Construction Equipments

Maryellen Kinder

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Concrete Mixer

This portable concrete/mortar mixer has wheels and a towing tongue so that it can be towed by a motor vehicle and moved around the worksite by hand, and its rotation is powered by mains electricity. The lever allows the concrete/mortar to be tipped into a wheelbarrow.

An outdated model of a small-scale concrete mixer. These older mixers are heavy and can not be moved as easily. They are still however equipped with a electrical motor, so they do not pollute the surroundings

A **concrete mixer** (also commonly called a **cement mixer**) is a device that homogeneously combines cement, aggregate such as sand or gravel, and water to form concrete. A typical concrete mixer uses a revolving drum to mix the components. For smaller volume works portable concrete mixers are often used so that the concrete can be made at the construction site, giving the workers ample time to use the concrete before it hardens. An alternative to a machine is mixing concrete or cement by hand. This is usually done in a wheelbarrow; however, several companies have recently begun to sell modified tarps for this purpose.


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verboten!


ERIE
CEMEX


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KEECO
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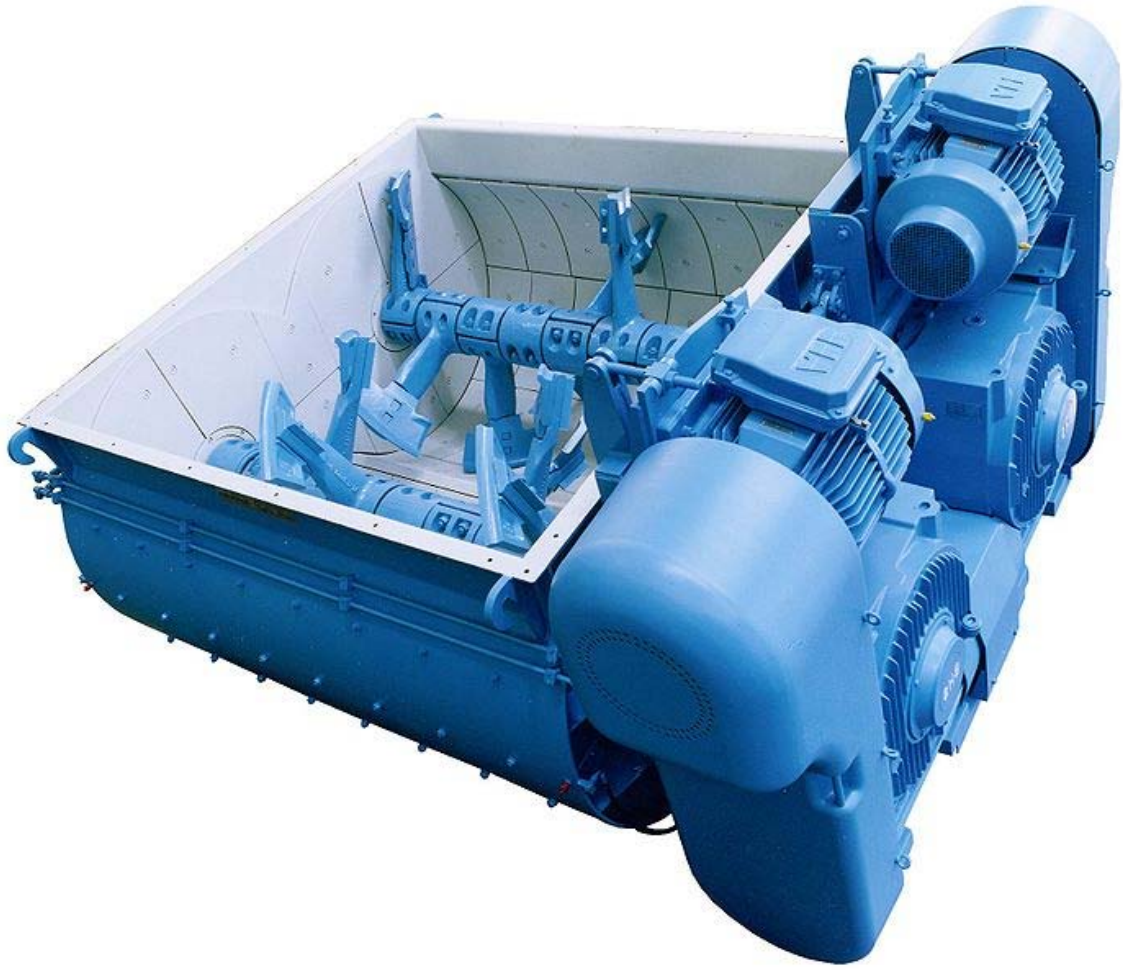
The concrete mixer was invented by Columbus industrialist Gebhardt Jaeger.

Industrial mixers



Twin-shaft concrete mixer.

Today's market increasingly requires consistent homogeneity and short mixing times for the industrial production of ready-mix concrete, and more so for precast/prestressed concrete. This has resulted in refinement of mixing technologies for concrete production. Different styles of stationary mixers have been developed, each with its own inherent strengths targeting different parts of the concrete production market. The most common mixers used today fall into 3 categories: Twin-shaft mixers, Vertical axis mixers (Pan and Planetary mixers) and Drum mixers (Reversing Drum and Tilting Drum).

Twin-shaft mixers are known for their high intensity mixing, and short mixing times. These mixers are typically used for high strength concrete, RCC and SCC, typically in batches of 2–6 m^3. Vertical axis mixers are most commonly used for precast and prestressed concrete. This style of mixer cleans well between batches, and is favoured for coloured concrete, smaller batches (typically 0.75–3 m^3), and multiple discharge points. Within this category, the Pan mixers are losing popularity to the more efficient Planetary

(or counter-current) mixers as the additional mixing action helps in production of more critical concrete mixes (colour consistency, SCC, etc.). Drum mixers (reversing drum mixer and tilting drum mixers) are used where large volumes of concrete are being produced (batch sizes of 3–9 m^3). This type of mixer dominates the ready-mixed market as it is known to be capable of high production speeds, ideal for slump concrete, and where overall cost of production is important. Drum mixers are known to have the lowest maintenance and operating cost of the three styles of mixers. All the mixer styles have their own inherent strengths and weaknesses, and all three styles of mixers are used throughout the world to varying degrees of popularity.

Concrete mixing transport truck

Terex Advance front discharge truck with three lift axles including one tag axle

Front discharge truck cab detail

Volumetric Concrete Mixer

A rear–discharge concrete transport truck

Low-Profile Mining and Tunneling Concrete Mixer Truck

Special concrete transport trucks (**in–transit mixers**) are made to transport and mix concrete up to the construction site. They can be charged with dry materials and water, with the mixing occurring during transport.With this process, the material are already been mixing and also the concrete mixing transport truck maintains the material's liquid state, through agitation, or turning of the drum, until delivery. The interior of the drum on a concrete mixing truck is fitted with a spiral blade. In one rotational direction, the concrete is pushed deeper into the drum. This is the direction the drum is rotated while the concrete is being transported to the building site. This is known as "charging" the mixer. When the drum rotates in the other direction, the Archimedes' screw-type arrangement "discharges", or forces the concrete out of the drum. From there it may go onto chutes to guide the viscous concrete directly to the job site. If the truck cannot get close enough to the site to use the chutes, the concrete may be discharged into a concrete pump, connected to a flexible hose, or onto a conveyor belt which can be extended some

distance (typically ten or more meters). A pump provides the means to move the material to precise locations, multi-floor buildings, and other distance prohibitive locations. The drum is traditionally made of steel but on some newer trucks as a weight reduction measure, fiberglass has been used.

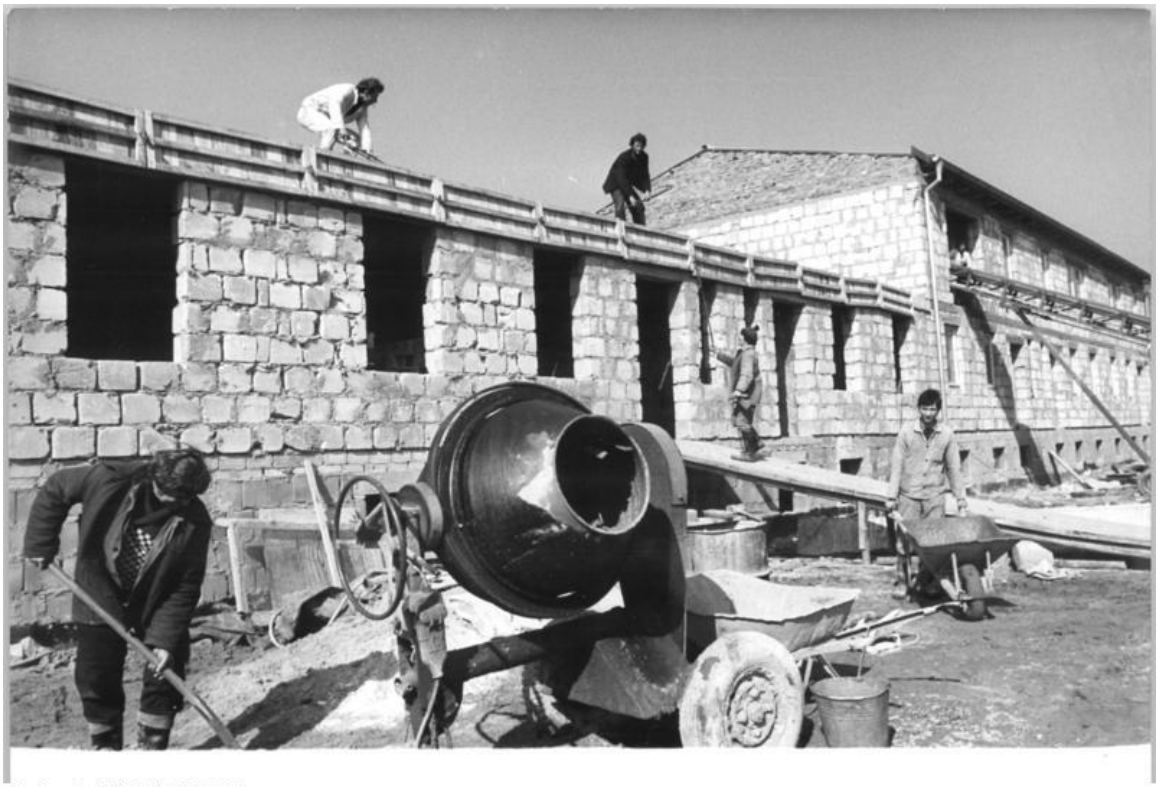


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Foto: Bartocha, Benno | 8. April 1986

Bundesarchiv, Bild 183-69250-0002
Foto: Martin | 2. Dezember 1959

"Rear discharge" trucks require both a driver and a "chuteman" to guide the truck and chute back and forth to place concrete in the manner suitable to the contractor. Newer "front discharge" trucks have controls inside the cab of the truck to allow the driver to move the chute in all directions. The first front discharge mixer was designed and built by Royal W. Sims of Holladay, Utah.

Concrete mixers are equipped with anywhere from two axles and up. Four, 5 and 6 axle trucks are the most common with the number being determined by the load and local legislation governing allowable loads on the road. These are necessary to distribute the load evenly and allow operation on weight restricted roads and to reduce wear and tear on normal roads. A two or three axle truck during the winter when road weight limits are reduced has no usable payload in many jurisdictions. Other areas may require expensive permits to operate. Additional axles other than those used for steering ("steers") or drivetrain ("drives") may be installed between the steers and drives or behind the drives. Mixers commonly will have multiple steering axles as well, which generally result in very large turning radii. To facilitate maneuvering the additional axles may be "lift axles" which allows them to be raised off the ground so that they do not scrub (get dragged sideways across the ground) on tight turns, or increase the vehicle's turning radius. Axles installed behind the drives are known as "tag axles" or "booster axles", and are often equipped to turn opposite to the steering axle to reduce scrubbing and automatically lift when the truck is put into a reverse gear.

Tractor trailer combination mixers where the mixer is installed on a trailer instead of a truck chassis are used in some jurisdictions, such as the province of Quebec where even 6 axle trucks would have trouble carrying a useful load.

Concrete mixers generally do not travel far from their plant, as the concrete begins to setup as soon as it is in the truck. Many contractors require that the concrete be in place within 90 minutes after loading. If the truck breaks down or for some other reason the concrete hardens in the truck, workers may need to enter the barrel with jackhammers; dynamite is still occasionally used to break up hardened concrete in the barrel under certain circumstances.

Stephen Stepanian filed a patent application for the first truck mixer in 1916. Trucks weigh 20,000 pounds (9,100 kg) to 30,000 pounds (14,000 kg), and can carry roughly 40,000 pounds (18,000 kg) of concrete although many varying sizes of Mixer Truck are currently in use. The most common truck capacity is 8 cubic yards (6 m^3).

Most concrete mixers in the UK are limited to a speed of 56 miles per hour (90 km/h).

Concrete mixer trailer

1 Yard Cart-Away Mixing Trailer

A variant of standard concrete transportation is the concrete or cement mixing trailer. These small versions of a transit-mix truck are used to supply short loads of concrete. These cart-away style trailers have a concrete mixing drum with a capacity of between 1-yard and 1.75 yards. Cart-aways are usually pulled behind a pick-up truck and batched from smaller batching systems. The mixing trailer system is popular with rental yards and building material locations, who use them to supply ready-mix to their regular customer base.

Chapter- 2

Concrete Pump

Because it is a fluid, concrete can be pumped to where it is needed. Here, a concrete transport truck is feeding concrete to a concrete pumper, which is pumping it to where a slab is being poured.

A **concrete pump** is a tool used for transferring liquid concrete by pumping. There are two types of concrete pumps.

The first type of concrete pump is attached to a truck. It is known as a trailer-mounted boom concrete pump because it uses a remote-controlled articulating robotic arm (called a *boom*) to place concrete with pinpoint accuracy. Boom pumps are used on most of the larger construction projects as they are capable of pumping at very high volumes and because of the labour saving nature of the placing boom. They are a revolutionary alternative to truck-mounted concrete pumps.

Construction site with concrete pump.

A Putzmeister concret pump in Germany in 1985.

Folded concrete pump for transport.

The second main type of concrete pump is either mounted on a truck and known as a truck-mounted concrete pump or placed on a trailer, and it is commonly referred to as a *line pump* or trailer-mounted concrete pump. This pump requires steel or rubber concrete placing hoses to be manually attached to the outlet of the machine. Those hoses are linked together and lead to wherever the concrete needs to be placed. Line pumps normally pump concrete at lower volumes than boom pumps and are used for smaller volume concrete placing applications such as swimming pools, sidewalks, and single family home concrete slabs and most ground slabs.

Boom concrete pump

Concrete pump

Putzmeister brand positive displacement mortar and plaster pump.

There are also skid mounted and rail mounted concrete pumps, but these are uncommon and only used on specialized jobsites such as mines and tunnels.

World record

The world record was set at on 7 August 2009 during the construction of the Parbati Hydroelectric Project, near the village of Suind, Himachal Pradesh, India, when the concrete mix was pumped through a vertical height of 715 m (2,346 ft)using SCHWING STETTER concrete pump.

Chapter- 3

Dumper

Dumper in action

A **dumper** is a vehicle designed for carrying bulk material, often on building sites. Dumpers are distinguished from dump trucks by configuration: a dumper is usually an open 4-wheeled vehicle with the load skip in front of the driver, while a dump truck has its cab in front of the load. The skip can tip to dump the load; this is where the name "dumper" comes from. They are normally diesel powered. A towing eye is fitted for secondary use as a site tractor. Dumpers with rubber tracks are used in special circumstances and are popular in some countries.


Bobcat
HDX 1000
P73


HDX 1000

Early dumpers had a payload of about a ton and were 2-wheel drive, driving on the front axle and steered at the back wheels. The single cylinder diesel engine (sometimes made by Lister) was started by hand cranking. The steering wheel turned the back wheels, not front. Having neither electrics nor hydraulics there was not much to go wrong. The skip was secured by a catch by the driver's feet. When the catch is released, the skip tips under the weight of its contents at pivot points below, and after being emptied is raised by hand.


TEREX


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Modern dumpers have payloads of up to 10 tonnes and usually steer by articulating at the middle of the chassis (pivot steering). They have multi-cylinder diesel engines, some turbocharged, electric start and hydraulics for tipping and steering and are more expensive to make and operate. An A-frame known as a ROPS (Roll-Over Protection) frame, may be fitted over the seat to protect the driver if the dumper rolls over. Some dumpers have FOPS (Falling Object Protection) as well. Lifting skips are available for discharging above ground level. In the 1990s dumpers with swivel skips, which could be rotated to tip sideways, became popular, especially for working in narrow sites such as road works. Dumpers are the most common cause of accidents involving construction plant.

These vehicles are also called "dumper" in some mainland European languages.

Chapter- 4

Hard Hat

Hard hat

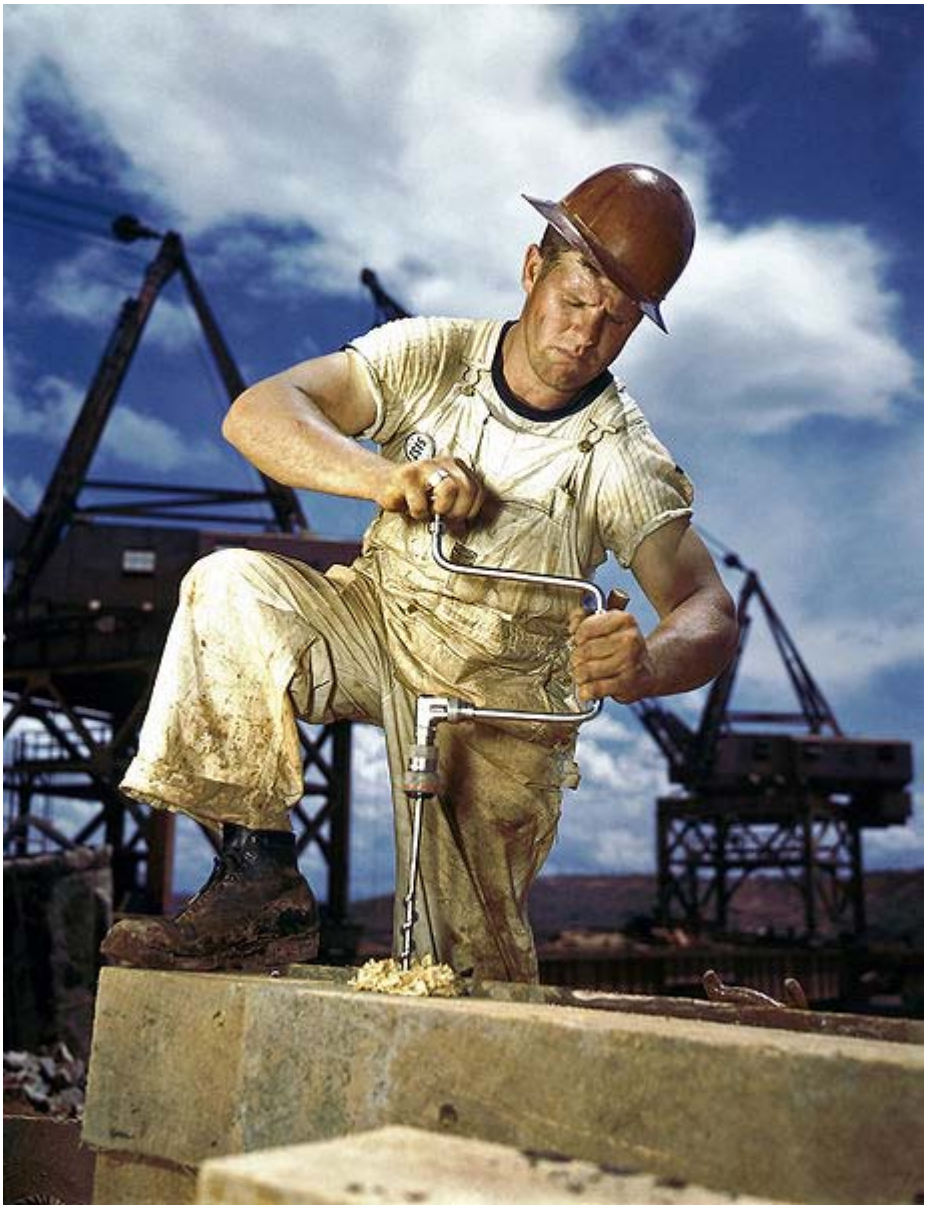
The inside of a typical hard hat

A **hard hat** is a type of helmet predominantly used in workplace environments, such as construction sites, to protect the head from injury by falling objects, impact with other objects, debris, bad weather and electric shock. Inside the helmet is a suspension that spreads the helmet's weight over the top of the head. It also provides a space of approximately 30 mm (1.2 inch) between the helmet's shell and the wearer's head so that if an object strikes the shell, the impact is less likely to be transmitted directly to the skull. Sometimes the helmet shell has a midline reinforcement ridge, which strengthens it against impact.

History

Management professor Peter Drucker credits writer Franz Kafka with developing the first civilian hard hat when he was employed at the Worker's Accident Insurance Institute for the Kingdom of Bohemia (1912), but this is not supported by any document from his employer.

Hard hat



Construction worker at Douglas Dam, Tennessee (TVA), 1942

The 2000-year-old remains of Ancient Rome, Italy, are being excavated by these archaeologists

Workman's safety helmet with visor and chinstrap

In the United States, the E.D. Bullard Company was a mining equipment firm in California, created by Edward Dickinson Bullard in 1898, who was in the industrial safety business for 20 years. The company sold protective hats, but they were only made of leather. His son, E.W. Bullard, arrived home from World War I with a steel helmet, which provided him with an idea to improve industrial safety. In 1919 Bullard patented a "Hard-Boiled Hat", made of steamed canvas, glue and black paint. That same year the U.S. Navy commissioned Bullard to create a shipyard protective cap, which began the widespread use of hard hats. Not long after, Bullard developed an internal suspension that would provide a more effective hat. These early designs bore a resemblance to the military M1917 "Brodie" helmet, which served as their inspiration.


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Foto: Petzold | 15. Januar 1951

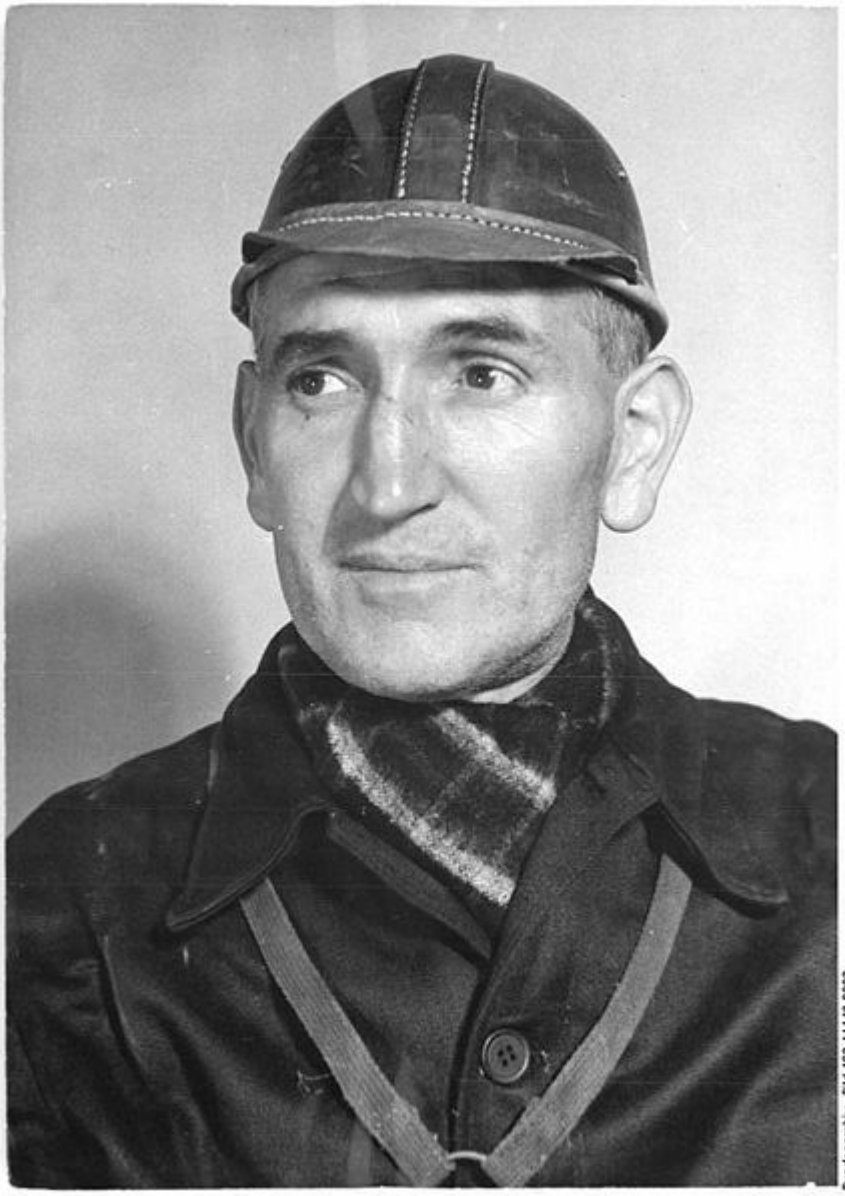
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Foto: Vogel | 29. Juni 1951

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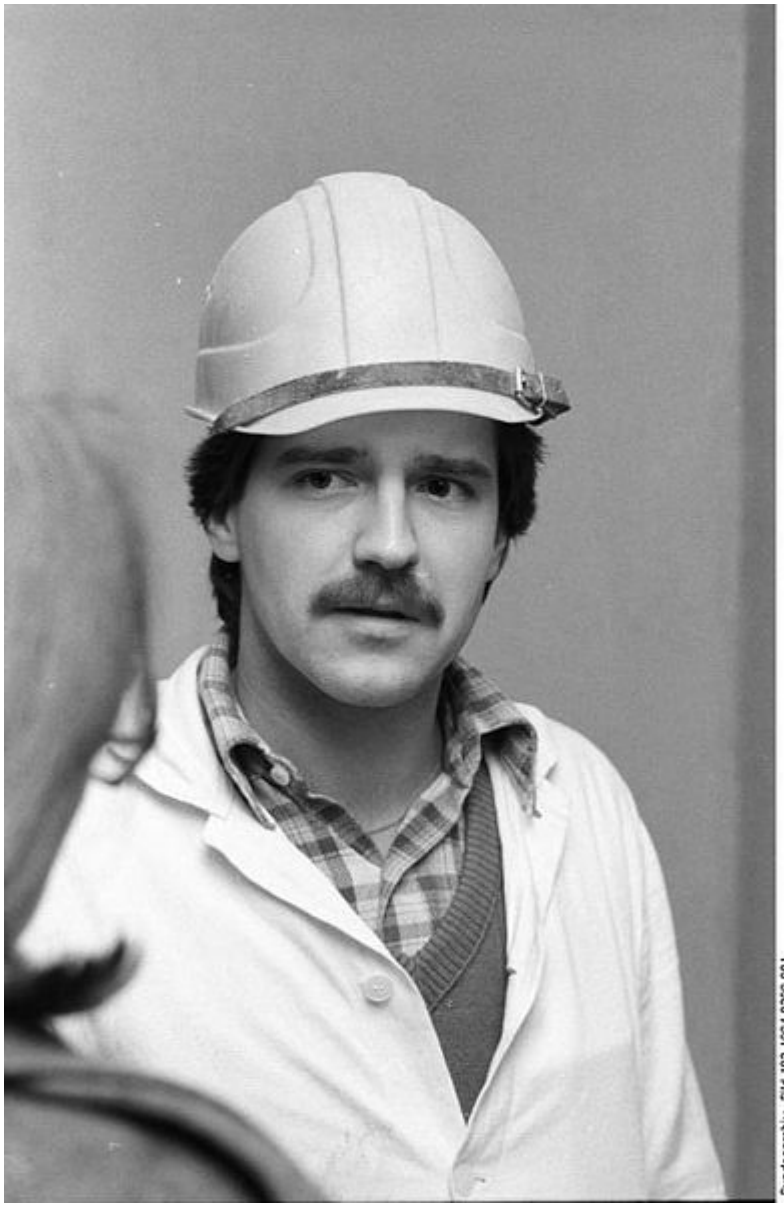
Foto: Panzold, Ralf | 25. März 1982



In 1933 construction began on the Golden Gate Bridge in San Francisco California. This was the second construction site in history where construction workers were required to wear hard hats(the first being the Hoover Dam project in 1931, as mandated by Six Companies, Inc), by order of Joseph Strauss, the project chief engineer. He wanted the workplace to be as safe as possible; hence, he installed safety nets and required hard hats while on the job site. Strauss also asked Bullard to create a hard hat to protect workers who performed sandblasting. Bullard produced a design that covered the worker's face, provided a window for vision and a supply of fresh air via a hose connected to the air compressor.

Aluminum became a standard for hard hats around 1938, except in electrical applications.

Fiberglass came into use in the 1940s.

Thermoplastics took over in the 1950s, because they were easy to mold and shape with heat and cost less to manufacture. Today, most hard hats are made from high-density polyethylene (HDPE) or advanced engineering resins, such as Ultem.

In 1997 ANSI allowed the development of a ventilated hard hat to keep wearers cooler. To it could be added accessories like face shields, sun visors, earmuffs, and perspiration-absorbing cloths which line the hats. Today, attachments include radios, walkietalkies, pagers, and cameras.

Design

Hard hats are typically required personal protective equipment where heavy labor is being performed. They were originally made from metal, then fiberglass, but from the 1950s rigid plastic has been the most common material.

Some contemporary cap-style hard hats feature a rolled edge that acts like a rain gutter to channel rainwater to the front, allowing it to drain off the bill, instead of letting the water run down the wearer's neck. A **cowboy hard hat** is a hard hat shaped like a wide rimmed cowboy hat

U.S. Navy sailors loading cargo onto a container ship in Antarctica

A hard hat issued by a firm may have that firm's name or some word or logo on its front.

Hardhats may also be fitted with:

- Visor:
  - As in a welding helmet, or
  - A safety visor
- Ear protectors
- Mirrors for increased rear field-of-view
- A helmet light mount
- A chinstrap to keep the helmet from falling off if the workman bends over
- Thick insulating side pads to keep the sides of the head warm in very cold places. Examples are seen in *Ice Road Truckers*.

Hard hat colors can signify different roles on construction sites. For instance, white might signify supervisors or engineers, blue technical advisors, red safety inspectors, and yellow laborers.

A hard hat also gives a worker a distinctive profile, identifiable even in peripheral vision, for safety around equipment or traffic. Safety colors like orange or green do not appear in peripheral vision, but the hard hatted shape of a worker will be avoided.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ur
ass
Sorry WE'RE
CORRUPT

In 1997, the American National Standards Institute revised its performance standards for hard hats. Conformity to these standards and regulation are not necessary but almost all manufactures comply:

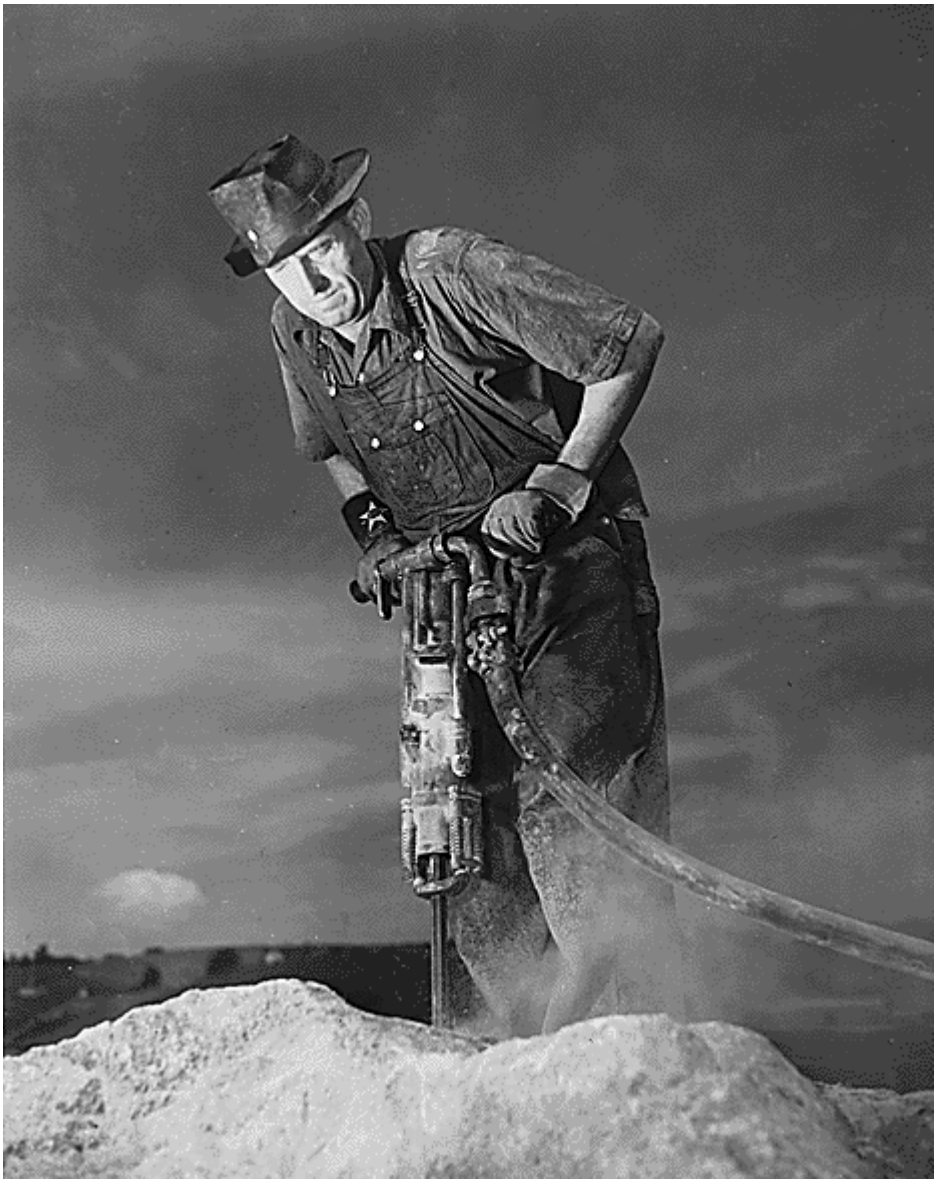
- ANSI Type I / CSA Type 1 hard hats meet stringent vertical impact and penetration requirements.
- ANSI Type II / CSA Type 2 hard hats meet both vertical and lateral impact and penetration requirements and have a foam inner liner of expanded polystyrene (EPS).
- A Class E hard hat has been proof-tested to insulate up to 20,000 volts of electrical potential.
- ANSI have compliance for hard hats and their combustibility or flammability criteria.

Blue-collar workers, especially union shop construction workers, engaged in occupations that require protective equipment are sometimes metonymically referred to as "**hard hats**".

A **bump cap** is a lightweight kind of hard hat with simplified suspension or padding in lieu of suspension and having only a chin strap. It is used where there is a possibility of scraping or bumping one's head on equipment or structure projections, but is not strong enough to absorb large impacts, such as from a tool dropped several stories.

Chapter- 5

Jackhammer



Drilling a blast hole with a jackhammer

A **jackhammer** is a power tool that combines a hammer and chisel. Hand-held jackhammers are typically powered by compressed air, but some used electric motors. Larger jackhammers used on construction machinery are usually hydraulically powered. They are usually used to breakup rock, pavement, and concrete.

A jackhammer operates by driving an *internal* hammer up and down. The hammer is first driven down to strike the back of the *bit* and then back up to return the hammer to the original position to repeat the cycle. The bit usually recovers from the stroke by means of a spring. The effectiveness of the jackhammer is dependent on how much force is applied to the tool.

Terminology

The word "jackhammer" is used in North American English and Australia, while "pneumatic drill" is used colloquially elsewhere in the English speaking world, although strictly speaking a "pneumatic drill" refers to a pneumatically driven jackhammer. In Britain, the term "jackhammer" usually refers to electromechanical version of the tool.

Use

A full-sized portable jackhammer is impractical for use against walls and steep slopes, except for a very strong man, as the user would have to both support the weight of the tool, and push the tool back against the work after each blow. A technique developed by experienced workmen is a two-man team to overcome this obstacle of gravity: one man operates the hammer and the second assists by holding the hammer either on his shoulders or cradled in his arms. Both use their combined weight to push the bit into the workface. This method is commonly referred to as horizontal jackhammering.

Another method is overhead jackhammering, requiring strength conditioning and endurance to hold a smaller jackhammer, called a rivet buster, over one's head.

Types

Pneumatic

A compressor for running a pneumatic jackhammer

A pneumatic jackhammer, also known as a *pneumatic hammer*, is a jackhammer that uses compressed air as the power source. The air supply usually comes from a portable air compressor driven by a diesel engine. Reciprocating compressors were formerly used. The unit comprised a reciprocating compressor driven, through a centrifugal clutch, by a diesel engine. The engine's governor provided only two speeds:

- idling, when the clutch was disengaged
- maximum, when the clutch was engaged and the compressor was running

Modern versions use rotary compressors and have more sophisticated variable governors. The unit is usually mounted on a trailer and sometimes includes an electrical generator to supply lights or electric power tools.

Electromechanical

A single phase demolition breaker.

This tool is useful where the work is light and inaccessible to a compressor.

Hydraulic

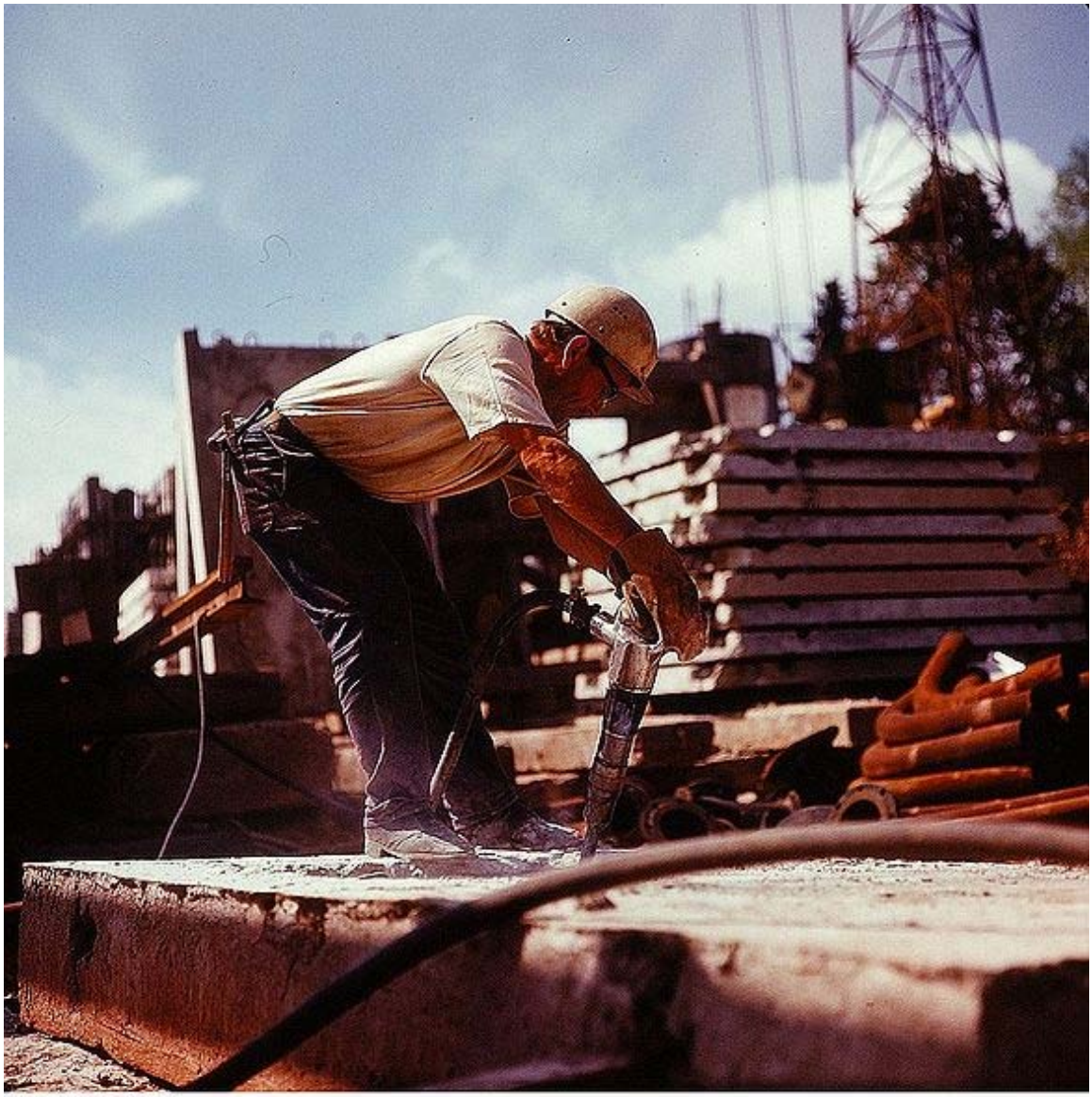
An excavator-mounted hydraulic jackhammer being used to break up concrete.

A hydraulic jackhammer, much larger than portable ones, may be fitted to mechanical excavators or backhoes and is widely used for roadwork, quarrying and general demolition or construction groundwork. Such tools can also be used against vertical walls (or ceilings for that matter), since the vehicles involved are massive enough and powerful enough to exert the forces involved without needing the help of gravity in operating the

tool. Pneumatic or hydraulic tools are particularly likely to be used in mines where there is an explosion risk (such as underground coal mines), since they lack any high-power electrical circuitry that might cause a triggering spark.

Quelle: Deutsche Fotothek

Quelle: Deutsche Fotothek



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Hydraulic breakers usually use a hydraulic motor driving a sealed pneumatic hammer system, as a hydraulic hammer would develop a low strike speed and transfer unacceptable shock loads to the pump system.

Bits

Bit types include:

- Spade - provides flat finish for concrete or edging in asphalt or dirt
- Flat tip - allows direction control or finer edge finish
- Point - general breaking

- Stake driver - drives concrete form stakes
- Scrabbler - finishes surface smooth or for cleaning prior to bonding

Health

A jackhammer with black silencer attached

The sound of the hammer blows, combined with the explosive air exhaust, makes pneumatic jackhammers dangerously loud, emitting 100 decibels at two meters. Sound-blocking earmuffs must be worn by the operator to prevent a form of hearing damage of which tinnitus is the main symptom. Most pneumatic jackhammers now have a silencer around the barrel of the tool.

Prolonged exposure to the pronounced vibration set up by the tool can lead to blood-circulation failures in the fingers, a condition known as white finger. Applying athletic tape is not effective in preventing white finger but seems to help alleviate some of its discomfort. Pneumatic drill usage can also lead to a predisposition for development of carpal tunnel syndrome.

Chapter- 6

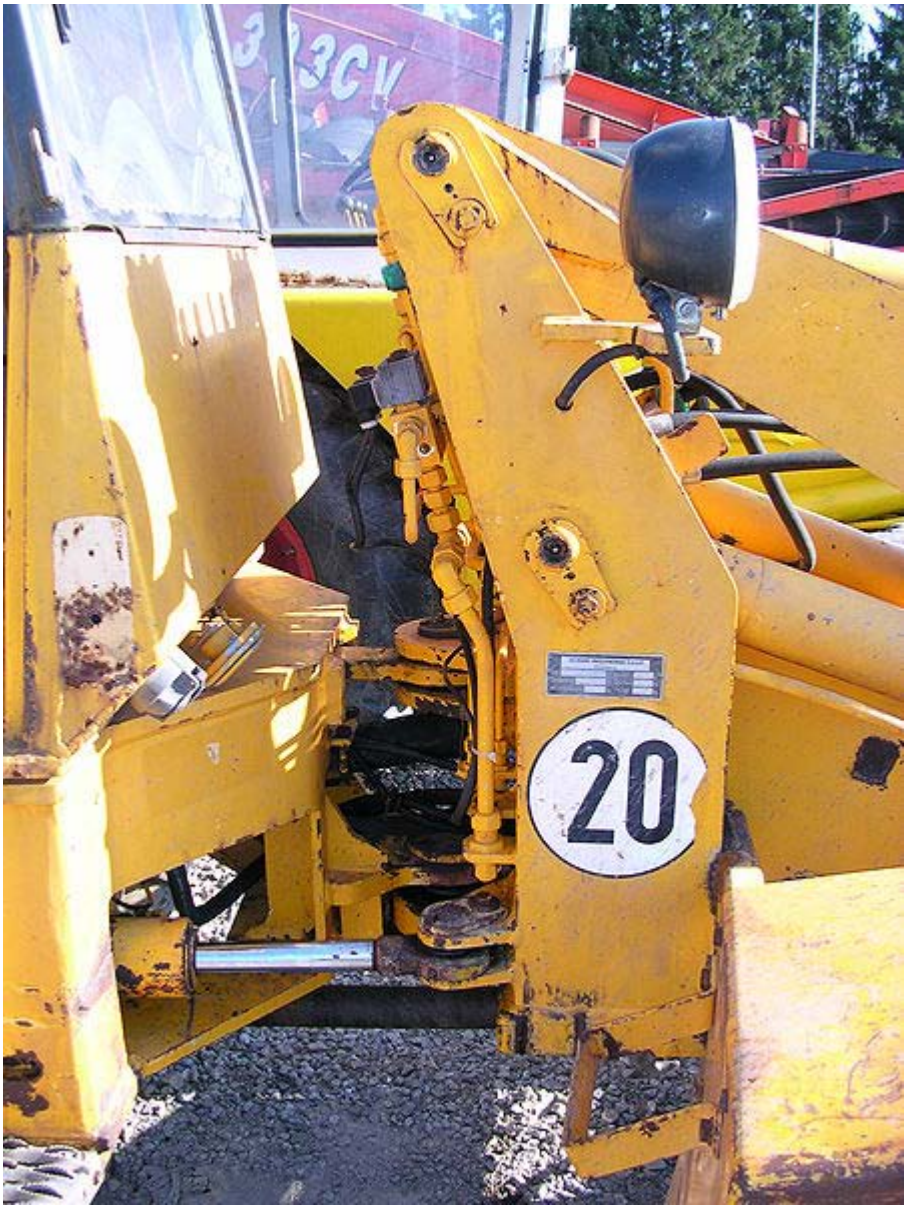
Loader

A **loader** is a heavy equipment machine often used in construction, primarily used to load material (such as asphalt, demolition debris, dirt, snow, feed, gravel, logs, raw minerals, recycled material, rock, sand, and woodchips) into or onto another type of machinery (sich as a dump truck, conveyor belt, feed-hopper, or railcar).

Volvo L120E front loader

Caterpillar 988 adapted for log handling

A track loader



Close-up of articulated steering apparatus

Loader removing snow in Jyväskylä, Finland

Heavy equipment front loaders

A loader (also known as: **bucket loader**, **front loader**, **front end loader**, **payloader**, **scoop loader**, **shovel**, **skip loader**, and/or **wheel loader**) is a type of tractor, usually wheeled, sometimes on tracks, that has a front mounted square wide bucket connected to the end of two booms (arms) to scoop up loose material from the ground, such as dirt, sand or gravel, and move it from one place to another without pushing the material across the ground. A loader is commonly used to move a stockpiled material from ground level and deposit it into an awaiting dump truck or into an open trench excavation.

The loader assembly may be a removable attachment or permanently mounted. Often the bucket can be replaced with other devices or tools—for example, many can mount forks to lift heavy pallets or shipping containers, and a hydraulically-opening "clamshell" bucket allows a loader to act as a light dozer or scraper. The bucket can also be augmented with devices like a bale grappler for handling large bales of hay or straw.

A Hanomag loader

DK45 with and without a toothbar on the bucket

A relatively small front loader

Large **loaders**, such as the *Kawasaki 95ZV-2*, *John Deere 844K*, *Caterpillar 950H*, *Volvo L120E*, *Case 921E*, or *Hitachi ZW310* usually have only a front bucket and are called *Front Loaders*, whereas small loader tractors are often also equipped with a small backhoe and are called backhoe loaders or loader backhoes or JCBs, after the company that first invented them.

The largest loader in the world is LeTourneau L-2350. Currently these large loaders are in production in the Longview, Texas facility. The L-2350 uses a diesel electric propulsion system similar to that used in a locomotive. Each rubber tired wheel is driven by its own independent electric motor.

Loaders are used mainly for uploading materials into trucks, laying pipe, clearing rubble, and digging. A loader is not the most efficient machine for digging as it cannot dig very deep below the level of its wheels, like a backhoe can. The capacity of a loader bucket can be anywhere from 0.5 to 36 m^3 depending upon the size of the machine and its application. The front loader's bucket capacity is generally much bigger than a bucket capacity of a backhoe loader.

Unlike most bulldozers, most loaders are wheeled and not tracked, although track loaders are common. They are successful where sharp edged materials in construction debris

would damage rubber wheels, or where the ground is soft and muddy. Wheels provide better mobility and speed and do not damage paved roads as much as tracks, but provide less traction.

A loader with a specialized claw used to move logs at a sawmill

A Caterpillar 930G fitted with a loader rake on a residential construction site in South Florida.

The front of a Caterpillar 930G fitted with loader rake.

In construction areas loaders are also used to transport building materials - such as bricks, pipe, metal bars, and digging tools - over short distances.

Front loaders are commonly used to remove snow especially from sidewalks, parking lots, and other areas too small for using snowplows and other heavy equipment. They are sometimes used as snowplows with a snowplow attachment but commonly have a bucket or snowbasket, which can also be used to load snow into the rear compartment of a snowplow or dump truck.

High-tip buckets are suitable for light materials such as chip, peat and light gravel and when the bucket is emptied from a height.

Unlike backhoes or standard tractors fitted with a front bucket, many large loaders do not use automotive steering mechanisms. Instead, they steer by a hydraulically actuated pivot point set exactly between the front and rear axles. This is referred to as "articulated steering" and allows the front axle to be solid, allowing it to carry greater weight. Articulated steering provides better maneuverability for a given wheelbase. Since the front wheels and attachment rotate on the same axis, the operator is able to "steer" his load in an arc after positioning the machine, which can be useful. The tradeoff is that

when the machine is "twisted" to one side and a heavy load is lifted high, it has a greater risk of turning over to the "wide" side.

Front loaders gained popularity during the last two decades, especially in urban engineering projects and small earthmoving works. Heavy equipment manufacturers offer a wide range of loader sizes and duties.


FIATALLIS
R15B


ATLAS

The term "loader" is also used in the debris removal field to describe the boom on a grapple truck.

Armored Wheel Loaders

IDF armored wheel loader

The Israeli Combat Engineering Corps use armored Caterpillar 966 wheel loader for construction and combat engineering missions in hostile territories such as the West Bank. They are often seen building or removing road blocks, building bases and fortifications and starting in 2005, demolishing small houses. The IDF added armor plating for the loader, protecting it against rocks, stones, molotov cocktails, and light gunfire.

Rio de Janeiro's police elite squad BOPE have recently acquired one wheel loader of military purposes to open routes and make way for the police in Rio de Janeiro's slums, which are controlled, and blocked, by drugdealers. It is nicknamed "The Skulls' Transformer", being a reference to how they call themselves -- "The Skulls".

Tractor front loaders

These loaders are a popular addition to tractors from 50 to 200 hp. Its current 'drive-in' form was originally designed and developed in 1958 by a company called Quicke They were developed to perform a multitude of farming tasks, and are popular due to their relatively low cost (compared to Telehandler) and high versatility. Tractor loaders can be fitted with many attachments such as hydraulic grabs and spikes to assist with bale and silage handling, forks for pallet work, and buckets for more general farm activities.

Compact front end loaders

Semi-curved compact loader on a John Deere compact utility tractor

Visibility comparison of different loader designs

Popular additions to compact utility tractors and farm tractors are **Front End Loaders**, also referred to as a **FEL**. Compact utility tractors, also called CUTs are small tractors, typically with 18 to 50 horsepower (37 kW) and used primarily for grounds maintenance and landscape chores. There are 2 primary designs of compact tractor **FEL**s, the traditional dogleg designed style and the curved arm style.

John Deere Tractor manufactures a semi-curved loader design that does not feature the one piece curved arm, but also is not of the traditional two piece design. New Holland Ag introduced a compact loader with a one piece curved arm on its compact utility tractors, similar one piece curved arm loaders are now available on compact tractors on many brands including Case/Farmall, and some Montana and Kioti tractors. Kubota markets traditional loader designs on most of its compact tractors but now features a semi-curved loader design similar to the John Deere loader design on several of its small tractors.

While the **Front End Loaders** on CUT size tractors are capable of many tasks, given their relatively small size and low capacities when compared to commercial loaders, the compact loaders can be made more useful with some simple options. A **Toothbar** is commonly added to the front edge of a loader bucket to aid with digging. Some loaders are equipped with a quick coupler, otherwise known as a **Quick Attach** *(QA)* system, the *QA* system allows the bucket to be removed easily and other tools to be added in its

place. Common additions would include a set of **Pallet Forks** for lifting pallets of goods or a **Bale Spear** for lifting hay bales.

Compact utility tractor with a front loader showing two different measurement points for loader capacities

Skid loaders & track loaders

A skid loader is a small loader utilizing four wheels with hydraulic drive that directs power to either, or both, sides of the vehicle. Very similar in appearance and design is the track loader, which utilizes a continuous track on either side of the vehicle instead of the wheels. Since the expiration of Bobcat's patent on its quick-connect system, newer tractor models are standardizing on that popular format for front end attachments.

Swingloaders

A swing loader is a rigid frame loader with a swinging boom. The boom can swing 180 degrees or more. Swingloaders are primarily used by the railroad industry to lay rail. Like other loaders many attachments can be attached to the boom such as magnets, forks, and buckets. Smaller swingloaders are used in farming applications for loading out. A swinging boom is advantageous where space is limited. The loader is able to lift on all sides and dump off on all sides.

Chapter- 7

Power Trowel

Walk Behind Power Trowel

13hp Boren Power Trowel

6.5hp Boren Power Trowel

A **power trowel** (also known as a "power float", "helicopter" or "trowel machine") is a piece of light construction equipment used by construction companies and contractors, to apply a smooth finish to concrete slabs.

Power trowels differ in the way they are controlled:

- Ride-on power trowels are used by an operator sitting on a seat upon the machinery, controlling the power trowel with the necessary buttons.
- Walk-behind power trowels are used by an operator walking behind the machine.

Operation

Both walk-behind and ride-on operate on the same principle. A spinning disc (either a disc or 'pan' or blades. The image of the ride-on Power Float has the disc/pan fitted to both rotors) has pressure applied to one area where the additional friction of the blades against the floor moves the Power Float in the opposite direction of the rotor blades.

The machine is steered by applying the weight of the machine at a certain segment of the rotor arc, which will take the machine in the desired direction. With the 'walk behind' model, the handle is pressed or lifted. This puts weight on the rear or front of the rotor which will move it from side to side, and with judicious positioning of the handle, forward or backward motion is possible using this side-to-side control.

With the 'ride on' model, there is a control for each blade that fulfills the same role. There is either a pole or hydraulic control that fulfills the same principle as the walk-behind but the ride-on differs in that its control of rotor direction is like that of a helicopter.

To operate them: start the engine, adjust throttle control and pull in the clutch lever which spins the rotor. They all have a 'dead man' control for the clutch, that is, the machine stops the rotors when the lever is released.

Then the trowel is glided over the surface at different periods during the concrete 'set', starting with a flat disc or 'pan' that fits over the rotor blades, which brings up the 'fat' of the concrete while filling depressions and removing high spots. Later the blades are used at an increasingly sharp angle until the surface is hard, flat, and starts shine.

Edges to the bay, or areas the Power Float can't access, are finished with a hand trowel. Newer Power Floats have blades with curved ends that are flush with the wire skirt so the edges can be troweled, plus the blades don't hit or snag objects.

Which type?

The walk-behind is cheaper to buy, lighter to move, and the user can see what the discs do while the disc is at that area. But it is one disc and the big ones can 'give your abs a workout' as you try stop their motion at the end of each pass.

The ride-ons have two rotors so one can theoretically double the area trowelled; they also tend to have more blades per rotor. But you are looking in front at where you are going, not at what surface the machine has left leaving you with the possibility of picking up defects 'next time around'. They are expensive, heavier to move and only pay for themselves on big areas, but they are very comfortable and easy to use.

Other uses

There is a trend to use walk-behind machines, or versions of the same but designed to be light weight and using pneumatic air via hoses instead of a heavy power plant and fuel, for the use in thin epoxy coatings and/or thin coloured decorative coatings.

Chapter- 8

Quick Coupler

Automatic Quickhitch in the closed position. Note the large spring on the ram, this helps to prevent accidental release of the attachment. Additional safety is available by way of a large pin manually inserted through the hole on the bottom left preventing any movement by the hitch.

Automatic Quickhitch in the open position, allowing the required attachment to be picked up or released.

Quick couplers (also called quick hitches) are used with construction machines to allow the rapid change of buckets and attachments on the machine. They remove the need to use hammers to manually drive out and insert the mounting pins for attachments. They also bring with them additional safety risks that must be overcome by careful design and manufacture, and proper use.

Description

Quick couplers are devices installed at the outer end of the work equipment of various types of construction and earth-moving machines. They facilitate the rapid exchange of working tools or buckets. Quick couplers are most common on hydraulic excavators and compact excavators and on the backhoe equipment of backhoe loaders, but are also installed on telescopic handlers, wheel loaders (loading shovels), skid-steer loaders and the loader equipment of backhoe-loaders. They are also occasionally installed on attachments installed on agricultural tractors. Quick couplers do not normally have a specific function themselves in that they do not carry out handling or digging operations, but when installed on a machine they become a part of the overall system. They are usually mounted on the machine by means of the pins that would otherwise be the mountings for the bucket or attachment.

Types

There are many variations in the design of quick couplers. The initial divergence is between those that can pick up any of a range of buckets and attachments by clamping onto the mounting pins for the attachment (known as "pin grabbers" or "pin couplers") and those that work only with buckets and attachments designed to suit that quick coupler (known as "dedicated"). The claimed advantage of pin-grabbers is flexibility in use in that a machine owner can use a variety of buckets and attachments without changing the quick coupler or buying an adaptor. The claimed advantages of dedicated couplers depend on their individual design but often include better performance and smaller size.

Operation

The method of operation (the picking up and releasing of buckets and attachments) causes the next divergence in design. The types can be described as manual, semi-automatic, and automatic.

Manual
: The operation of this type is done, usually by the use of tools, at the coupler itself. The operator needs to leave the operator's station (usually the cab) to go to the end of the work equipment in order to effect the release of a bucket or attachment, and to do the same in order to attach the next bucket or attachment to be used.

Semi-automatic
: With this type the hydraulic system of the machine is used to operate the main attachment mechanism but the manual operation of a safety device is necessary at the coupler itself to ensure that the bucket or attachment is safely locked onto the coupler. The safety device is intended to prevent the release of the bucket or attachment in the event of the failure of the hydraulic system, or other major failure of the attachment mechanism. The safety device is most commonly a pin that must be inserted to prevent one of the components in the quick coupler moving to release the bucket or attachment but some designs require the manual operation of a lever on the quick coupler.

Automatic
: This type use the hydraulic system of the machine to operate the main attachment mechanism and have an internal safety device. As with semi-automatic systems the safety device is designed to prevent the release of the bucket or attachment in the event of a failure of the hydraulic system.

Within the above three categories there are many further divergences in operating principles and detail designs. There are many competing claims relating to the safety and performance benefits and demerits of each design.

Safety issues

Fatalities have occurred due to buckets being accidentally released from work equipment during operation. Released buckets have hit bystanders causing fatal injuries. These have been reported in most detail in the UK, but there are reports of fatalities in Australia, the Republic of Ireland and the USA (reference required). The causes of the fatal accidents are not always the same and the views of safety authorities in different countries differ on how to reduce risk. In the UK the Health and Safety Executive (HSE) analysed the accident data and concluded that all of the known fatalities were caused by the operator not inserting the safety pin in semi-automatic couplers. Even without the safety pin inserted the buckets would not have been released unless there had been a failure of some part of the mechanism, or some error in operation by the operator. The HSE concluded that the most effective way to reduce the risk of further accidents was for semi-automatic couplers to be withdrawn from sale. The suppliers of these couplers agreed to this voluntarily so semi-automatic couplers were withdrawn from sale in the UK by around October 2008. Safety authorities in other countries have taken a different approach. In Australia the authorities took the view that the problems were caused by designs of quick couplers that did not incorporate a safety pin. That is, they believe that semi-automatics are fundamentally safe. The Australian standard for quick couplers published by Standards Australia, AS 4774 - 2008 therefore does not exclude this design option. It is therefore obvious that the views of the safety authorities of the UK and Australia on what constitutes a safe design are very divergent. In the UK some major construction contractors have written their own specifications for quick couplers allowed on sites under their control. That is, they have pursued site safety via a procurement policy. An alternative approach has been put forward by the Strategic Forum Plant Safety Group. A working party under this group has drawn up a best practice guide that has been endorsed, inter alia, by the HSE. This provides an alternative route to site safety: adhering to best practice in the use of quick couplers.

Market

The market for quick couplers is mainly supplied by a large number of small and medium-sized enterprises. Many of the manufacturers of quick couplers are small, flexible and innovative, leading to the wide variation in design concepts. Many Original Equipment Manufacturers (OEMs) of construction equipment market a range of quick couplers. Some of these are designed and manufactured by the OEM but more often they are the products of one of the quick coupler manufacturers branded by the OEM and sold through the OEM's distribution chain or installed by the OEM in their factory. In addition to the supply route from the OEMs many distributors of construction machinery will install quick couplers onto machines before delivery at the request of a customer. Quick coupler manufacturers will also sell direct to end-users and usually complete the installation as part of the sale.

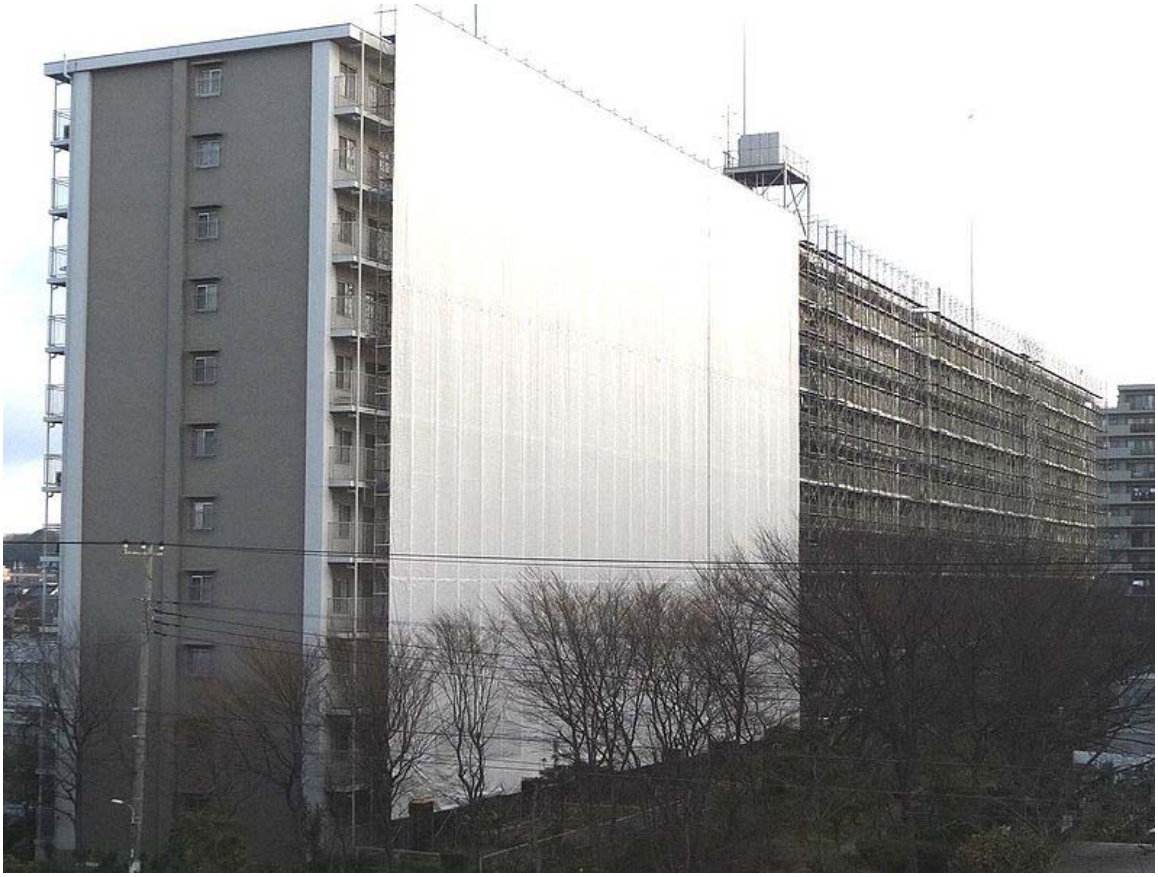
Development of international safety standards

A European standard in place since 1996 gives some guidance on the safety of quick couplers (EN474-1). However, this standard is unclear in many aspects leading to uncertainty as to whether semi-automatic couplers comply with it or not. Because of this the UK government launched a "safeguard action" under the Machinery Safety Directive (98/37/EC) challenging the validity of the standard and demanding that it be improved. The European Committee for Standardisation (CEN) have therefore undertaken to revise the relevant section of the standard. Because of the divergence in design concepts and in opinions on how to manage the associated risks the International Organization for Standardization (ISO) has undertaken to draft an International Standard on the safety of quick couplers. This project is being undertaken by Technical Committee 127 (ISO TC/127). A Working Group has been set up to draft the standard, which will be reviewed internationally through normal ISO procedures and will be published as ISO 13031. This work will probably be completed in around 2012. The intention in Europe is that, subject to the standard being suitable, the ISO standard would then be adopted as the standard for Europe.

Chapter- 9

Scaffolding

Bamboo scaffolding can reach great heights



A condominium in periodical (every 10-15 years) large scale repairing/maintenance in Japan under regulation. In most cases the entire building is covered by steel scaffolding and mesh for easy work and safety. Typically it continues 3-5 weeks per planned schedule.

Scaffolding, 10 months after Tokyo Sky Tree construction start.

Scaffolding is a temporary structure used to support people and material in the construction or repair of buildings and other large structures. It is usually a modular system of metal pipes or tubes, although it can be made out of other materials. Bamboo is frequently used in some Asia countries for example People's Republic of China.

Scaffolding in the ancient world

The Berlin Foundry Cup depicts scaffolding in ancient Greece (early fifth century BC). The ancient Egyptians, Nubians and Chinese are also recorded as having used scaffolding-like structures to build tall buildings. The ancient Africans have also used wooden scaffoldings to support mosques.

Scaffolding in the modern day

This European Standard specifies performance requirements and methods of structural and general design for access and working scaffolds. Requirements given are for scaffold structures that rely on the adjacent structures for stability. In general these requirements also apply to other types of working scaffolds.

The purpose of a working scaffold is to provide a safe place of work with safe access suitable for the work being done. This document sets out performance requirements for working scaffolds. These are substantially independent of the materials of which the scaffold is made. The standard is intended to be used as the basis for enquiry and design.

Thus the requirements of BS EN 12811-1. TG20 is largely based on BS 5973 with extracts taken directly from the old code, it also uses permissible stress design method. However, TG20 received a mixed response from the UK industry and as a result TG20 is being re-written and the new version is due for release sometime in 2008. This is the reason for the 'limbo' situation. Until the release of the revised TG20 the HSE continue to allow scaffold to be built in accordance with BS 5973.

Materials

The basic materials are tubes, couplers and boards.

Tubes are either steel or aluminium, although composite scaffolding uses filament wound tubes of glass fibre in a nylon or polyester matrix. If steel they are either 'black' or galvanised. The tubes come in a variety of lengths and a standard diameter of 48.3 mm. (1.5 NPS pipe). The chief difference between the two types of tubes is the lower weight of aluminium tubes (1.7 kg/m as opposed to 4.4 kg/m) and also a greater flexibility and so less resistance to force. Tubes are generally bought in 6.3 m lengths and can then be cut down to certain typical sizes.

Extensive scaffolding on a building in downtown Cincinnati, Ohio.

Boards provide a working surface for users of the scaffold. They are seasoned wood and come in three thicknesses (38 mm (usual), 50 mm and 63 mm) are a standard width (225 mm) and are a maximum of 3.9 m long. The board ends are protected by metal plates called hoop irons or sometimes nail plates. Timber Scaffold boards in the UK should comply with the requirements of BS 2482. As well as timber, steel or aluminium decking is used or laminate boards. As well as boards for the working platform there are sole boards which are placed beneath the scaffolding if the surface is soft or otherwise suspect, although ordinary boards can be used,another design called the scaffpad is another solution as it is made from a rubber base with a base plate moulded inside, these are great to put on uneven ground because they adapt to any ground where sole boards would split costing more money to replace.

A short section of steel scaffold pole.

Couplers are the fittings which hold the tubes together. The most common are called scaffold couplers, there are three basic types: *right-angle couplers*, *putlog couplers* and *swivel couplers*. To join tubes end-to-end *joint pins* (also called spigots) or *sleeve couplers* are used, or both together. Only right angle couplers and swivel couplers can be used to fix tube in a 'load bearing connection'. Single couplers are not load bearing couplers and have no design capacity.

Other common materials lnclude base plates, ladders, ropes, anchor ties, reveal ties, gin wheels, sheeting, etc.

Despite the metric measurements given many scaffolders measure tubes and boards in imperial units. With tubes from 21 feet down and boards from 13 ft down.

Basic scaffolding

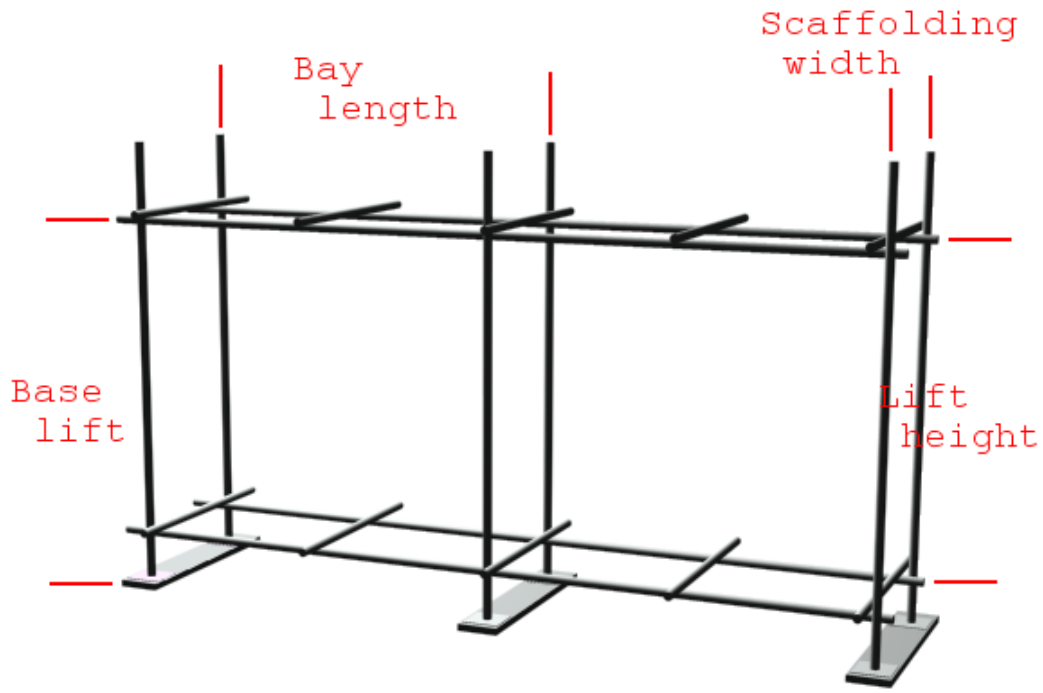
The key elements of a scaffold are *standards*, *ledgers* and *transoms*. The standards, also called uprights, are the vertical tubes that transfer the entire mass of the structure to the ground where they rest on a square *base plate* to spread the load. The base plate has a shank in its centre to hold the tube and is sometimes pinned to a *sole board*. Ledgers are horizontal tubes which connect between the standards. Transoms rest upon the ledgers at

right angles. *Main transoms* are placed next to the standards, they hold the standards in place and provide support for boards; *intermediate transoms* are those placed between the main transoms to provide extra support for boards. In Canada this style is referred to as "English". "American" has the transoms attached to the standards and is used less but has certain advantages in some situations. Since scaffolding is a physical structure, it is possible to go in and come out of scaffolding.

Scaffolding in Tretyakovsky Proyezd, Moscow

As well as the tubes at right angles there are *cross braces* to increase rigidity, these are placed diagonally from ledger to ledger, next to the standards to which they are fitted. If the braces are fitted to the ledgers they are called ledger braces. To limit sway a *facade brace* is fitted to the face of the scaffold every 30 metres or so at an angle of 35°-55° running right from the base to the top of the scaffold and fixed at every level.

Of the couplers previously mentioned, right-angle couplers join ledgers or transoms to standards, putlog or single couplers join board bearing transoms to ledgers - Non-board bearing transoms should be fixed using a right-angle coupler. Swivel couplers are to connect tubes at any other angle. The actual joints are staggered to avoid occurring at the same level in neighbouring standards.



Basic scaffold dimensioning terms. No boards, bracing or couplers shown

The spacing of the basic elements in the scaffold are fairly standard. For a general purpose scaffold the maximum bay length is 2.1 m, for heavier work the bay size is reduced to 2 or even 1.8 m while for inspection a bay width of up to 2.7 m is allowed.

The scaffolding width is determined by the width of the boards, the minimum width allowed is 600 mm but a more typical four-board scaffold would be 870 mm wide from standard to standard. More heavy duty scaffolding can require 5, 6 or even up to 8 boards width. Often an *inside board* is added to reduce the gap between the inner standard and the structure.

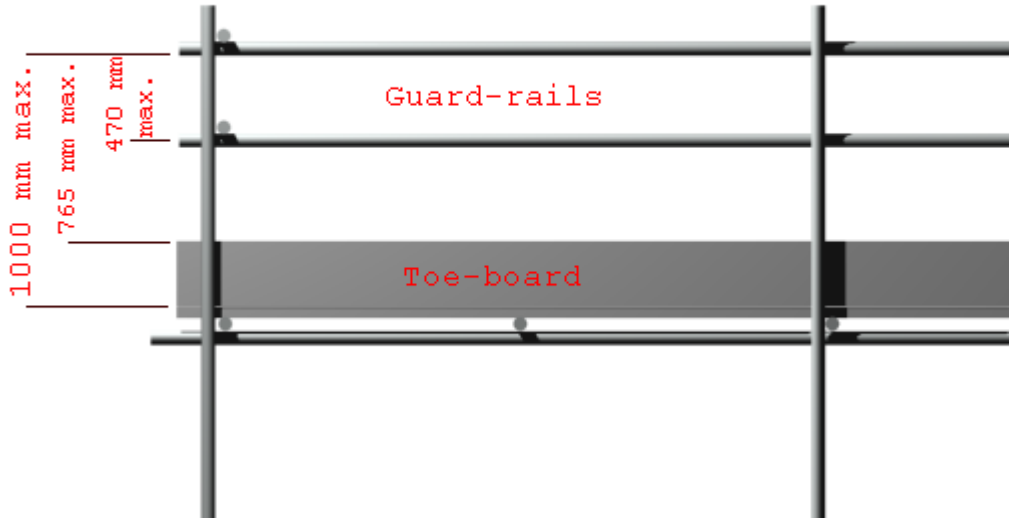
The lift height, the spacing between ledgers, is 2 m, although the base lift can be up to 2.7 m. The diagram above also shows a kicker lift, which is just 150 mm or so above the ground.

Transom spacing is determined by the thickness of the boards supported, 38 mm boards require a transom spacing of no more than 1.2 m while a 50 mm board can stand a transom spacing of 2.6 m and 63 mm boards can have a maximum span of 3.25 m. The minimum overhang for all boards is 50 mm and the maximum overhang is no more than 4x the thickness of the board.

Foundations

Good foundations are essential. Often scaffold frameworks will require more than simple base plates to safely carry and spread the load. Scaffolding can be used without base plates on concrete or similar hard surfaces, although base plates are always recommended. For surfaces like pavements or tarmac base plates are necessary. For softer or more doubtful surfaces sole boards must be used, beneath a single standard a sole board should be at least 1,000 cm² with no dimension less than 220 mm, the thickness must be at least 35 mm. For heavier duty scaffold much more substantial baulks set in concrete can be required. On uneven ground steps must be cut for the base plates, a minimum step size of around 450 mm is recommended.

A working platform requires certain other elements to be safe. They must be close-boarded, have double guard rails and toe and stop boards. Safe and secure access must also be provided.



Scaffolding showing required protection of a working platform with maximum dimensions. Butt-board not visible. No couplers shown

Ties

The Holy Trinity Church in Vladimir, with scaffolding wrapped in safety mesh.

Scaffolds are only rarely independent structures. To provide stability for a scaffolding (at left) framework ties are generally fixed to the adjacent building / fabric / steelwork.

General practice is to attach a tie every 4m on alternate lifts (traditional scaffolding) prefabricated System scaffolds require structural connections at all frames - ie.2-3m centres (tie patterns must be provided by the System manufacturer / supplier). The ties are coupled to the scaffold as close to the junction of standard and ledger (node point) as possible. Due to recent regulation changes, scaffolding ties must support +/- loads (tie/butt loads) and lateral (shear) loads.

Due to the different nature of structures there are a variety of different ties to take advantage of the opportunities.

Through ties are put through structure openings such as windows. A vertical inside tube crossing the opening is attached to the scaffold by a transom and a crossing horizontal tube on the outside called a bridle tube. The gaps between the tubes and the structure surfaces are packed or wedged with timber sections to ensure a solid fit.

Box ties are used to attach the scaffold to suitable pillars or comparable features. Two additional transoms are put across from the lift on each side of the feature and are joined on both sides with shorter tubes called tie tubes. When a complete box tie is impossible a l-shaped *lip tie* can be used to hook the scaffold to the structure, to limit inward movement an additional transom, a *butt transom*, is place hard against the outside face of the structure.

Sometimes it is possible to use *anchor ties* (also called *bolt ties*), these are ties fitted into holes drilled in the structure. A common type is a ring bolt with an expanding wedge which is then tied to a node point.

The least 'invasive' tie is a *reveal tie*. These use an opening in the structure but use a tube wedged horizontally in the opening. The reveal tube is usually held in place by a reveal screw pin (an adjustable threaded bar) and protective packing at either end. A transom tie tube links the reveal tube to the scaffold. Reveal ties are not well regarded, they rely solely on friction and need regular checking so it is not recommended that more than half of all ties be reveal ties.

If it is not possible to use a safe number of ties *rakers* can be used. These are single tubes attached to a ledger extending out from the scaffold at an angle of less than 75° and securely founded. A transom at the base then completes a triangle back to the base of the main scaffold.

Putlog scaffold

As well as putlog couplers there are also putlog tubes, these have a flattened end or have been fitted with a blade. This feature allows the end of the tube to be within or rest upon the brickwork of the structure. They can be called a bricklayer's scaffold and as such consist only of a single row of standards with a single ledger, the putlogs are transoms - attached to the ledger at one end but integrated into the bricks at the other. Spacing is as general purpose scaffold and ties are still required.

Chapter- 10

Other Construction Equipments

Breaker (hydraulic)

A breaker is mounted on the excavator on the left side

A **breaker** is a powerful percussion hammer fitted to an excavator for demolishing concrete structures or rocks. It is powered by an auxiliary hydraulic system from the excavator, which is fitted with a foot-operated valve for this purpose. Additionally, demolition crews employ the hoe ram for jobs too large for jackhammering or areas where blasting is not possible due to safety or environmental issues.

Breakers are often referred to as "hoe ram" or "hoe rammer." This term is popular and commonly used amongst construction/demolition workers.

Concrete moisture meter

A **concrete moisture meter** is a type of moisture meter used by installers of flooring to measure the moisture levels of concrete. These meters have been used for decades to measure the moisture content in different materials and substances. Concrete meters have evolved from the successful wood moisture meter as flooring contractors tried to use their wood meters to measure the moisture in concrete.

Concrete moisture meters are designed to detect moisture to a depth of 1" of a concrete slab in order to avoid the rebar reinforcement below the surface. They are designed to be used as a relative test. The meters are used to "'Spot check' the top surface at one particular location on the slab." The results can determine the best place to put a concrete relative humidity test.

Limitations

There is no ASTM standard for using a concrete moisture meter to determine a final moisture content reading.

Concrete moisture meters, either non-pin or pin meters are affected by what it sees in the concrete. This can be anything from the density of the concrete and aggregate size to the chemical properties of the slab.

Uncovered concrete dries from the top down. Concrete moisture meters measure only the top inch at most and this area is drier than the concrete further down. Once a floor covering has been installed the moisture in the slab equilibrates. In order to ensure the equilibrated moisture will be a safe level for a floor covering, a relative humidity sensor must be drilled and placed at 40% of the depth of the slab. This depth has been proven to be the relative humidity percentage that the slab will equilibrate once the top has been covered by a floor covering.

Drifter (drill)

A **Drifter** is either a hydraulic or pneumatic powered rock or ground drill placed on top of a feed. The feed is like a rail that the drill travels on, aka. drifts. This kind of drilling procedure is also called drifting. The feed is usually attached with a flexible boom (like an arm) to a stationery or mobile unit that contains the powerpack (engine and hyd. pump or compressor). Drifters are used in mining, construction, exploration and natural science.

A hydraulic rock drill or drifter is usually a machine, that consists of a percussive system and a rotative system. The percussive system strikes the drill steel, for example 2000-5000 strikes per minute as the rotation can be, for example, 100-400 rounds per minute.

Combined together, these functions enable drilling holes into rock. The excess material (cuttings) is then pushed up from the bottom of the hole by means of pressurized air or water.

Hydraulic rock drills are also called hydraulic top hammers, which explains the position of the actual drilling device concerning the drill rod. Opposite to a top hammer drill or drifter is the down-the-hole hammers, which are usually pneumatic.

Laser level

A laser level set up and being used to level sand fill in trenches. The staff is leaning on the pile of sand.

In surveying and construction, the **laser level** is affixed to a tripod, leveled and then spun to illuminate a horizontal plane. The laser beam projector employs a rotating head with a mirror for sweeping the laser beam about a vertical axis. If the mirror is not self-leveling, it is provided with visually readable level vials and manually adjustable screws for orienting the projector. A staff carried by the operator is equipped with a movable sensor which can detect the laser beam and gives a signal when the sensor is in line with the beam (usually an audible beep). The position of the sensor on the graduated staff allows comparison of elevations between different points on the terrain.

A tower-mounted laser level is used in combination with a sensor on a wheel tractor-scraper in the process of land laser leveling to bring land (for example, an agricultural field) to near-flatness with a slight grade for drainage. The laser line level was invented by Steve Orosz. US. 5836081 Converting a dot into a line using a lens. This is the level that does not require a heavy motor to create the illusion of a line from a dot.

Laser line level

Typical consumer laser line level using spirit levels for three planes and including a digital stud sensor display.

A **laser line level** is a tool combining a spirit level and/or plumb bob with a laser to display an accurately horizontal or vertical illuminated line on a surface the laser line level is laid against. Laser line levels are used wherever accurate verticals and horizontals are required, typically in the construction and cabinetry industries. Some models are inexpensive enough for do-it-yourself applications.

The laser beam is fanned to produce a thin plane beam accurately horizontal or vertical, rather than a pinpoint beam. The axis of the laser is offset from the wall, so that a pinpoint beam would be parallel to and offset from the wall, and would not illuminate it; the fanned beam will intersect the wall, creating an accurately horizontal (or vertical) illuminated line along it.

The level is set up using the built-in spirit level or plumb bob, and the line along the surface is then guaranteed to be accurately horizontal or vertical to within a certain tolerance, specified either in millimetres per metre or fractions of an inch over a specified distance in feet. A more advanced device may be accurate to within 0.3 mm/m; while lower-end models may be closer to 1.5 mm/m.

The illuminated line is necessarily absolutely straight, so that the line level can be used as a straightedge; for example, to see if a shelf is warped, even if not horizontal.

Rig mat

A **rig mat** is a portable platform used to support equipment used in construction and resource-based activities including drilling rigs, camps, tanks, helipads, etc. It also includes a structural roadway to provide passage over unstable ground, pipelines and more. Strad Energy Services is currently recognized as the world's largest producers of rig mats. Their products can be found worldwide including Canada, USA, Mexico, Russia, Middle East, Asia and Australia.

TYPES

Access Mats

Also known as swamp mats. Commonly made out of Spruce, Pine, Fir or a combination thereof, access mats are held together by lag bolts, nails or screws. However, this can create a problem when the access mat breaks, as the screws or bolts spread all over the ground, causing an environmental concern which must be addressed by the owner/renter of the mats. Common sizes are 8' x 14' and 8' x 16'. Most, if not all, access mats are six inches thick and are untreated.

Interlocking Mats

Patented by Strad Energy Services, the SteelLock interlocking mat is constructed without nails, bolts or pins.

Wood And Steel Mats

Also known as steel frame mats. Commonly made of spruce, pine, fir or a combination thereof surrounded on the edges by I Beam or HST steel. The steel is used to strengthen the mats and enable the manufactures of the mats to build them in larger sizes and to support more weight than an access mat. Common sizes are 6' x 30' or 8' x 40'. The biggest problem with this type of mat, particularly I Beam mats, is the fact that they can bend, and once the steel bends the mat cannot be repaired. Another common problem is wood breakage, on an I Beam mat this cannot be repaired, however an HST mat can still be repaired quite easily and cost effectively, reducing the cost to the owner/renter of the mats. However due to the increased cost of construction of HST mats, most companies do not build them.

Webfoot Mats

A special design of access mats currently only being constructed by one company, Tracker Sales and Rentals (Bowden, AB, Canada). The mat was named by Eric Buff of Buff Lumber LTD., and is named such as it is believed to be the most environmentally friendly matting available. Made exclusively in British Columbia Canada from Pine Trees killed by the Mountain Pine Beetle Infestation, the construction of these mats is aiding in an important environmental cleanup. Unlike traditional access matting it is held together with 4 steel rods, eliminating the environmental cleanup needed if a traditional access mat breaks. ie) cleaning up lag bolts, nails, or screws that traditional access mats are held together with. The steel rods can also be reused to make new mats, and the wood can be ground up to be biomass fuel at the end of the mats lifecycle (too damaged to be rented/used). Encana builds a similar style mat but does not refer to them as Webfoot Mats.

This type of platform is often used in Alberta, Canada.

Self Propelled Modular Transporter

SPMT being transported on low-loader

288 wheels SPMT carrying a 1350 tonnes vessel

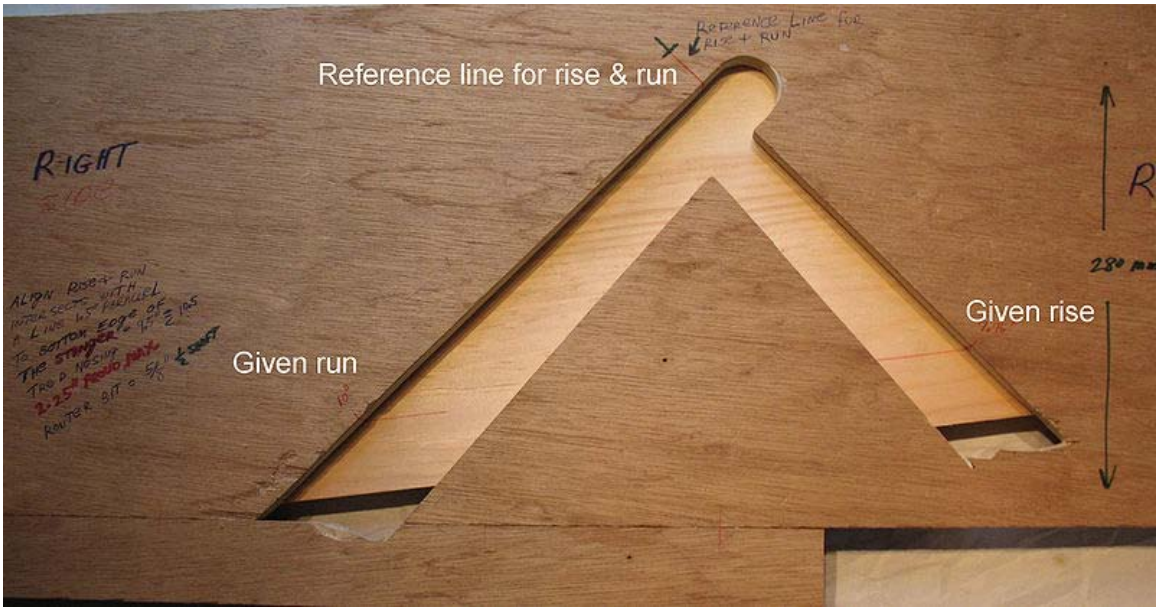
A **Self Propelled Modular Transporter** (SPMT) is a platform vehicle with a large array of wheels on the bottom. They are used for transporting massive objects such as bridges, oil refining equipment, huge motors, large bridge sections, and other objects that are too big or heavy for trucks but trucks can provide traction and braking for the SPMTs on inclines and descents. These vehicle may also be called a Self Propelled Modular Trailer.

SPMTs are increasingly used in the construction and oil industries, and have been recently begun to be used to replace bridge spans, in the United States and Europe, and more recently, Canada.

A typical SPMT can have a grid of several dozen computer-controlled wheels, all individually controllable and steerable, in order to evenly distribute weight and steer accurately. Each individual wheel can swivel independently from other wheels, to allow the SPMT to turn, move sideways, or even spin in place. Some SPMTs allow each wheel to telescope independently of each other, so that the load can be kept flat and evenly distributed while moving over uneven terrain. As SPMTs often carry the world's heaviest loads on wheeled vehicles, they are very slow vehicles, often moving at under one mile per hour while fully loaded. Some SPMTs are controlled by a worker with a hand held

control panel, while other SPMTs have a driver cabin. In addition, multiple SPMTs can be combined to transport massive building-sized objects.

Staircase jig



A staircase jig

A **staircase jig** is a woodworking tool that incorporates both a right angle and an acute angle in its design. The jig is easily transported due to its small size and light weight. Precise measurements are required to layout the diagonal locations.

This jig uses a zero reference line from which the rise and tread are measured. The upper part of the jig is a right triangle with a roundover overhang. The template allows for a tight fit of the tread into the stringer in the overhang section. The bottom of the jig incorporates an acute angle. This tapered angle allows a space for a wedge (mechanical device) to fit against the back side of the vertical and the horizontal plane of the stringer. This jig can be used to lay out different rise (vertical) and tread (horizontal) widths. The jig is used with a plunge router and a bushing guide. The router plows out a precise groove into the finished product that allows all the parts to fit together.

Uses of jig

The jig is used to make finish stringers, in interior staircase fabrication. The stringer is also referred to as a skirtboard. It can be used in a closed staircase or an open staircase where one side of the staircase is exposed and the other is housed into the skirtboard.

Design of jigs

The jig in the image is designed to cut only one segment of the stringer at a time. Some industrial staircase jigs are designed to cut out an entire stringer in one setup. There are jigs to cut dovetails, mortise & tenon joints, box joints, keyed miters, finger joints, bridle joints, scarf joints, and many other joints. All these jigs add precision, consistency, and productivity to a job.

Storey pole

Rarely used in building construction after the mass production of the steel tape measure, a **storey pole** (or **story pole**) is a length of narrow board, often a 1x4 usually cut to the height of one storey. It was used as a layout tool for both wood framing and brickwork, measured and marked by the master carpenter for the heights from (usually) the floor platform of a building for dimensions such as window sill heights, window top heights (or headers), exterior door heights (or headers), interior door heights, wall gas jet heights (for gas lamps) and the level of the next storey joists. It made for quick, repeatable measurements without the need of otherwise calibrated measuring devices or workers skilled in using them.

For wood construction, the storey pole was placed against the studs and the studs were marked at the proper places for their location in the building. For brickwork, they were used as a reference for openings in the walls. Once laid out, storey poles could be used on building after building of the same general design.

In wood balloon framing construction, a storey pole would be taller than one storey, and have marks for the attachment level of the next storey joists to the studs and rafter plate at the top.

It was common to have different storey poles for each floor, with ceiling heights being higher and window sizes being larger for the first storey. In residential buildings, the first storey was often over 8'6", the second and any succeeding storey(s) being usually significantly less than 8'. Commercial building ceiling heights were generally proportionally higher, with first story heights of 10' or more, though this has varied considerably by time, place, materials available and budgets.

Storey poles have also been used in cabinet making and kitchen cabinet installation to mark heights and positions of different elements.

Strand jack

Strand jacks (also known as **strandjacks**) are jacks used to lift very heavy (e.g. 20,000 tons or more with multiple jacks) loads for construction and engineering purposes. They were invented in Europe in the 1970s as a development of post tensioning systems, and are now used all over the world to erect bridges, offshore structures, refineries, power stations, major buildings and other structures where the use of conventional cranes is either uneconomic or impractical.

A strandjack is a hollow hydraulic cylinder, with a set of steel cables (the "strands" in the name) passing through the open centre, each one passing through two clamps - one mounted to either end of the cylinder. The jack operates in the manner of a caterpillar's walk: climibing (or descending) along the strands by releasing the clamp at one end, expanding the cylinder, clamping there, releasing the trailing end, contracting, and clamping the trailing end before starting over again. The real significance of this device lies in the facility for precision control. The expansion/contraction can be done at any speed, and paused at any location. Although a jack may lift only 1000 tons or so, there exist computer control systems that can operate 40 jacks simultaneously, offering fingertip feel movement control over extremely massive objects.

Strand jacking is a construction process whereby large pre-fabricated building sections are carefully lifted and precisely placed. The alternative would be to do all assembly *in situ*, even if expensive, technically risky, or dangerous.

Strand jacks for heavy lifting and skidding operations are owned and operated by a large number of construction and heavy lifting companies around the world. They are currently manufactured by a small number of companies based in Europe.

Tiltrotator

Rototilt with grapple

A **tiltrotator** (known under a number of trade names, particularly **Rototilt**) is an hydraulic attachment/tool used on most excavators, and backhoes between 3-30 tons in the Nordic countries (Sweden, Finland, and Norway). A tiltrotator is mounted on the excavator such that the excavator bucket can be rotated through 360 degrees and tilted +/- 40 degrees, in order to increase the flexibility and precision of the excavator. A tiltrotator can best be described as a wrist between the arm of the excavator and the bucket (or

whatever other tool is fitted to the excavator tool). With its integral quick coupler and rotary swivel, Rototilts also use extra hydraulic functions to power and manipulate other worktools such as a breaker, grapple or an auger, which can be attached to the quickcoupler on the tiltrotator, for simplified attachment mounting, dramatically increasing the machine's utilization on the jobsite.

The Rototilt was invented in Sweden in the early 1980s by the Norgrens under the family owned and operated company named Noreco, and has become the standard in Scandinavia. The concept has recently gained popularity in other countries such as Holland, Germany, UK, Canada and since 2002, are now being distributed in the United States. There are only two major manufacturers of the Rototilt concept today (although similar products are sold by various competitors); Indexator, (founded in 1973 by Alan Jonsson) who purchased Noreco in 1992, hired the Norgren brothers, and registered the brandname Rototilt, and Engcon,(founded in 1993 by also ex-Noreco employee, Stig Engstrom) who started manufacturing their own product using only "tiltrotator" to avoid trademark infringements.

Other companies manufacturing their version of Rototilt on a smaller scale include ABL, Steelwrist, Sandco, SMP, and HKS, under various product names as tiltrotator, swingrotator, swingotilt, etc., although it's still commonplace on the market as a genericized trademark to call all versions a Rototilt.