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Instruction

For the determination of the dynamic CBR value using the Light Drop - Weight Tester

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1. Purpose and range of application

The dynamic CBR - test is used for the determination of an empirical measure for the strength of layers made of steel works slags or granular layers.
The Light Drop Weight tester can determine the so called dynamic CBR value CBR_d within a range of 20 % $\leq CBR_d \leq$ 150 %.

The dynamic CBR - value is a complex strength coefficient. It depends on
- the firmness, the particle shape, the frost resistance and the grain roughness of the single grain;
- the grading, the content of finenesses, the water content and the compression of the mixture of mineral materials from steel work slags
- as well as the sensivity to moisture of the finenesses contained in the mixture of mineral materials.

It serves e.g. for the evaluation of the frost susceptibility of the layer or for the estimatation of trafficability and compactability as well as the load-carrying capacity of the inserted slug. The dynamic CBR - test is executed in the laboratory at disturbed samples, with which the maximum particle size does not exceed 22 mm and the over grain proportion is usually smaller than 50 %.

The dynamic CBR - test can alternatively used to the static CBR test. (German regulation "Technical test regulation for soil and rock in road construction, TP BF - StB part of B 7,1 [1]"). It is used because of the small expenditure of time as high-speed testing method in the context of the self-monitoring checks for the production control with the production of mixtures of mineral materials from steel plant slugs. Favourably opposite to the static CBR - test is the omission of the load framework and the appropriate static load device.

2. Terms

The dynamic CBR test is a stamp penetration test. The stamp is pressed into the sample under a defined jerky load and the setting amplitude (deflection) of the CBR - load stamp is measured and used for the calculation of the dynamic CBR - value.
The defined jerky load is produced with the load device of the Light Drop Weight Tester (German regulation: "Technical test regulation for soil and rock in road construction, TP BF - StB part of B 8,3" [2]).
The dynamic CBR - value is approx. calculated with the equation: [3]

$$CBR_d = 24.26 * p / s^{0,59} \qquad (1)$$

s [mm]: setting amplitude of the CBR - load stamp
p [N/mm²]: loading amplitude of shock

Depending upon different pretreatment of the samples 3 types of dynamic CBR - values are defined as follows:

CBR_{do}: is determined immediately after compressing the samples without further pretreatment.

CBR_{dw}: is determined after storage of the samples in water

CBR_{dft}: is determined at samples, that were embedded in water and subjected to freezing and thawing cycles

3. Devices

For the execution of the test are necessary:

- CBR-cylinder (Ø 150 mm), loading dics, two removable baseplates, 50 mm thick application disk, CBR - piston rams (Ø 50 mm loading stamp), 10 mm thick application disk, 2.5 kg - tension devices and a measuring device for the determination of the swelling measure during storage in water (according to TP BF - StB part of B 7,1 [1])
- Proctor compactor according to DIN 18127: "Building ground, tests and test devices [4]"
- loading device consisting of 10 kg - drop weight, guide tube and spring element to prduce a force of 7070 N ± 70 N (peak) (according to TP BF - StB part of B 8,3 [2])
- device for the measurement of the total setting of the loading plate perpendicularly to the loaded surface. The measuring instruments should at least have a error of max. 1 % in a frequency range from 5 to 100 Hz and in a temperature range from 0 to 30 °C and in a measuring range for the setting amplitude from 0,5 to 10 mm a measuring accuracy of ± 0.02 mm.
- a hard rigid base to execute the CBR test on it

See fig. 1 for the principle sketch of the entire dynamic CBR device.

4. Investigational procedure

4,1 Sampling, sample preparation, sample compaction and storage of the compacted sample

Grab the samples according to the "Technical test regulation for mineral materials in road construction" - TP min - StB, paragraph 2.2 [5].

Sample preparation and sample compression in the CBR - cylinders as well as the storage of the compressed samples for the execution of the CBR - test (storage in water or freezing and thawing cycle after storage in water) are always correct with in the "Technical test regulation for soil and rock in road construction, TP BF - StB part B 7.1, CBR - Test [1]" described procedure.

Deviating from this test regulation a 22.4 mm sieve is used for sieving of the over grain proportion (and not the 20 mm sieve). The grain proportion > 22.4 mm is not used for CBR. From the respective delivery granulation 0/32 mm, 0/45 mm or 0/56 mm only the test granulation 0/22 mm is examined.

Further deviations from the test regulation "TP BF - StB part B 7.1" are to be noted in the inspection report. If doubts exist that the grain proportion > 22 mm indicates a too small grain strength, the shock test at crushed stones is to be executed according to DIN 52.115 part 2.

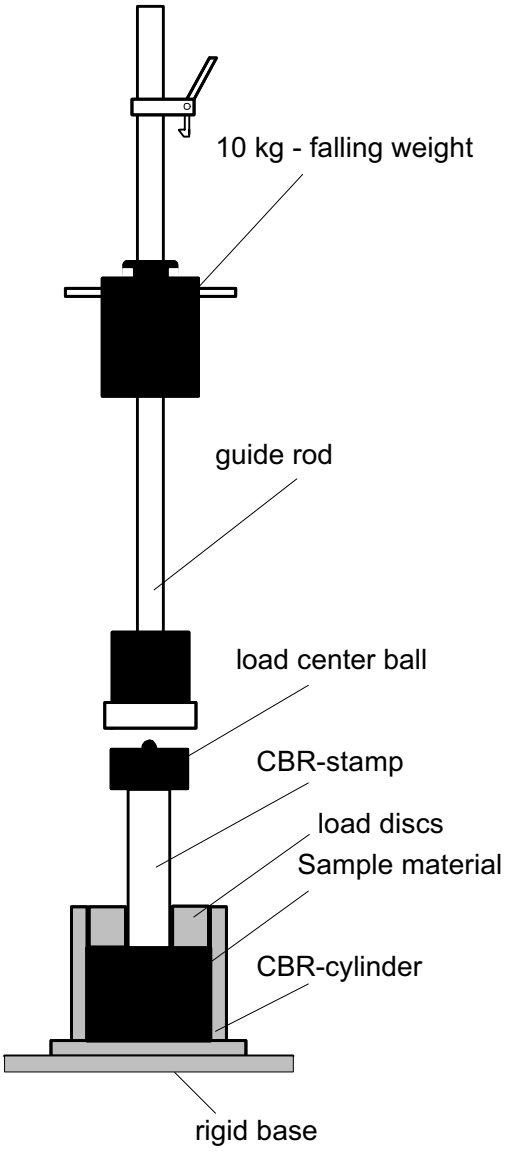

Fig 1: CBR tester

4,2 Execution of the dynamic CBR - test

After the sample is in accordance with paragraph 4,1 inserted and prepared, the CBR - cylinders is placed on a rigid surface and secured against lateral shifting. The load discs and the load stamp are applied on the compressed sample. Please ensure that the CBR stamp is perpendicularly.
The load device of the light drop weight tester is carefully and centric placed on the CBR stamp. Unfix the transport lock of the drop weight, keep the guide rod perpendicular, uplift the the drop weight and latch it at the upper impact latch. Execute one preloading impact: Release the weight with the latch, the weight drops down and bounces back. Catch the drop weight during the bouncing and latch it again.

Now switch the measurement device on. Execute one measurement impact as described above. The setting amplitude (deflection) of the CBR stamp is displayed from the measurement device with an accuracy of ± 0.02 mm.

It is to be made certain that the drop height prescribed by calibration is accurately kept. After finishing of the measurement the transport lock of the load device is to be clamped, in order to prevent a shifting of the drop weight when transferring the device. Usually 2 measurements are done. If the two individual values of the measurements differ around more than 15 % from each other, the CBR test has to be repeated with new samples.

5. Inspection report and analysis

The inspection report must contain the following data:
- test-no. / test date / test personnel
- type of the load and setting measuring device
  (if necessary specification of a conversion or a calibration factor)
- remarks over deviations from the determined procedure and over unusual occurrences
- information over sampling, origin and type of the steel plant slug
- sample preparation
- sample compaction (simple or modified Proctor compaction)
- sample storage, e.g.
  test was executed immediately after the sample compression without further pretreatment,
  test was executed after storage in water of the samples,

test was executed after freezing and thawing cycles the samples
- density and water content of the samples in the CBR - Cylinder
- the setting amplitude s in mm
- the calculated dynamic CBR - value CBR_d in %, see equation (2)
- arithmetic means of the two individual values, when 2 measurements are done

Equation (1) can be simplified with a force of 7070 N and a diameter of the stamp of 50 mm (1963 mm² cross section) to equation (2): (p= 3600 N/mm²)

$$CBR_d = 87.3 / s^{0,59} \quad (2)$$

(deflection s [mm], CBR_d [%])

6. Calibration

Load device and setting measuring instrument must be calibrated annually by authorized testing institutes.
The calibration of the load device is described in "TP BF - StB part of B 8,3" [2] and includes the calibration of the maximum force (drop height) and the setting measuring instrument. Deviating from "TP BF - StB part of B 8,3" [2] the measuring device is additionally calibrated for the following setting amplitudes:

4,0 mm ± 1.0 mm
8,0 mm ± 2.0 mm

7. Literature

[1] Technische Prüfvorschrift für Boden und Fels im Straßenbau
TP BF - StB Teil B 7.1, CBR - Versuch, Ausgabe 1988
Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln

[2] Technische Prüfvorschrift für Boden und Fels im Straßenbau,
TP BF - StB Teil B 8.3, Dynamischer Plattendruckversuch mit Hilfe des Leichten Fallgewichtsgerätes, Ausgabe 1992
Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln

[3] Weingart, W., J. Hanebutt und W. Rummert : Dynamisches Labor- und Feldprüfgerät zur Bestimmung des CBR-Wertes von Mineralbeton
Die Straße (1986) Heft 2, S.48/51

[4] DIN 18 127 : Baugrund, Versuche und Versuchsgeräte
Proctorversuch, Ausgabe Mai 1987
Beuth Verlag GmbH, Berlin

[5] Technische Prüfvorschriften für Mineralstoffe im Straßenbau - TP Min - StB
Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln

7. Appendix

This Document is part of the leaflet

"Merkblatt zur Verwendung von Stahlwerksschlacken im Straßenbau"
Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln 1996

"Usage of steel work slugs in road works"
published by the German research society for road construction and transportation, FGSV Köln 1996

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