



Building on  
solid ground

Figure 3 – Trailer-mounted  
concrete pump.



## Creating concrete standards for the mobile construction machinery

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equipment

**T**he standardization work of ISO/TC 195, *Building construction machinery and equipment* encompasses a very diverse range of subjects that include equipment for pile driving, extracting, concreting, aggregate processing, finishing and maintenance, and also portable hand-held tools with electric or combustion engine drive, pedestrian controlled compaction machines, personal and material hoists, scaffolds, and specialist machinery for road building, tunnelling or trenchless technology (see About ISO/TC 195).

Most fall into the category of *mobile construction machinery*, but before reviewing this vital industry sector, a glimpse at its development.

## A leap forward – From manual to automatic

When William Smith Otis built the first single-bucket excavator in 1836 – replacing the work of 80 human diggers – it changed the face of the construction industry forever (Figure 1). His “American Steam Excavator”, also called the “Yankee Geologist”, was originally used in the construction of the Baltimore-Ohio railroad. Otis’s excavator may be considered one of the first mobile construction machines.

In 1874, Aveling & Potter developed the first steam-driven wheeled crane in the UK, followed by the first electrically driven railway excavator built by the Osgood Company in the US in 1890.

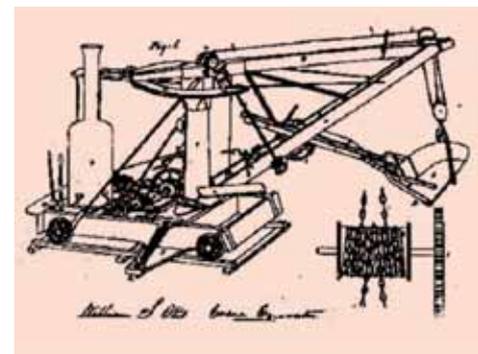
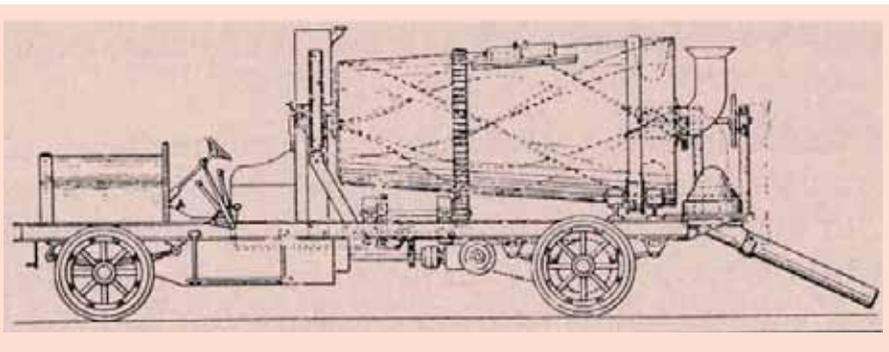


Figure 1 – Patent drawing of the  
first excavator, signed by W.S. Otis in  
February 1839.

## Main Focus

The combustion engine heralded the next leap forward in mobile construction machines, led by Nicolaus August Otto's four-stroke spark-ignition combustion engine in 1861 and Rudolf Diesel's compression-ignition engine in 1897. Travelling tower cranes followed around 1900 with crawler cranes, concrete mixers (**Figure 2**) and bitumen boilers mounted on automotive chassis appearing at the end of the First World War.

Massive rebuilding after the ravages of World War II spurred the dramatic development of the whole field of construction machinery and equipment. At the same time, increasing reliability and transportability, aided by hydraulic and pneumatic drives and control systems incorporating electronics, boosted the industry.



**Figure 2** - Truckmounted concrete mixer designed by Stephan Stepanias in the US in 1914.

In the last 25 years, the introduction of computer technology and improved energy-efficient load-sensing hydraulic systems, as well as achievements in materials engineering have driven impressive advances in machine design.

### Defining the mobile construction machine

A simplified definition of a mobile construction machine is one capable of being relocated on its own wheeled, track or leg type chassis. The description "mobile" distinguishes machines adapted to frequent relocation from stationary machines designed for long-term service on one site, set up on the ground or a foundation, and



**Figure 4** - Truck mixer with concrete pump and distributing boom.

whose position is fixed by anchoring or deadweight.

Each mobile machine consists of two basic units: a truck- or trailer-wheeled chassis, track chassis or tractor, and a working device. Typical examples are truck concrete mixers, pumps (**Figure 3** – top of page 9, and **Figure 4**), tracked asphalt pavers (**Figure 5**), and the screed unit in asphalt pavers towed by a tractor.

### How are they used?

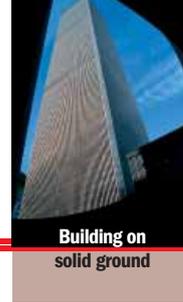
Mobile machines are used in most building construction works such as earth moving, lifting and mounting elements, and laying concrete. Depending on the mode of locomotion, they can be divided into three types:

- self-propelled (on wheels, crawlers or legs);
- truck mounted;
- towed on wheels.

The choice is determined by economic and technical considerations. For example, where frequency of relocation and cost of the driving system are concerned, then a self-propelled machine is likely to be chosen.

**Figure 5** - Tracked asphalt paver.





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A machine which does not change its working location – e.g. a concrete mixer or plastering unit – and stays on site longer than a month is usually designed to be towed. Those designed to travel on public roads are equipped with braking systems and lights.

Important technical considerations include the terrain over which the machine moves – i.e. is it paved or soft –, the characteristics of the transported materials, the power of the towing tractors and the distances over which the machine is to be relocated.

used for crushing stones and concrete debris are offered as self-propelled crawler-, truck- or semi-trailer-mounted machines.

Modern self-propelled machines are usually equipped with a single hydraulic drive unit powering all the other units, i.e. wheels, outriggers, steering system and attachments, with energy-efficient state-of-the-art load-sensing systems to ensure precise control. They offer higher reliability and lower operating costs than other types of hydraulic control systems. Examples include:

## The committee's achievements

Much has been achieved by ISO/TC 195 since it was established in 1989. However its first task was to develop the classifications and general terminology for the many groups of machines and equipment within its scope. To do so, the committee produced two fundamental documents:

- ISO/TR 12603:1996, *Building construction machinery and equipment – Classification*
- ISO 11375:1998, *Building construction machinery and equipment – Terms and definitions*

We then began developing standards for the specific groups of machines and equipment, covering mainly terminology and commercial specifications, the aim being to facilitate mutual understanding between machinery manufacturers, dealers and



Figure 6 – Road milling machine.

**“When William Smith Otis built the first single-bucket excavator in 1836 it changed the face of the construction industry forever.”**

Machine manufacturers offer many options with regard to price and ease of relocation to a new work site. For example, concrete pumps can be offered as truck mounted, single- or double- axle mounted and skid mounted. The latter are mainly used on building sites where unusually large quantities of concrete are continuously delivered. Trailer-mounted machines are now being replaced by more economical truck-mounted units. Intensively developed mobile crushers

- Track-mounted machines, often incorporating a hydromechanical travel drive comprising a hydrokinetic torque converter, a gearbox with multiple-disk clutches, a steering mechanism with brakes and clutches, and side gears.
- Machines such as loaders, in which the travel drive is transmitted from the diesel engine by means of a hydrodynamic coupling via the gearbox, the rear axle and two planetary gears in the rear wheels.



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Professor Budny served as President of the International Association for Automation and Robotics in Construction (IAARC), and has been Chair of ISO/TC 195 and the Polish Committee for Standardization in the field of building construction machinery since 2005.

users, and form the basis for further standardization work.

At present, standards for safety and methods of testing machines still constitute little more than 20 % of the committee's work and concern mainly smaller machines such as internal and external concrete vibrators, portable hand-held cutting-off machines for building materials, and concrete mixers.

ISO/TC 195 has published 16 ISO standards and one technical report to date, mostly concerning machinery for road construction and maintenance, and concrete works.

**“The standards we have developed serve to enhance knowledge about the current state of technology in road building machinery.”**

### The road building challenge

Road building and maintenance is a major challenge, particularly for developing countries. Standardization of the necessary construction equipment has high priority and is a subject of great interest to ISO/TC 195. The standards we have developed serve to enhance knowledge about the current state of technology in road building machinery.

ISO 22242:2005, *Road construction and road maintenance machinery and equipment – Basic types – Identification and description*, is the basic standard covering the sector. Although it does not include machines used in other fields such as earthmoving, concreting, agriculture and forestry, the standard encompasses a total of 65 types of machine, divided into 10 subgroups.

In addition, a further seven standards for basic road construction machines such as asphalt mixing plants, bituminous binder spreaders/sprayers, chippings spreaders, soil stabilizers, powder binder spreaders, slipform pavers and road milling machinery have been developed by the committee. Work on ISO/DIS 15878, *Road construction*

## About ISO/TC 195

ISO/TC 195, *Building construction machinery and equipment* was established in 1989 following a proposal by the Polish Committee for Standardization (PKN). PKN, entrusted with running the secretariat, delegated the task to the Institute of Mechanised Construction and Rock Mining (IMBiGS) in Warsaw, which is why the seat of the secretariat is now at the Institute.

The Chair, Secretary and several Polish experts on the committee are employees of the Institute. Prior to endorsing final documents, the test methods proposed in draft standards are experimentally verified by IMBiGS. Currently ISO/TC 195 has 14 participant members and 16 observer members.

Its scope encompasses standardization of machines and equipment used on construction sites, with the exception of *cranes* (ISO/TC 96), *earthmoving machinery* (ISO/TC 127) and *elevating work platforms* (ISO/TC 214).

The committee comprises:

- Subcommittee SC1, *Machinery and equipment for concrete work*, and
- Four working groups:
  - WG 5, *Road construction and maintenance equipment*,
  - WG 6, *Hand-held machinery and equipment*,
  - WG 7, *Pedestrian controlled compaction equipment*,
  - WG 8, *Aggregate processing*.

Working groups WG 1, *Classification*, WG 2, *Terminology* and WG 3, *Pile driving equipment* were disbanded after completing their work. New working groups are formed in response to subjects proposed by the participant members.

Machinery manufacturers, represented through domestic associations of manufacturers, play a dominant role in the work of the committee. Another participant group comprises representatives of scientific research units and standardization institutions. However, equipment dealers and users (including construction equipment leasing companies) are not represented. Prominent among countries most actively engaged in the work of ISO/TC 195 through their standards bodies are Japan (JISC-JCMA), the USA (ANSI-AEM) and Germany (DIN-VDMA).



*and maintenance equipment – Asphalt pavers – Terminology and commercial specifications*, is currently at draft international standard stage.

Road construction machines can be divided into mobile and stationary categories, but the latter are also available in stationary-transferable versions, which can be easily disassembled, transported and reassembled at a new road construction site. The stationary group includes machines for the production and storing of road construction materials, e.g. certain types of soil mix plants, bituminous binders storage tanks, bituminous emulsions and asphalt mixing plants. All remaining machines for road building and maintenance are mobile types designed to be self-propelled, truck mounted or towed. **Figures 5 and 6** illustrate working road machines.

### A major task

A major task now facing the committee is the adaptation of European (EN) construction equipment and machinery safety standards to ISO standards. We are working closely with CEN/TC 151, *Construction equipment and building material machines – Safety*. The resulting International Standards will represent significant progress in unifying safety requirements to facilitate international trade.

Another challenge is to standardize groups of machinery which have so far not been covered by international standardization. This includes scaffolds and equipment for finishing works and installations, such as water-pipe networks, gas grids and telephone networks. ■