ASPHALTIC CORE

for Embankment Dams

Veidekke Industry

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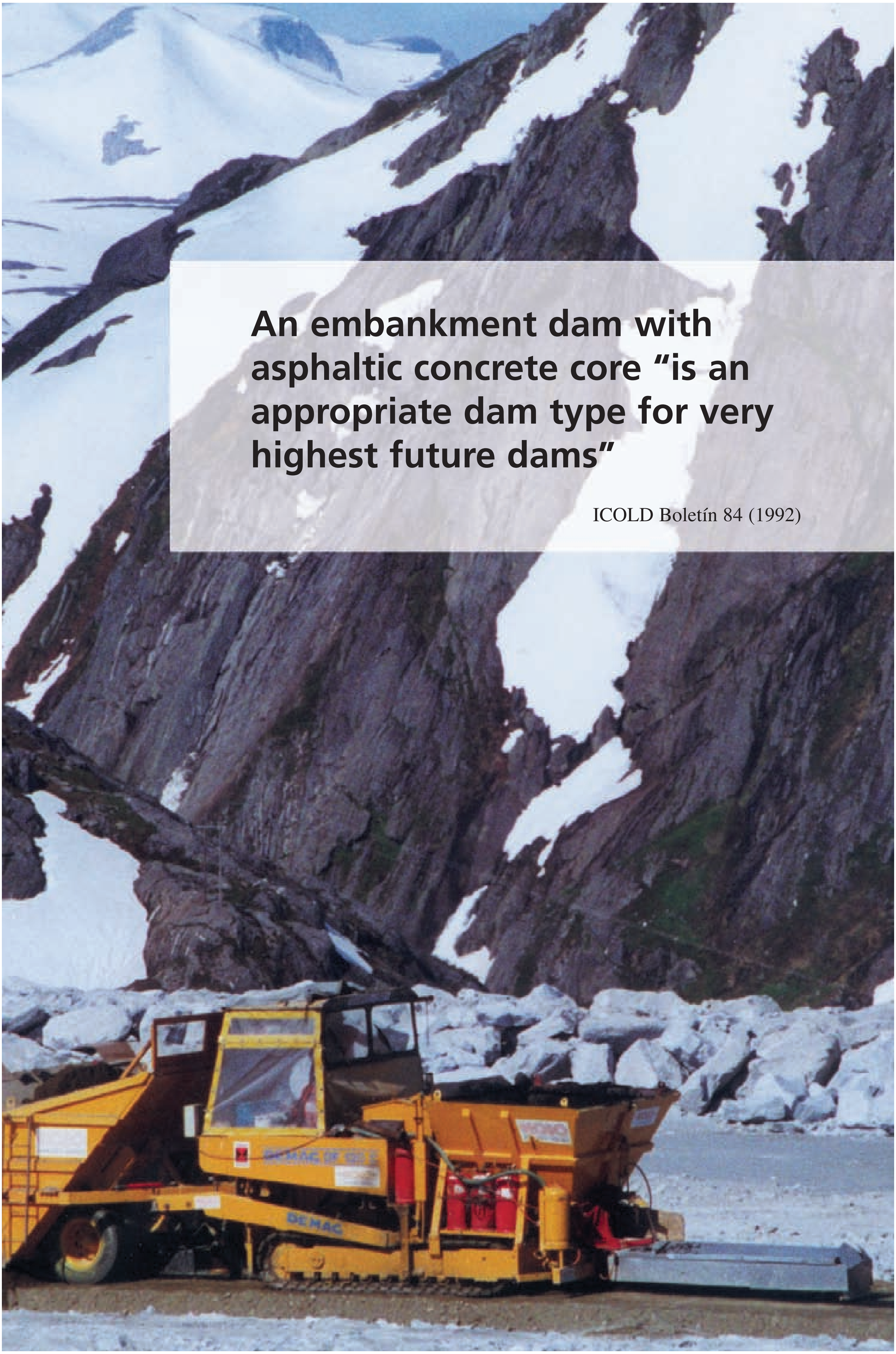
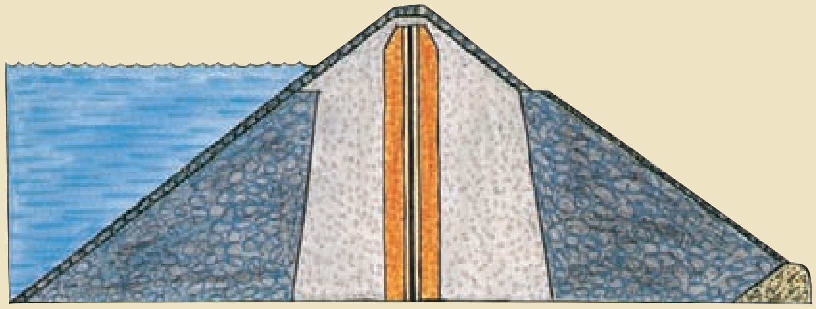
Asphalt Core Dams



An embankment dam with asphaltic concrete core “is an appropriate dam type for very highest future dams”

ICOLD Boletín 84 (1992)



Since 1955, about 100 embankment dams with an asphaltic concrete core have been completed. All of them show excellent performance records.

Asphalt is a viscoelastic-plastic material with a self-healing ability when exposed to:

- Differential settlements from compressible foundations, or possible arching effect.
- Earthquake cracks or damage.
- General settlements of the embankment.

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Inside the dam body the asphalt exists under near ideal conditions. It will remain flexible and impervious over the dams lifetime.

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Placements of asphaltic cores are to a great extent independent of the weather conditions. In areas with much rain, the overall construction when choosing an asphalt core design is simplified and construction time shortened when comparing with construction of clay cores, or asphalt- or concrete face dams. In cold climates the construction season can be prolonged.

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Asphalt is completely non harmful to fresh water- and irrigation water reservoirs. Bitumen, the binder element in asphaltic concrete, is a natural product and contains no additives that can pollute the environment or the water itself.

Dams with asphaltic cores permit impounding during construction, allowing potential seasonal water to be collected prior to full completion of works. Cofferdam design can often for the same reason be simplified.

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Asphalt cores in the interior of dams provide the highest protection against damage caused by acts of war or sabotage

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With asphaltic cores, the many scars from clay borrow pits are eliminated.

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Performance records from all existing ACC dams show no leakage through the core, and properly designed and built asphalt core dams are maintenance free.

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Asphalt core dams are today a safe alternative for the highest dams and have proven to be a very competitive alternative with other dam types.

Greater Ceres Dam, 1998

Asphalt laboratory

Laboratory tests are performed on a continuous basis to make sure that the specifications are met. Test specimens are analyzed for void content, and the asphalt mix is tested to make sure it is in accordance with the mix-design.

Fairly standard mix-design criteria have been developed for the asphaltic concrete in asphaltic cores. The most economical mix, and one which has the necessary workability complies with the Fuller's gradation curve improved with a fine grade component smaller than 0,075 mm (filler content). To eliminate segregation and to improve workability, maximum aggregate size should be less than 18 mm. Both gravel and crushed rock may be used. Normal binder content lies between 6 and 7 %.

The properties of asphalt concrete can to a great extent be tailored to satisfy specific design criteria. More and/or softer binder improves ductility and the self healing properties of the core. This makes asphaltic cores especially suited for dams on compressible foundations or in earthquake areas.

A rule of thumb has previously called for a core thickness at any level of 1% of the water head. With modern construction procedures and quality control this seems unduly conservative for high dams. New experience suggest a minimum thickness of 0.5 m, and no more than 1.0 m should be necessary, unless under special circumstances.

For Storglomvatn Dam on the Svartisen sceme in Northern Norway the 125 m high dam had a core that gradually tapered from 0.95 m to 0.5 m.

The machinery for placement of the asphalt cores in layers has been greatly improved over the last 15 years. Mobility is better, the extent of required hand placement is reduced, and transportation and loading of the asphalt are simplified, increasing the capacity, reducing heat loss and improving quality.

The placing machine in operration

Cleaning the previous layer

The asphalt should be produced in a modern batch plant keeping strict control on all mixing parameters. A plant with automatic weighing and a printout for each batch is recommended.

The material for the transition zones on each side of the core is transported to site by lorries or dumpers, and loaded in the paving machine by a normal excavator. The asphalt concrete and transition zones are placed and compacted simultaneously giving the hot asphalt immediate lateral support.

Three rollers, two on the transition zones working in parallel and one on the asphalt core, normally do the compaction.

The level of the screed is automatically controlled by a rotating laser witch ensures a horizontal base for the next overlay.

The centerline is marked for each layer and fixed with a thin metal string. A video camera mounted in front of the machine and a monitor inside the cab enable the operator to steer with precision following the string. In front the machine is supplied with a gas fired infrared heater witch dries and heat the previous layer if required. No tack coat is applied between the asphalt concrete layers, as core sampling has proved that the joint is tight and hardly detectible.

Storglomvatn Dam, 1997

Veidekke Industry
is Norway's major asphalt contractor with a good financial standing
and annual turnover of 400 million US$. Veidekke Industry is a subsidiary of Veidekke ASA,
Norway's leading general contractor.

LIST OF REFERENCES

Name	Country	Dam volume	Height	Asph.volume	Altitude top	Constr.period
Storvatn	Norway	10 mill m³	95 m	49000 m³	1055 m	1981-1987
Riskallvatn	Norway	1.2 mill m³	45 m	8000 m³	985 m	1983-1986
Berdalsvatn dam	Norway	1 mill m³	64 m	6800 m³	1066 m	1986-1988
Styggevatn dam	Norway	2.5 mill m³	52 m	15275 m³	1206 m	1987-1990
Queen Valley dam	Jersey	0.25 mill m³	25 m	2100 m³	40 m	1990-1991
Storglomvatn dam	Norway	5.3 mill m³	125 m	22500 m³	591 m	1993-1997
Holmvatn dam	Norway	1.2 mill m³	56 m	7000 m³	591 m	1993-1997
Urar dam	Norway	0.14 mill m³	40 m	1400 m³	1180 m	1996-1997
Ceres dam	South Africa	0.65 mill m³	60 m	4500 m³	646 m	1997-1998
Mao Ping Xi dam	China	12 mill m³	95 m	48500 m³	186 m	1998-2006
Miduk dam	Iran	0.4 mill m³	43 m	4000 ³	2333 m	2004-2005
Mora de Rubielos dam	Spain	0.16 mill m³	34 m	1700 m³	1126 m	2004-2005
Murwani Main dam	Saudi Arabia	5.35 mill m³	101 m	23800 m³	244 m	2004-2009
Murwani Saddle dam	Saudi Arabia	0.65 mill m³	30 m	3700 m³	244 m	2004-2009
Nemiscau 1 dam	Canada	0.05 mill m³	15 m	700 m³	300 m	2008
Kjøsnesfjorden Main dam	Norway	0.1 mill m³	25 m	1400 m³	1004 m	2008
Kjøsnesfjorden Saddle dam	Norway	0.06 mill m³	20 m	600 m³	1004 m	2008
Knezovo dam	Macedonia	1.6 mill m³	85 m	8400 m³	1065 m	2008-2010
Shur River Main dam	Iran	2.9 mill m³	80 m	16000 m³	2364 m	2009-2011
Shur River Saddle dam	Iran	0.05 mill m³	27 m	2000 m³	2364 m	2009-2011
Foz do Chapeco dam	Brazil	1.5 mill m³	48 m	17000 m³	268 m	2009-2010
La Romain-2 Main dam	Canada	4.4 mill m³	109 m	16500 m³	247 m	2012-2013
La Romain-2 Dike A2	Canada	0.08 mill m³	31 m	1030 m³	247 m	2011-2012
La Romain-2 Dike B2	Canada	0.07 mill m³	26 m	713 m³	247 m	2011-2012
La Romain-2 Dike D2	Canada	0.7 mill m³	45 m	6190 m³	247 m	2011-2012
La Romain-2 Dike E2	Canada	0.2 mill m³	38 m	2170 m³	247 m	2011-2012
La Romain-2 Dike F2	Canada	2.2 mill m³	80 m	10600 m³	247 m	2012-2013
Jurau dam	Brazil	2 mill ³	63 m	17000 m³	93 m	2011-2012

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