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Schakt och fyllning för anläggningsbyggande – Yttäckande Packningskontroll (YPK)

Earthworks – Continuous Compaction Control (CCC)

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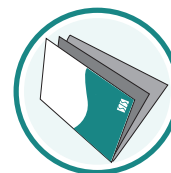
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Terrassements - Contrôle du Compactage en Continu
(CCC)

Erdarbeiten - Kontinuierliche Verdichtungskontrolle

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SIS-CEN/TS 17006:2017 (E)

Contents	Page
European foreword.....	4
1 Scope	5
2 Terms and definitions	5
3 Fundamentals and principles of CCC measurements.....	7
4 Influences on the CCC measuring value	8
4.1 General.....	8
4.2 Roller	8
4.2.1 General.....	8
4.2.2 Static linear load of roller drum	8
4.2.3 Vibration amplitude.....	8
4.2.4 Vibration frequency	8
4.2.5 Operating speed.....	8
4.2.6 Direction of roller	9
4.3 Measuring depth.....	9
4.4 Soils, granular materials and rockfill materials	9
4.4.1 Type of material and water content	9
4.4.2 Evenness and inhomogeneities on the layer surface	10
4.4.3 Resting time of the compacted layer.....	10
5 Preconditions and requirements	10
5.1 Soils, granular materials and rockfill materials	10
5.1.1 Soil type	10
5.1.2 Requirements for the layer surface.....	10
5.2 Requirements for CCC rollers	10
5.3 CCC Measuring and documentation system.....	11
5.3.1 Structure of the measuring and documentation system.....	11
5.3.2 Requirements for the CCC measuring and documentation system.....	11
5.4 Reproducibility	12
5.5 Personnel requirements.....	12
6 CCC applications	12
7 CCC with calibration for indirect continuous density and stiffness control and QC and QA purpose.....	12
7.1 General.....	12
7.2 CCC quality control and acceptance testing with calibration.....	13
7.2.1 Procedure.....	13
7.2.2 Control areas / inspection areas	13
7.2.3 Alternative decision rules	14
7.3 Selection of the calibration test area	14
7.4 Calibration procedure	14
7.5 Development of correlations	15
7.5.1 General principles.....	15
7.5.2 Quality and validity of correlation.....	15
7.5.3 Examples of correlations.....	16
8 CCC weak area analysis and documentation for QC and QA purpose.....	16
8.1 General.....	16
8.2 CCC quality control and acceptance testing for weak area analysis	16

9	CCC – documentation of maximum compaction achievable for QC and QA purpose.....	17
9.1	General	17
9.2	CCC quality control and acceptance testing for documentation of maximum compaction for QA purpose.....	17
10	CCC - documentation of compaction method.....	17
10.1	General	17
10.2	CCC quality control and acceptance testing for method specification.....	18
11	CCC test report	18
Annex A (informative) Analysis of the vibration behaviour		19
A.1	Principle of compaction energy.....	19
A.2	Principle of harmonic wave	20
A.3	Measuring the dynamic stiffness.....	21
Annex B (informative) Statistical evaluation of CCC values based on decision rules for CCC application with calibration		22
B.1	Decision rules – Analysis of the unweighted fall-below areas if normally distributed measuring values exist	22
B.2	Evaluation of the unweighted fall-below areas in case of arbitrary distribution of the measuring values or the total fall-below area ratio.....	24
B.3	Evaluation of the weighted fall-below areas in case of arbitrary distribution of the measuring values or the total fall-below area ratio.....	24

SIS-CEN/TS 17006:2017 (E)

European foreword

This document (CEN/TS 17006:2016) has been prepared by Technical Committee CEN/TC 396 “Earthworks”, the secretariat of which is held by AFNOR.

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1 Scope

This technical specification provides guidance, specifications and requirements on the use of Continuous Compaction Control (CCC) as a quality control method in earthworks by means of roller integrated dynamic measuring and documentation systems.

The CCC method is suitable for soils, granular materials and rockfill materials which can be compacted using vibratory rollers.

NOTE A continuous Compaction Control (CCC) technology based on the measure of propel energy necessary to overcome the rolling resistance is also available and can be used as a quality control method in earthworks. The propelling power of the compactor provides an indication of the material stiffness and it is measured as a function of the machine ground speed, slope angle and rolling resistance. This method is not included in this document.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1

vibratory roller

vibratory roller is a roller which generates:

- a) vertical vibrations (circular exciters) with fixed amplitudes; or
- b) horizontal vibrations (oscillation rollers) with fixed amplitudes; or
- c) vibrations with a direction, amplitude and/or frequency that can be automatically or manually adjusted during operations

Note 1 to entry: Vibratory rollers operating with automatic amplitude and/or frequency mode are called 'intelligent rollers'.

2.2

measuring roller

vibratory roller which is equipped with a compaction measuring and documentation system which measures and maps the dynamic properties of the compacted surface

Note 1 to entry: See Figure 1.

2.3

Continuous Compaction Control

CCC

use of measuring rollers for quality control in earthworks

2.4

CCC measuring value

dynamic value which depends on the measuring principle, the type of roller, operating weight, amplitude, frequency and operating speed used, the type of soil or granular or rockfill material and its water content

Note 1 to entry: CCC measuring values determined by different systems are not necessarily equivalent.

2.5

stiffness of a soil

quotient of applied force (loading) and the corresponding deformation

SIS-CEN/TS 17006:2017 (E)

2.6

dynamic stiffness of a soil

quotient of variation of dynamic soil reaction force and the corresponding variation of deformation (soil displacement)

2.7

compaction depth

depth below the point at which the drum meets the investigated surface over which the roller provides a significant compaction effect

2.8

measuring depth

depth below the point at which the drum meets the investigated surface over which the resulting response from the underlying materials still has an effect on the CCC measuring value

2.9

CCC inspection area

part of the production that has been processed under uniform conditions for which a unique compaction requirement is valid

2.10

fall-below spot

part of the control areas in which the CCC measuring value falls below a certain CCC target value

2.11

measuring area unit

part of a control area, the width of which equals the drum width of the roller and the length of which corresponds to the product of the operating speed and duration of the individual measurement

2.12

jump operation

roller drum that partially loses ground contact, which occurs with increasing soil stiffness

2.13

double jump

jump operation when the drum loses contact during a complete vibration cycle

Note 1 to entry: The roller drum hits the very stiff ground, rebounds and then makes a full cycle in the air before hitting the ground again

Note 2 to entry: When jump operation becomes more pronounced because of high soil stiffness double jump can occur, which usually significantly reduces the magnitude of the CCC measured values. In this way, the CCC measuring system can identify and indicate jumping operation.

2.14

positioning system

system for georeferencing the compaction or measuring roller on the area being processed

2.15

roller pass

one forward or backward operation of a vibratory roller over a certain distance

2.16

weak area

part of CCC control area, which presents lower CCC values than the rest of the control area

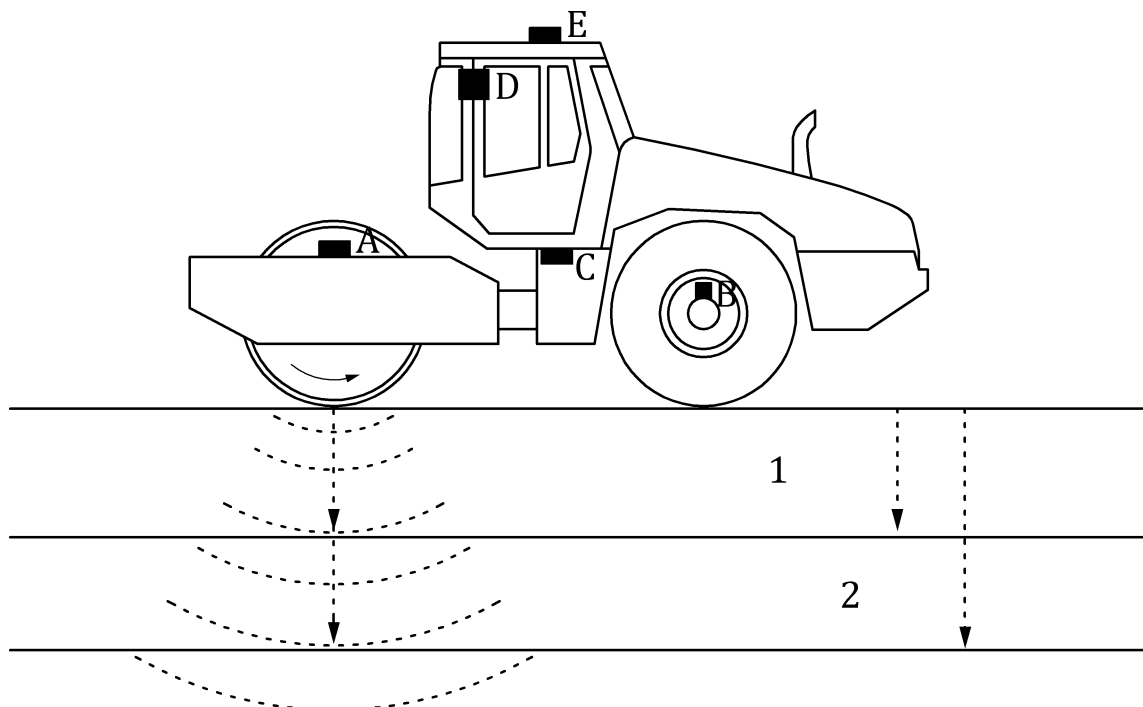
3 Fundamentals and principles of CCC measurements

Roller integrated continuous compaction control (CCC) is based on the dynamic interaction between the excited drum of a vibratory roller and the soil or granular or rockfill material that has to be compacted. The dynamically measured value determined from the movement behaviour of the drum shall be physically clearly defined.

Vibratory rollers are characterized by a drum that is excited by one or more eccentric masses rotating at constant speed. CCC rollers are equipped with acceleration transducers, processors and a display to provide a record of the drum to soil interaction (Figure 1).

During the roller pass of a vibratory roller there is a continuous exchange of kinetic energy between the roller drum and the roller/soil vibrating system.

Both the soil stiffness and the absorption of the roller vibration change with increasing compaction. By analysing the vibration behaviour, conclusions can be made about the compaction quality. This analysis can follow various principles. See Annex A.



Key

- 1 compaction depth
- 2 measuring depth
- A acceleration transducer
- B distance sensor
- C processor
- D display and recorder
- E positioning systems (GNSS antenna)

Figure 1 — Single drum roller for CCC measurements (schematic diagram)