EFFECT OF SOAKING TIME ON UNIFORM DENSITY & RESILIENT MODULUS

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Abstract

This research is directed to evaluate the relation ship between sub base resilient modulus (Mr) with uniform dry density during testing; only the deformation in the central portion of the specimen is measured.

It is noticed that the divided layer of sub base sample is affected by the period of soaking and reflects this effect on the (Mr) of the material .In this research ,the samples from the Nibaee quarry were took. These samples were representing the lower limit of gradation of the specification. The specimens were classified into two groups. The first one is soaked for a period of two days and the second group was soaked for four days.

تاثير فترة الغمر على كثافة الحصى الخابط ومعامل الرجوعية

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الخلاصة

في هذا البحث تم دراسة تقييم العلاقة بين معامل الرجوعية (Mr) والكثافة الجافة للحصى الخابط مع تحديد تأثير فترات الغمر المختلفة على معامل الرجوعية وهذا تم ملاحظته في الطبقات المختلفة للنموذج .وفي هذا البحث تم أخذ نماذج من مقالع النباعي وكانت هذه النماذج تمثل الحدود الدنيا في التدرج للمواصفة , وقسمت النماذج إلى مجموعتين , وكانت المجموعة الأولى غمرت في الماء لفترة يومين والمجموعة الثانية غمرت لأربعة أيام .

Nomenclature

Mr = Resilient modules.

σ_3 = Minor principal stress.

σ_a = Deviator stress.

θ = Principal stress.

Introduction:

The use of locally available material in a road construction is one of the most important aspects for minimizing the construction cost. The properties of these materials are essential for proper designs and construction of roads.

The resilient modulus of unbound materials as determined by repeated triaxial load tests, the density of the specimen is important parameter.

Bowles (1979) defined the resilient modulus as the initial tangent modulus of a triaxial test stress-strain curve which has been cycled several times with a deviator stress.

Donald. M.C, (1984) stated that pavement systems (roads, airfields, railways) which subject to traffic, soil, deposits, and soils beneath offshore structures subject to earth quake and wave loading are all classical examples were the soils will experience varying degrees principle stress rotation.

Mamlouck M.S & Daves T.G, (1985) stated that the stress – strain relation of isotropic elastic materials in classical formulation expressed in terms fundamental parameters (e.g. young's modulus and poisons ratio.) .

But in highway engineering it is common to define stats dependent parameters are often used to interpret the non-liner and time-dependent response of pavement materials.

Correlation of (Mr) with Uniform Density:

According to Nordic road and transport research No.2 (1997), the resilient modulus of unbounded material as determined by repeated load triaxial testes, the density of the specimen is an important parameter.

During testing, only the deformation in the central portion of the specimen varies significantly the overall density may not be the same as the density of the mid-section, and an incorrect relationship between density and resilient modulus may be obtained. Therefore, method for measuring the density gradients has been developed to ensure uniform specimens.

In this study, the deformation in the central portion of the specimen was measured. If the density within the specimen varies significantly, the overall density may not be the same as that in the mid-section. An incorrect relationship between density and resilient modulus may be obtained; therefore, a method for measuring the density gradients has been developed to overcome this situation.

In this test, the fact that the specimens compacted from the center outwards by static compaction is that it is difficult to obtain a uniform density gradient, and this may affect the resilient modulus measured in the traxial test.

Experimental work:

This study deals with the effect of properties of sub-base materials from Al- Nibaee quarry, and the durability properties of these materials on life of roads.

To study the effect of distribution of moisture content along the height of specimen. The sample was divided into four portions through its height, to study the effect of soaking for periods 2 and 4 days, so specimens were classified into two groups. The first one is soaked for a period of two days and the second group was soaked for four days.

At the end of these periods the specimens are compacted in four layers.

The effect of the soaking period on the relation-ship between the resilient modulus (Mr) and the value of the CBR and the dry density was examined. The moisture content is measured with (ASTM T-180). The gradation of the specimens was as specified by the upper and lower limits of SORB specification for sub-base materials as shown in **Fig.(1)** .

During testing, only the deformation in the central portion of the specimen was measured. If the density within the specimen varies significantly, the overall density may not by the same as that in the mid-section.

In this test, the specimens compacted from the center outwards by static compaction were found to be difficult to obtain a uniform density gradient, and this may affect the resilient modulus measured in the triaxial test.

Analysis of Results:

These materials are some-times not suitable for use, as they do not satisfy the allowable limitation of specifications such as strength requirements.

O'Flaherty (1988), stated that CBR is an empirical test and depends upon condition of the material at the time of testing. This means that soil must be tested in a condition that is critical to the design.

The factor's affecting the design such as soil type, dry density and other factors are relevant to the soil condition.

It is noticed, that the value of CBR for soaking period of 2 days is more than the value of CBR for soaking 4 days, this may be due to the residual strength that soil still posses. But for fine gradation, it is noticed that the condition will be inversely due to the effect of fine particles that increased the value of CBR.

The specimen was divided into four portions through its height, as shown **Fig.(2)**.

It was found that dry density increases in the middle portion than other portions (upper & lower), this happens due to it's far away from the direct touches of water during soaking period.

Also it could be noticed that the dry density in the period of soaking for 2 days is less in value than for 4 days soaking, this was because of the increase of moisture content.

From **Fig.(2)** the specimen is most dense in the second and third layers, this may be due to the compaction process for each layer. While the permeability to the sample according to the oldness of the mould affects the density of the sample.

Fig.(1) shows the above mentioned relationship for the two soaking periods (2 and 4 days).

For the relationships shown in these figures, it is a fact that increasing the CBR value or the only density would cause an increase in the resilient modulus.

Fig.(3 , 4) indicate that for the same CBR value soaking the specimens for 4 days would lead to decrease the Mr value. This could be attributed to the increase of the pore water pressure inside the specimen for longer soaking period .the pore water would develop higher reaction against loading than the case of 2 days soaking due to higher saturation degree.

From figures above, the relationship between CBR and Mr is best described by a nonlinear equation. However, for the relationship between dry density and (Mr), it seems that the soaking period has no distinguished effect on the value of (Mr), as shown in **Fig. (5 & 6)** This may be explained by the fact that the average density for the all height of the specimen does not depend much on the soaking period.

Conclusions:

Through out this study, and according to the results obtained from the experimental work, which was carried out on sub-base material loads to the following conclusions can be drawn:

1- The value of resilient modulus gives good guide for evaluating sub-base material and can be taken instead of CBR value in specifications.

2- The relation between resilient modulus and deviator stress could be taken into consideration for acceptance each type of sub-base material.

3- It was found that adopting values of CBR for period of soaking of two days gives reasonable results, which could be depend on.

4- It was observed that, the saturation degree for the period of soaking of two days almost reaches to the optimum saturation more than other soaking periods.

5- There is a relation between dry density of different layers of CBR molds and resilient modulus.

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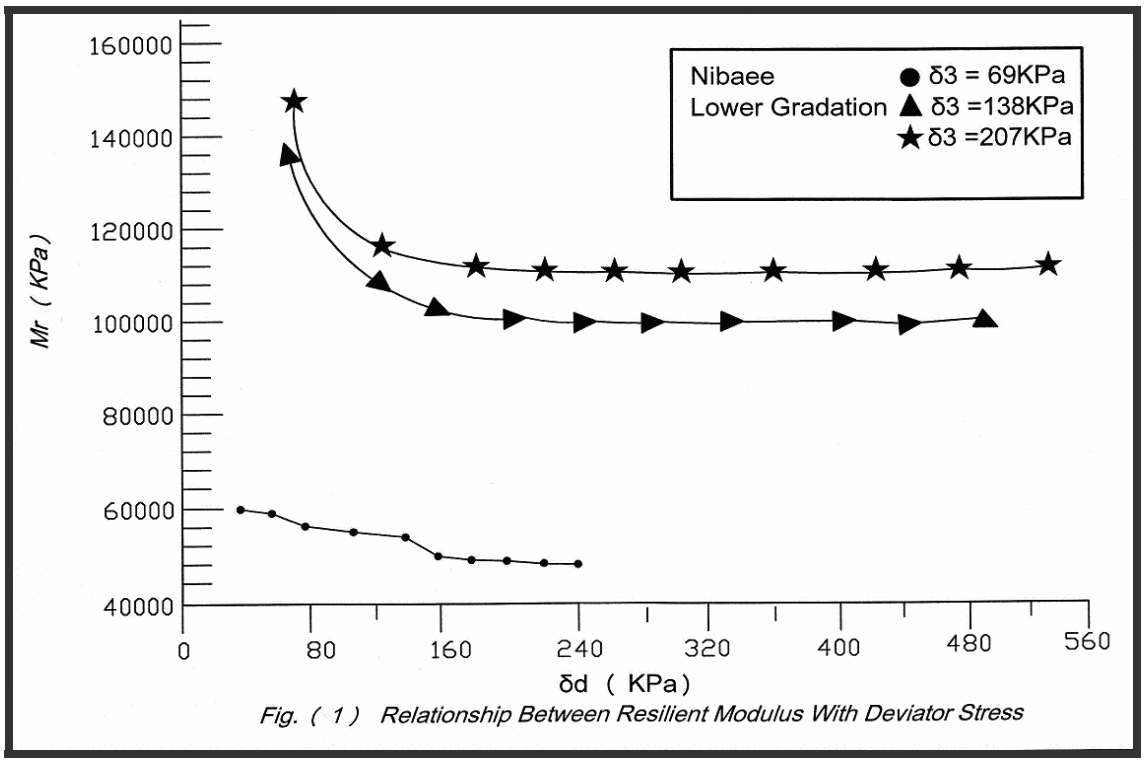

Fig. (1) Relationship Between Resilient Modulus With Deviator Stress

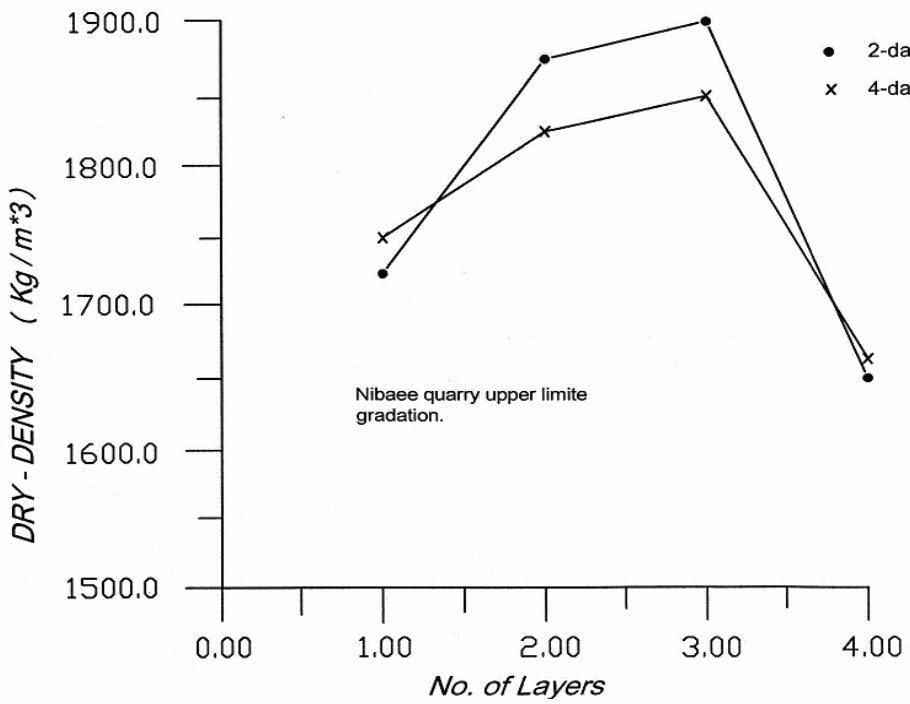

Fig.(2) Relationship between Dry-Density and Number of Layers with Different Soaking Periods

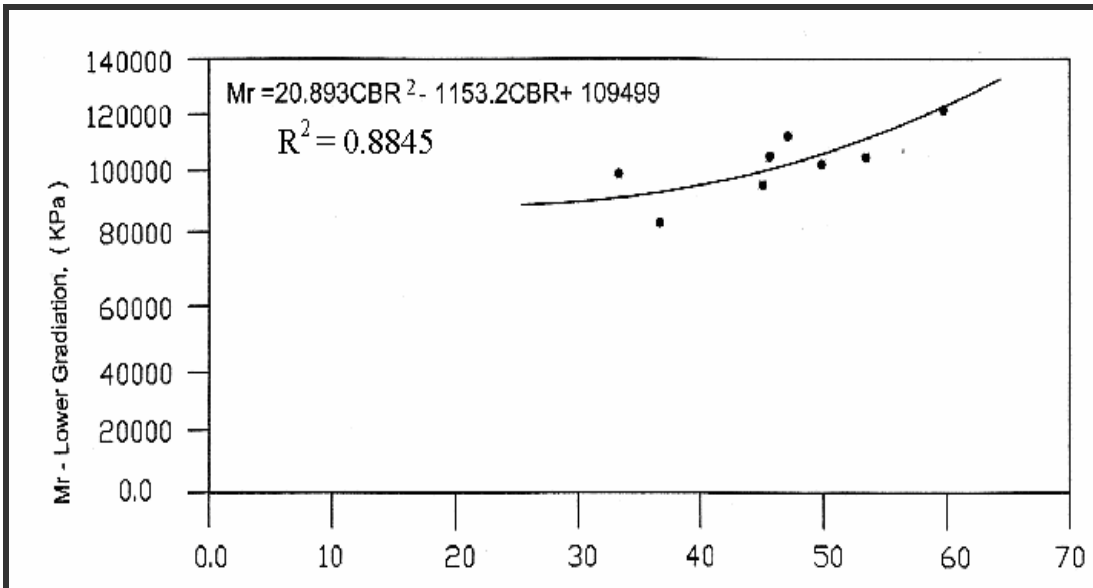

Fig.(3) Relationship Between Mr (Lower Limit) and CBR Value For Nebaee Quarry For Soaking Period 2-days

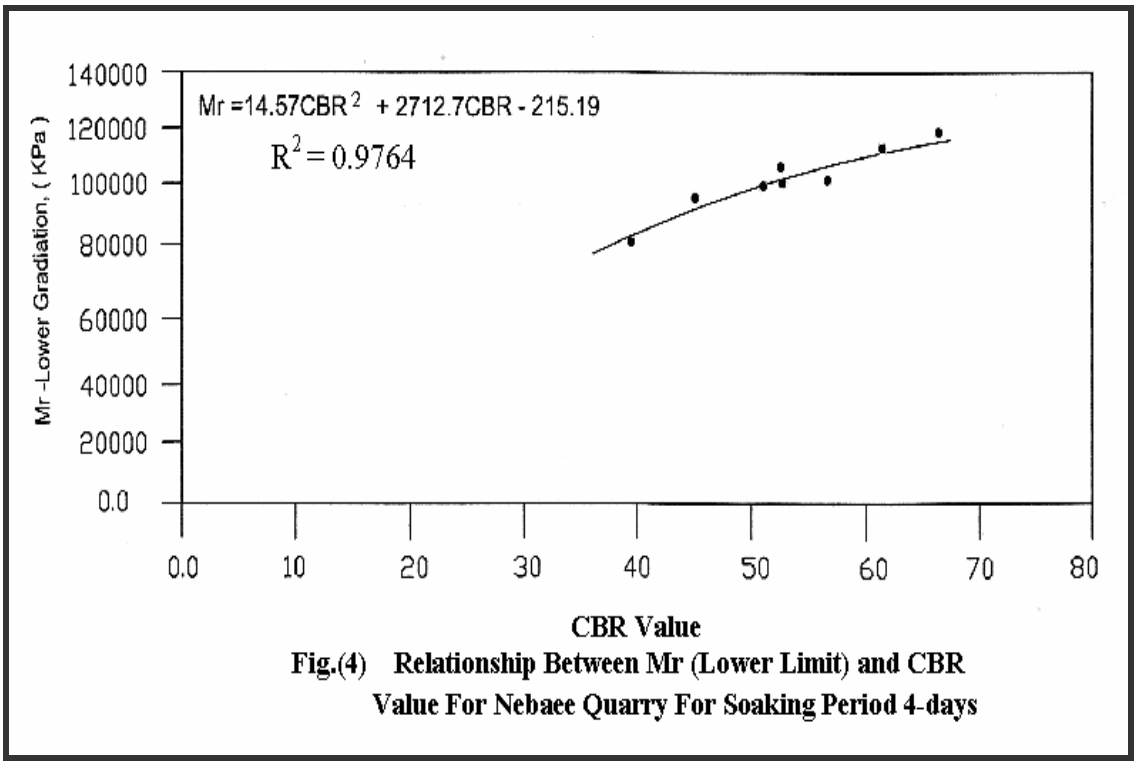

Fig.(4) Relationship Between Mr (Lower Limit) and CBR Value For Nebaee Quarry For Soaking Period 4-days

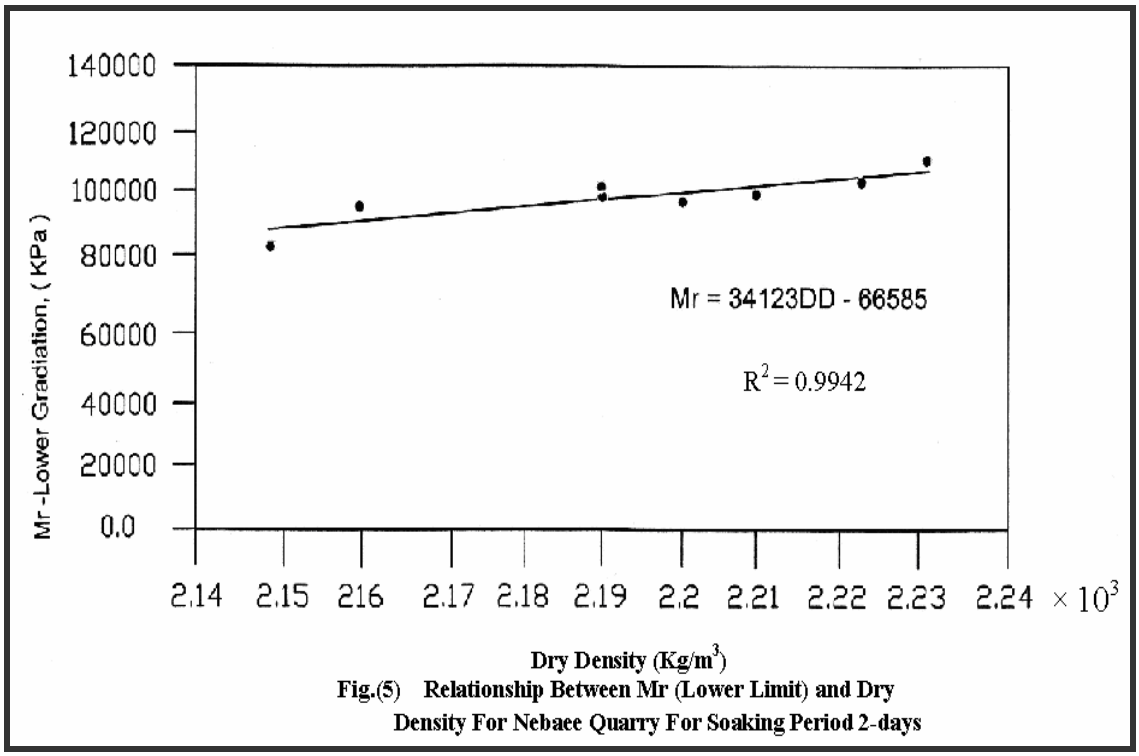

Fig.(5) Relationship Between Mr (Lower Limit) and Dry Density For Nebaee Quarry For Soaking Period 2-days

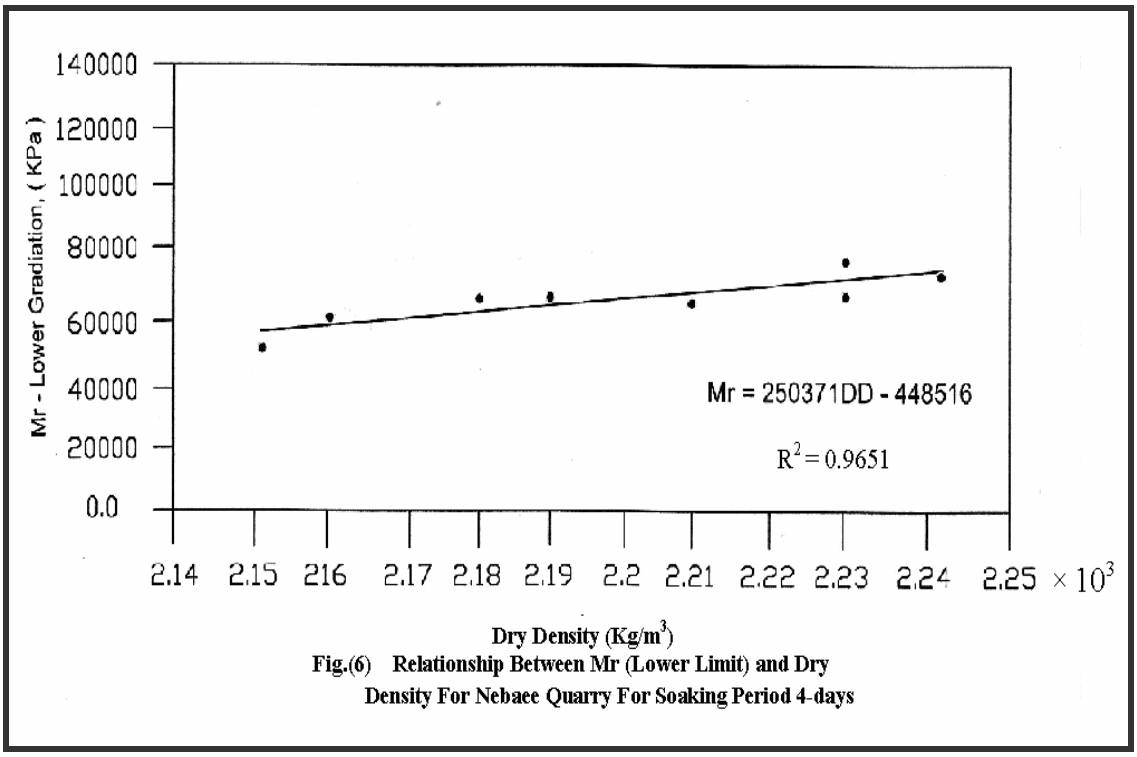

Fig.(6) Relationship Between Mr (Lower Limit) and Dry Density For Nebaee Quarry For Soaking Period 4-days