Mr. Robin Dawson

Dawson

Hydraulic Pile Hammers

Contracting background.

Dawson Construction Plant Ltd has its roots in contracting. The company evolved to manufacture equipment which would make pile driving more productive and safer. We believe that safe working practice and productivity are mutually complimentary.

Safe Control.

Pile hammers are potentially dangerous pieces of equipment as they are heavy, often used at height and have destructive power. Controlling the destructive capacity is essential. Hydraulic hammers are inherently more controllable than Diesel hammers which have been the industry standard from 1950 to 2000. Diesel hammer combustion is uncertain in the earlier, softer stages of driving. Several miss-fires can be followed by ignition with excess, un-burnt fuel which can then cause over stroking delivering excess energy. Hydraulic hammers can be regulated at the power source, avoiding uncontrolled explosion.

Speed of action.

With regard to productivity Dawson Hammers are the fastest in the world at full energy for their size at full energy. Pile driving is often on the critical path of a construction project. The cost of a pile being driven is, in these circumstances, the cost of running the whole project. This may be several thousand pounds or dollars per hour. A hammer which can operate at double the speed of other hammers without loss of driving capability can therefore save time and cost far beyond the price of the hammer. To quote an old adage, "Time is money". In order to achieve as many blows per minute as possible Dawson hammers are double acting, meaning that they are accelerated downwards as well as upwards. This is all done hydraulically, unlike some other hammers, which use Nitrogen gas springs. On the downward stroke of a hydraulic hammer the power supply would not normally be doing anything. Dawson use this otherwise unwanted supply to accelerate the drop weight downwards. This enables most Dawson hammers to deliver full power at 80 blows per minute, which is 50% faster than other double acting hydraulic hammers and 100% faster than single acting of a similar size. The user knows that if the hammer is being hoisted up then it is also being accelerated down. In hammers using a gas spring if It has leaked and lost pressure the hammer may, unknowingly, not perform in accordance with its specification.

Energy - v – Momentum.

Since the introduction of Diesel hammers it has become the industry standard to compare hammers in terms of "Energy". This has also been perpetuated by purveyors of high impact velocity hydraulic hammers. We believe this is commercial exploitation of an engineering misunderstanding. We quote the following example:

If we compare two hammers, one with a ram mass of 5 tonnes and a stroke of two metres and another with a ram mass of 10 tonnes and a stroke of one metre their "Energy" is apparently identical, 2 x 5 or 1 x 10 = 10 tonne metres.

If we then compare their "Momentum" M x V

The velocity from a two metre free fall stroke is 6.264 m/sec
The velocity from a one metre free fall stroke is 4.429 m/sec

The 5 tonne hammer has a momentum of 5 x 6.264 = 31.32 Tm/sec
The 10 tonne hammer has a momentum of 10 x 4.429 = 44.29 Tm/sec

In terms of Momentum these two "equal energy" hammers are significantly different. So which method of comparison is right? Energy dissipates in many different forms, movement, heat, light and sound. Momentum dissipates only as momentum.

These figures demonstrate that hammers which have a long stroke/high impact velocity look better in terms of energy than heavier, lower impact velocity hammers. That is why they have been promoted on the basis of energy. If they are compared in terms of momentum, which is what drives piles, they are not so attractive.

Diesel deception.

Diesel hammers have been sold on the basis of their “Energy”. They quote energy and ram weigh but not stroke. The engineer will need to divide the energy by the ram weight in order to calculate stroke. This figure will be in the region of 3 to 3.5 metres. This free fall can never be achieved in a diesel hammer. As the ram weight falls, after it has passed the exhaust ports, it begins to compress the trapped gas. It cannot function unless it compresses the trapped gas to a compression of about 20:1. Compression has to take energy from the falling weight and impede its fall. The claimed energy is therefore unachievable. This is further proved by impact velocity. If a ram weight falls freely through 3 metres its impact velocity will be 7.67m/sec. This impact velocity will destroy steel and cast iron so the hammer will therefore destroy itself. Diesel hammers have been used extensively in the past on concrete piles. This means the actual impact velocity is probably less than 4.8m/sec, a figure beyond which concrete is destroyed. Dawson hammers with impact velocity monitoring record only the facts.

5 Metres/Sec.

Dawson have concluded that an impact velocity of 5 m/sec is an optimum standard. Steel piles can be driven at the resulting stress for long periods of time if required. The stroke and downward acceleration of the ram weight to deliver this velocity enables 80 blows per minute to be delivered at full momentum. This is faster than any other hammer of similar size.

By coincidence a pattern appears in the load carrying capacity of hammers with an impact velocity of 5 m/sec which appears as follows:

1 T ram, at 5 m/sec, set of 10 blows to 25mm gives 50 T, SWL, 100 T ultimate.

2	5	10	25	100	200
5	5	10	25	250	500

Higher loads are achievable by driving to higher sets but this should be used with caution and for limited periods and distances.

New Features.

The most recent development in the Dawson hammer range is the 15K. Unfortunately we have had to comply to the industry standard of using "Energy" for designation. 15K means 15,000kgm of energy. It has the momentum of another hammer of 20,000kgm. This hammer has a drop weight of 12 tonnes and an impact velocity of 5m/sec.

This hammer has been designed for all hammer applications. But it also has features which recognise two particular problems:

1. **Flushing, drilling.**

   Hammers of this size are most commonly used to drive steel pipe piles. When these piles are long and hard ground layers are encountered driving becomes difficult. Big hammers are then required and the wall thickness of the pile has to be increased in order to withstand the higher driving stresses. Cranes and associated plant all become larger and more costly. If it is possible to remove or disturb the soils on the inside of the pile, during pile driving, in order to reduce internal skin friction, much of this additional expense may be avoided. The 15K has been designed with a hole through the middle of the drop weight and anvil to facilitate flushing or drilling. This enables drilling and/or flushing to run concurrently with impact driving, but without the drill of flushing pipe being impacted.

2. Modular construction.

When driving conductor piles on oil platforms there is often a lifting limitation, particularly with older platforms, when offloading from supply vessels. The limitation is normally 17 tonnes. The 15K hammer has been designed in such a way that it can be easily dismantled and shipped in modules of less than 17 tonnes. It can then be quickly assembled on an oil platform where it will outperform a hammer of 17 tonnes all up weight, by a considerable margin.

3. Underwater pile driving.

All Dawson hammers can be sealed to facilitate under water pile driving. The 15K has a cover plate over the through hole to change it from flushing and drilling to fully sealed for under water use.

Robin Dawson

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