

Taking the Strain

Silo-Weigh solves high-capacity weighing challenge at Castle Hill Quarry

A high-capacity Silo-Weigh system, installed by AV Technology Ltd (AVT) on two large limestone silos, is playing a vital operational role at Castle Hill Quarry, in Cannington, Somerset. The two outdoor silos, which have a combined capacity of 400 tonnes, are mounted on a common structure supported by six steel legs.

Achieving accurate contents measurement on such silos is a notoriously difficult task. Modern level control systems may be able to achieve reasonable average level measurement results, but void formation together with changes in bulk density and surface topography during filling and emptying prevent them from providing sufficiently accurate weight-related contents. Retrofitting traditional load-cells is not only very disruptive but also prohibitively expensive, with structural cross-talk further complicating matters.

The cost-effective Silo-Weigh solution brings a fresh approach to high-capacity silo weighing and is the result of extensive development over more than a decade. It has a solid track record on large steel and concrete silos in applications where established measurement systems do not give reliable results.

Unlike many traditional weighing companies, AVT have a detailed understanding of the behaviour of structures based on more than 25 years' experience in this area and their approach takes into account application problems such as low signal levels, temperature effects and cross-talk. While

UPVC thermal shielding on the six steel support legs



The two limestone silos at Castle Hill Quarry

most current retrofit sensors are based on electrical resistance strain gauges, which struggle to provide sufficient stability and accuracy, the Silo-Weigh system uses specially developed 'low-strain' sensors. These devices are insensitive to moisture, long cable runs and low signal levels.

Castle Hill set a number of difficult challenges for the AVT system: as well as wanting to measure the individual and combined contents of each silo, they also wanted to be able to weigh out known amounts into waiting vehicles while the silo-filling process was in progress. The latter allows optimum vehicle loading, prior to final check-weighing on the weighbridge.

The raw compressive strain levels in the legs are measured using six spot-weldable strain sensors, mounted so that any bending components of strain are cancelled out. Data from these, together with information from the adjacent temperature sensors, is fed

back to a powerful Campbell Scientific CR1000 data-logger. Engineers applied protective coatings to the sensors, while UPVC thermal shielding wrapped around the legs minimizes the temperature effects on the strain gauges.

Four individual weight displays are presented on the central control and readout unit. The first three show the combined weight contents of the two silos and the calculated individual content weights. The fourth display normally indicates the average fill rate in tonnes per hour, but is also used during load-outs to show the amount extracted from the silos. This is calibrated from 0–50 tonnes and is zeroed just prior to vehicle loading by pressing a button adjacent to the display. This action also increases the system measurement update rate to improve accuracy. To compensate for the material entering the silos as product is simultaneously discharged, the calculated weight taken out is automatically adjusted using an historic 10min fill rate measured just prior to vehicle loading.

The Silo-weigh system, which is totally non-intrusive, can be fitted without having to stop the process or empty the silos. Calibration

Advances in Weighing

at Castle Hill Quarry was achieved using theoretical values and known physical load additions. During the commissioning phase, data from the system were transmitted, via modem, to AVT's offices in Cheshire. This remote access to the data allowed AVT engineers to fine-tune the system over a period of several weeks, without the need for repeated site visits.

Castle Hill's operations manager, Stephen Ford, is delighted with the new Silo-Weigh system. 'At first we were a little sceptical about the system, but AVT were confident they could achieve what we wanted,' he commented. 'Our initial concerns were unfounded and we can now reliably measure combined silo capacity an accuracy better than 1.5%.

'Being able to measure and control how much material is loaded into vehicles is extremely useful and results are better than expected. Prior to the Silo-Weigh installation, over-loaded vehicles had to return from the weighbridge and discharge part of their load before departure from site. AVT's attention to detail has been excellent and they spent time remotely fine-tuning the system based on actual results.'

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The AVT central control and readout unit