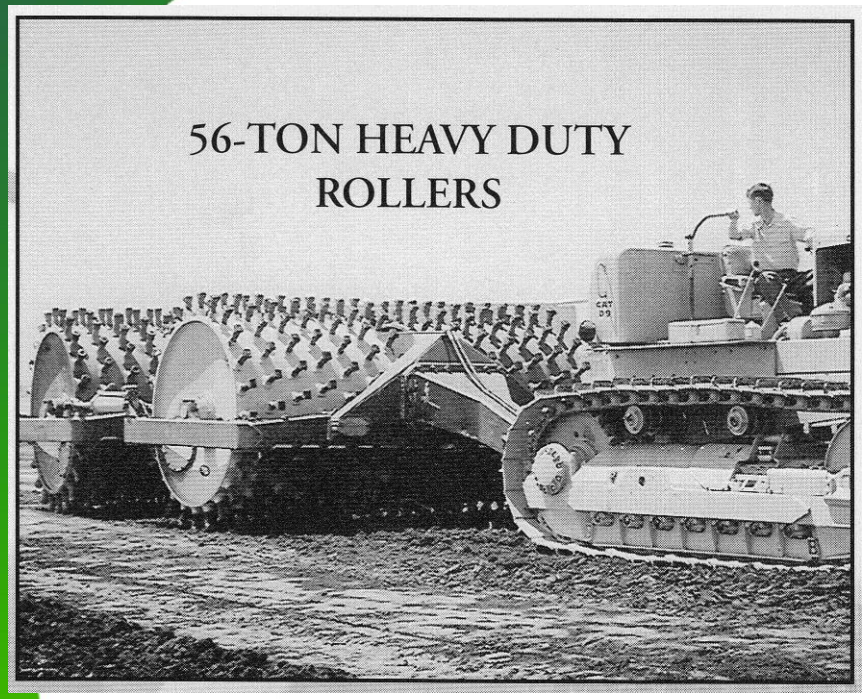
Hybrid Compactors

Above left: CAT 621B Scrapper converted to a padfoot roller compactor for highways work, where the distances are considerable.

Below: Converted CAT 631 scrapper dual-drive pad compactors built by Peterson Caterpillar in San Leandro, California for Guy F. Atkinson Company, and used on the Briones and Oroville Dams in the 1960s.



Rear view, working at Briones Dam near Orinda, CA



Large Special Duty Compactors

- **Upper image: Specially-built 56-ton heavy duty sheepsfoot rollers built for earth dam construction by Guy F. Atkinson in the 1960s.**

- **Lower image: 50 ton multiple box pneumatic-tire compaction roller being used on the damaged runway at Oakland International Airport in 1989. Note box segments, which are semi-articulated.**

COMMON PAD ROLLERS

- **Self-propelled tamping or pad rollers are not sheepsfoot rollers. They are only capable of delivering 5 to 75 psi contact pressures.**
- **They are well suited to most soil mixtures and may employ vibration (2500 to 4500 Hz) for compacting cohesionless (sandy or gravelly) materials.**
- **They have a high center-of-gravity, which makes them more prone to overturning near slopes**

Impact Rollers

The roller weighs 35,700 lbs

- The latest compaction equipment are ***high-energy impact rollers***, which use shaped (*e.g.*, triangular ellipsoids or hexagonal), as opposed to round drums, as shown at upper right. The high energy imparted by these systems allows them to achieve compaction at a faster rate and to greater depths.
- A comparison of different types of compaction equipment based on vertical settlement with number of passes is shown at upper left, demonstrating the superior effectiveness, both in terms of number of passes, and influence depth of high-energy equipment.

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