Vistina ACN 058346562 t/as

THOMAS EARTHMOVERS

Ph 0354470400
Fax 0354470301

15-35 Fairview Rd
Kangaroo Flat 3555

30 November 2001

To whom it may concern:

I have been asked by Mr Jim Crandell of Dr Baden Clegg Pty Ltd to make some comments regarding soil compaction and testing, including my usage of the Clegg Impact Soil Tester. Our company is involved primarily in road construction using heavy compactive effort on mainly crushed rock basecourse materials for local councils and the Main Road Department (Vicroads) in the Australian state of Victoria. We own both a Nuclear Density Gauge and a 4.5 kg Clegg Impact Soil Tester (Clegg Hammer). Both of these are used either during or immediately after construction prior to end-specification testing taking place.

We have tested with both devices together since 1999, though we have owned and used the Clegg Hammer since 1995. Our method is to use the Clegg Hammer while we are rolling to monitor the compaction and, once satisfied that we have reached a satisfactory level of stiffness and stability, as indicated by the Clegg Hammer as a means of quantifying this, we run nuclear tests for density and moisture along with further Clegg Impact Tests in conjunction with the nuclear method. This testing is for the "as compacted" moisture condition.

Our usual procedure when compaction is finished is to run three Clegg Impact Tests for each nuclear test. The Clegg Tests are carried out evenly around the nuclear gauge at a distance from the nuclear gauge of approximately 30 cm. We select a smooth, level area to run the tests, with the area looking as uniform as possible for the testing coverage. All of our end-test results are logged in a Apple Newton computer with records beginning in 1999 for both test methods and from 1995 for the Clegg results (CIV). From this testing, for the crushed rock material that is typically used, we have developed the correlation of C% (modified compaction) = 0.34 (CIV) + 88, for the moisture condition being in the "as compacted" state and on the slightly dry side of the optimum moisture content. We average the results of the three Clegg Tests when entering in the value for the CIV against the nuclear density results. We have a high level of confidence in this correlation, developed since 1999 on scores of road sections involving hundreds of tests and demonstrated as being "near enough" for all practical purposes taking into consideration the variability in the field.

It is advised when developing such a correlation between nuclear density and CIV that a sufficient soil sample taken from around the probe in each case be sent back to the lab for obtaining the actual moisture content through weighing, drying and weighing and that this moisture content be used as the moisture content in the statistical data with adjustments made to the density results of the nuclear gauge as required based on the moisture contents obtained in the lab on the soil samples rather than the moisture as measured in the field by the nuclear gauge, which can vary from the lab results.

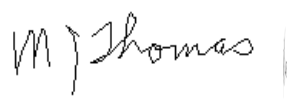
The main point I'd like to make, though, is that if the finished road is opened to traffic when at optimum moisture content (OMC) or wetter for the "as compacted" state where

close to 100 percent modified proctor compaction or higher has been achieved, it will not hold up; nor will it hold up if it returns to these moisture conditions later on. And if it is that we have not achieved a certain minimum CIV in the thirties, which for us is achieved at just below OMC using modified compactive effort, the road will not hold up to traffic if opened because there is simply not enough strength – and if it is at OMC or greater, not enough stability as well. I have seen a road section compacted dry of optimum at around 95 percent modified compaction hold up since it was constructed several years ago whereas roads compacted at or wet of optimum to the specified density of 98-99 percent or greater fail in a short time after being opened to traffic – or fail after returning to their "as compacted" moisture condition of optimum or above, for example with the onset of winter. Such failures show the value of having a specification for a certain minimum CIV because, even though the roads that failed were compacted to 98-99 percent or greater, the Clegg Hammer would have given low readings, indicating there was a problem.

A good thing about the Clegg Test as a test procedure is the ease and speed of testing. From my experience, I would say that something like twenty Clegg Tests can be carried out in the time it would take to do a couple of nuclear tests. Also, the Clegg Test tells us what we want to know while the compaction is occurring, namely that the material has become stiff enough. It is up to our experience and judgement to work the material at the appropriate moisture conditions during compaction so as to both get the strength that there needs to be and to pass the density testing.

In short, our aim is to always get the strength as well as the compaction. We achieve this by aiming to finish compacting with the moisture condition slightly below the OMC by approximately 0.5 of a percent. It takes a little more effort, but it gets us to where we want to be. We don’t want to finish the compacting when the moisture is at OMC because this isn’t an ideal moisture condition to be finishing at in the field, contrary to what the name might suggest. Rather, the OMC is a laboratory determined moisture which correlates to compacting the most material into a compaction mould for a standardised level of effort. The result, however, is a material in an unstable state. Material that is in this unstable state in the field, even though it might pass a density specification, is no good to us or anybody else because it doesn’t have enough strength to hold up to traffic in this condition. Nor is 100% compaction, which also sounds ideal, something to be aimed for in the field at the OMC for the same reason, i.e. the result is a material that is in an unstable state. Even proof rolling doesn't always help, this being because sometimes it is hard to see the movement of the material. Because of this, it is not always easy to determine through the process of proof rolling if the material is behaving as it should to hold up to traffic. The Clegg Impact Test tells us if enough strength and stability have been achieved and this is the test method in which we place the most reliance when compacting.

Yours faithfully,



Michael Thomas
Thomas Earthmovers