999808402 - 11/2024
en-GB

Formwork & Scaffolding.
We make it work.

Concremote

Original Operating Instructions

Please retain for future reference

Contents

Introduction

Elementary safety warnings

User target groups

- This booklet is aimed at all persons who will be working with the Doka product or system that it describes. It contains information on the standard design for setting up this system, and on correct, compliant utilisation of the system.
- All persons working with the product described herein must be familiar with the contents of this booklet and with all the safety instructions it contains.
- Persons who are incapable of reading and understanding this booklet, or who can do so only with difficulty, must be instructed and trained by the customer.
- The customer is to ensure that the information materials provided by Doka (e.g. User Information booklets, Instructions for Assembly and Use, Operating Instruction manuals, plans etc.) are up to date and available to all users, and that they have been made aware of them and have easy access to them at the usage location.
- In the relevant technical documentation and formwork utilisation plans, Doka shows the workplace safety precautions that are necessary in order to use the Doka products safely in the usage situations shown.
  In all cases, users are obliged to ensure compliance with national laws, standards and regulations throughout the entire project and to take appropriate additional or alternative workplace safety precautions where necessary.

Hazard assessment

- The customer is responsible for drawing up, documenting, implementing and continually updating a hazard assessment at every job-site.
  This booklet serves as the basis for the site-specific hazard assessment, and for the instructions given to users on how to prepare and utilise the system. It does not substitute for these, however.

Remarks on this booklet

- This document can be used as general Instructions for Assembly and Use (Method Statement) or be incorporated into site-specific Instructions for Assembly and Use (Method Statement).
- **The graphics, animations and videos in this document or app sometimes depict partially assembled assemblies and may require additional safety equipment and/or measures to comply with safety regulations.**
  The customer must ensure all applicable regulations are complied with, even if they are not shown or implied in the graphics, animations and videos provided.
- **Individual sections contain further safety instructions and/or special warnings as applicable.**

Planning

- Provide safe workplaces for those using the formwork (e.g. for when it is being erected/dismantled, modified or repositioned etc). It must be possible to get to and from these workplaces via safe access routes!
- **If you are considering any deviation from the details and instructions given in this booklet, or any application which goes beyond those described in the booklet, then revised static calculations must be produced for checking, as well as supplementary assembly instructions.**

Regulations; industrial safety

- All laws, Standards, industrial safety regulations and other safety rules applying to the utilisation of our products in the country and/or region in which you are operating must be observed at all times.
- If a person or object falls against, or into, the sideguard component and/or any of its accessories, the component affected may only continue in use after it has been inspected and passed by an expert.

Rules applying during all phases of the assignment

- The customer must ensure that this product is erected and dismantled, reset and generally used for its intended purpose in accordance with the applicable laws, standards and rules, under the direction and supervision of suitably skilled persons.
  These persons' mental and physical capacity must not in any way be impaired by alcohol, medicines or drugs.
- Doka products are technical working appliances which are intended for industrial / commercial use only, always in accordance with the respective Doka User Information booklets or other technical documentation authored by Doka.
- The stability and load-bearing capacity of all components and units must be ensured during all phases of the construction work!
- Do not step on or apply strain to cantilevers, closures, etc. until suitable measures to ensure their stability have been correctly implemented (e.g. by tie-backs).
- Strict attention to and compliance with the functional instructions, safety instructions and load specifications are required. Non-compliance can cause accidents and severe injury (risk of fatality) and considerable damage to property.
- Sources of fire in the vicinity of the formwork are prohibited. Heaters are permissible only when used correctly and situated a correspondingly safe distance from the formwork.
- Customer must give due consideration to any and all effects of the weather on the equipment and regards both its use and storage (e.g. slippery surfaces, risk of slipping, effects of the wind, etc.) and implement appropriate precautionary measures to secure the equipment and surrounding areas and to protect workers.
- All connections must be checked at regular intervals to ensure that they are secure and in full working order.
  In particular threaded connections and wedged connections have to be checked and retightened as necessary in accordance with activity on the jobsite and especially after out-of-the-ordinary occurrences (e.g. after a storm).
- It is strictly forbidden to weld Doka products – in particular anchoring/tying components, suspension components, connector components and castings etc. – or otherwise subject them to heating.
  Welding causes serious change in the microstructure of the materials from which these components are made. This leads to a dramatic drop in the failure load, representing a very great risk to safety.
  It is permissible to cut individual tie rods to length with metal cutting discs (introduction of heat at the end of the rod only), but it is important to ensure that flying sparks do not heat and thus damage other tie rods.
  The only articles which are allowed to be welded are those for which the Doka literature expressly points out that welding is permitted.

Assembly

- The equipment/system must be inspected by the customer before use, to ensure that it is in an acceptable condition. Steps must be taken to exclude components that are damaged, deformed, or weakened due to wear, corrosion or rot (e.g. fungal decay).
- Using our safety and formwork systems together with those of other manufacturers can create risks that may lead to injury and damage to property. This requires separate verification by the user.
- The equipment/system must be assembled and erected in accordance with the applicable laws, standards and rules by trained customer personnel whilst maintaining any applicable safety inspections that may be required.
- It is not permitted to modify Doka products; such modifications constitute a safety risk.

Closing the formwork

- Doka products and systems must be set up so that all loads acting upon them are safely transferred!

Pouring

- Do not exceed the permitted fresh-concrete pressures. Over-high pouring rates overload the formwork, cause greater deflection and risk breakage.

Stripping the formwork

- Do not strip out the formwork until the concrete has reached sufficient strength and the person in charge has given the order for the formwork to be stripped out!
- When stripping out the formwork, never use the crane to break concrete cohesion. Use suitable tools such as timber wedges, special pry-bars or system features such as Framax stripping corners.
- When stripping out the formwork, do not endanger the stability of any part of the structure, or of any scaffolding, platforms or formwork that is still in place!

Transporting, stacking and storing

- Observe all country-specific regulations applying to the handling of formwork and scaffolding. For system formwork the Doka slinging means stated in this booklet must be used – this is a mandatory requirement.
  If the type of sling is not specified in this document, the customer must use slinging means that are suitable for the application envisaged and that comply with the regulations.
- When lifting, always make sure that the unit to be lifted and its individual parts can absorb the forces that occur.
- Remove loose parts or secure them so that they cannot slip out of position and drop.
- When lifting formwork or formwork accessories with a crane, no persons must be carried along, e.g. on working platforms or in multi-trip packaging.
- All components must be stored safely, following all the special Doka instructions given in the relevant sections of this document!

Maintenance

- Only original Doka components may be used as spare parts. Repairs may only be carried out by the manufacturer or authorised facilities.

Miscellaneous

The weights as stated are averages for new material; actual weights can differ, depending on material tolerances. Dirt accretions, moisture saturation, etc. can also affect weight.
We reserve the right to make alterations in the interests of technical progress.

Symbols used

The following symbols are used in this document:

DANGER
This is a notifier drawing attention to an extremely dangerous situation in which non-compliance with this notifier will lead to death or severe, irreversible injury.

WARNING
This is a notifier drawing attention to a dangerous situation in which non-compliance with this notifier can lead to death or severe, irreversible injury.

CAUTION
This is a notifier drawing attention to a dangerous situation in which non-compliance with this notifier can lead to slight, reversible injury.

NOTICE
This is a notifier drawing attention to a situation in which non-compliance with this notifier can lead to malfunctions or damage to property.

Instruction
Indicates that actions have to be performed by the user.

Sight-check
Indicates that you need to do a sight-check to make sure that necessary actions have been carried out.

Tip
Points out useful practical tips.

Reference
Cross-references other documents.

Manufacturer

- Concrefy B.V.
- Subject to change without notice in the course of technological development.

Support

Landline:	+31 77 850 7220
E-mail:	support@concremote.com

Services

Support in every stage of the project

- Project success assured by products and services from a single source.
- Competent support from planning through to assembly directly on site.

Project assistance from start to finish

Every single project is unique and calls for individualised solutions. When it comes to the forming operations, the Doka team can help you with its consulting, planning and ancillary services in the field, enabling you to carry out your project effectively, safely and reliably. Doka assists you with individual consulting services and customised training courses.

Efficient planning for a safe project sequence

Efficient formwork solutions can only be developed economically if there is an understanding of project requirements and construction processes. This understanding is the basis of Doka engineering services.

Optimise construction workflows with Doka

Doka offers special tools that help you in designing transparent processes. This is the way to speed up pouring processes, optimise inventories and create more efficient formwork planning processes.

Custom formwork and on-site assembly

To complement its system formwork range, Doka offers customised formwork units. And specially trained personnel assemble load-bearing towers and formwork on site.

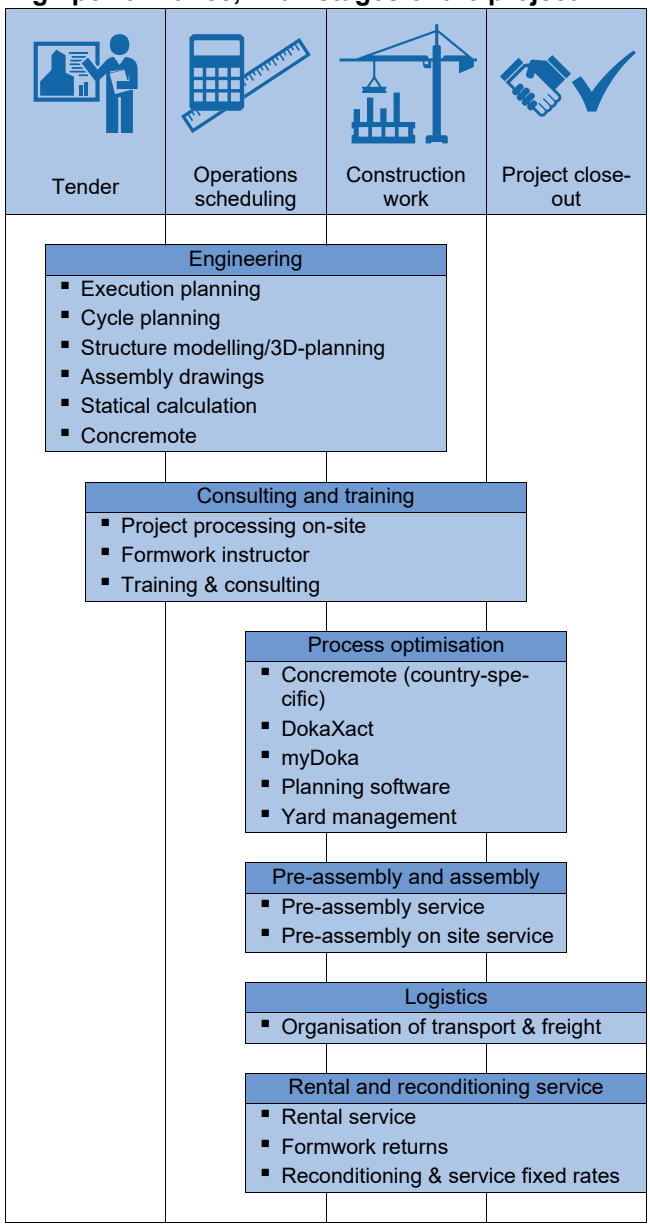
Just-in-time availability

Formwork availability is a crucial factor in realising your project on time and on budget. The worldwide logistics network puts the necessary formwork quantities on site at the agreed time.

Rental and reconditioning service

The formwork material needed for any particular project can be rented from Doka's high-performing rental park. Doka Reconditioning cleans and overhauls both client-owned equipment and Doka rental equipment.

High performance, in all stages of the project



Digital Services
for higher productivity in construction

From planning to completion of construction - with our digital services we want to set the pace for boosting productivity in construction. Our digital portfolio includes solutions for planning, procuring and managing to performing on site. Learn more about our digital offer at doka.com/digital.

System description

Intended use

Concremote measures concrete & ambient temperatures on site using Concremote sensors. These upload readings by wireless link to a data centre which computes in real-time the concrete strength development against a previously calculated calibration curve.

Concrete monitoring: how it works, how it is used

Measuring concrete strength in real time.
Concremote is an on-site service for performing non-destructive real-time measurement of temperatures and real-time calculation of concrete strength in structural members (floor-slabs, walls, beams, etc.).

This service comprises two parts:

- Measuring devices (sensors)
- Web portal and app for data processing

The **sensors** placed on the structural member continuously measure the heat development of the concrete, which is mainly influenced by the hydration heat of the cement and by ambient temperatures. The more intense the heat development, the more rapidly the strength development of the concrete takes place.

The **measured data** (temperature measurements) from the structural member are transmitted to the computing centre via the mobile communications network as data packets. At the computing centre, they are automatically evaluated by the maturity monitoring method, using calibration measurement.

A separate calibration measurement is needed for each different grade of concrete to be measured at the site. This calibration measurement must be performed either by the clients themselves, by the concrete supplier or by an appointed test laboratory – ideally, using the Concremote calibration box. In this process several test samples (cubes or cylinders) are stored under defined semi-adiabatic conditions. The samples are tested at different times, depending on the target value (for stripping, curing, etc.). It returns a compressive strength value with a corresponding concrete maturity (calculated by the weighted maturity method). From this calibration measurement, the correlation can be obtained between the strength and the maturity of the respective grade of concrete.

The Concremote web portal continuously provides users with access to their data and strengths via the app. This enables the user to follow temperature and strength development in the structural member in real-time.

When the target value is reached, a push message is sent to notify the user and the appropriate further measures (stripping, pre-stressing, etc.) can be initiated.

Precise measurement facilitates accurate control

Efficient construction processes
The strength values computed by Concremote according to the mainstream maturity methods (de Vree, Arrhenius, Nurse-Saul), permit targeted control of forming and concreting operations in real time.

Concremote provides very accurate results on the basis of reference values obtained from the calibration measurement.

Multi-functional

2 types of sensor
The Concremote **slab sensor** and the Concremote **cable sensor** can be used in a targeted manner in all areas of cast-in-place building construction.

- CIP concrete slabs
- Wall and column formwork
- Crane-climbed and automatic climbing projects
- Bridge and tunnel building sites
- Mass concrete structures

Exact results enabled by calibration

The Concremote calibration box is used to calibrate the different grades of concrete used. These calibration measurements provide reference data for computing the compressive strength development in relation to the maturity.
Before the sensors are used, Concremote generates a calibration curve for each grade of concrete, by means of the Concremote calibration boxes.

Follow the directions in the 'Concremote calibration box' Operating Instructions.

CAUTION
Injury to persons and/or damage to property.
➤ If the composition of the concrete is changed after calibration of the mixture, calibration must be repeated for the new mixture!

Certainty for the construction project

Helps you take decisions and records your data

- Compliant decision-making based on the measured data.
- Strength development can be estimated early on from graphs.
- Printing and storage of data for long-term verification.

Easy online access to the data

Via the user-optimised Concremote Web portal, users can access their measured data at any time.
Accurate documentation ensures both certainty for the building process and transparency.

Wireless data transmission and easy access from anywhere

The temperature, maturity and strength data will help you take many decisions more accurately:

- Stripping time
- Crack width limitation (stresses)
- Loads
- Curing measures
- Pre-stressing
- Optimisation of cycle times
- Temporary reshoring
- Construction conditions
- Concrete orders
- Team coordination

etc.

Process scheme

Follow the directions in the 'Concremote calibration box' Operating Instructions.

Follow the directions in the 'Concremote Software' User Manual.

Areas of use

Concremote is non-formwork dependent and can be used in any kind of structural concrete element.

For each structural element and cycle, a minimum of 2 sensors are required.

The information given herein must be observed at all times depending on the specific area of use.

The installation points are determined separately for each project. The examples given in this section are to be considered as possible applications of Concremote.

The advice of the structural engineer should be sought for determining those points that are critical for static requirements. The sensors must be positioned at points relevant for measuring temperature and strength development, for example at locations of maximum stress or other most critical points. If necessary, protect the sensors from factors such as sunlight, radiant heaters, etc.

WARNING

➤ The Concremote system must be handled and used correctly in order for it to function properly. Non-compliance with the information provided herein may lead to accidents.

Floor-slabs

In floor-slabs, the use of slab sensors is recommended. For thick slabs (> 40 cm) we recommend using cable sensors and lost measuring cables.

Number of sensors in a floor-slab cycle:

- up to 500 m²: at least 2 sensors
- more than 500 m²: more than 2 sensors, as required

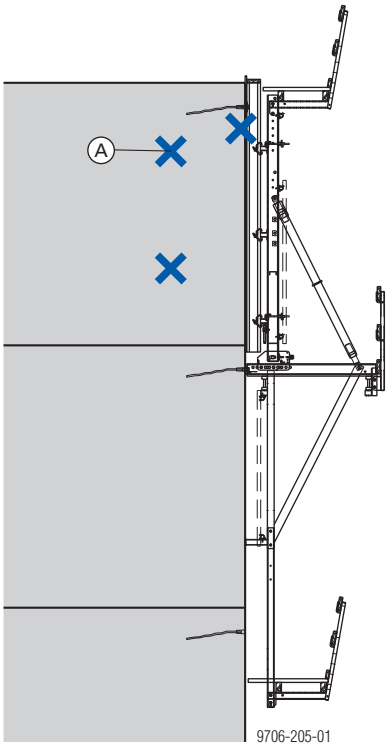
Mass concrete structures

Cable sensors are recommended for registering heat development in solid concrete structural members (mass concrete).

The measuring points of the cables can be chosen freely, but stipulations laid down in applicable standards, for example, apply and must be met in each individual case.

Fix the measuring points (black marks on the cable) at an adequate distance from the reinforcement in order to prevent the temperature of the reinforcement from affecting the concrete measurement.

For performing measurements at any desired position in the concrete, an auxiliary, single-use construction may have to be fitted by the user (e.g. reinforced steel).



A Measuring points in the concrete structural member

Climbing formwork

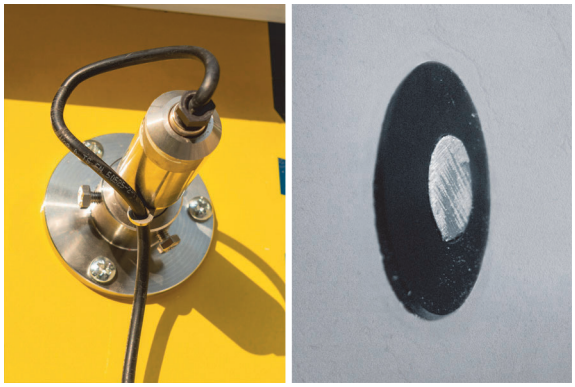
In the area of suspension points

In order for a climbing formwork suspension point to provide sufficient load-bearing capacity, the concrete must have sufficient strength.

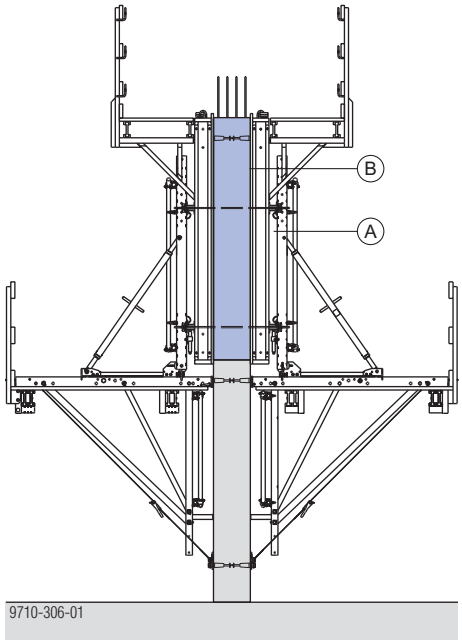
With Concremote, the strength development of the concrete can be displayed easily and in a verifiable manner.

For measuring the strength development at a suspension point, use the cable sensor in conjunction with the wall sensing unit.

A cable sensor with cable can also be used as an alternative.



For measuring core temperatures, the cable sensor in combination with a measuring cable (up to 3 measuring points) is best suited.



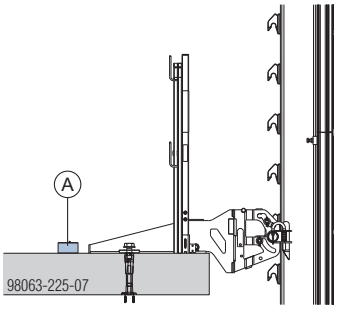
Example: Climbing cycle

A Concremote cable sensor installed in the wall formwork
B Concremote wall sensing unit

At least 2 measuring positions are required for each climbing cycle.

For protection screens

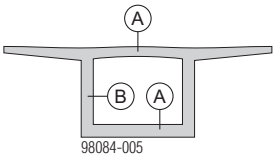
Slab sensors can be used to determine the concrete strength in the area of suspension points.



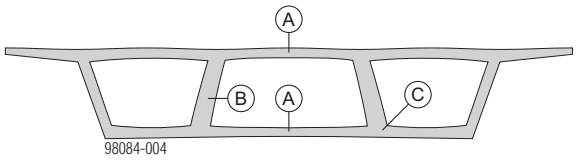
A Concremote slab sensor

Bridge formwork

Cross sections through bridges



Example: single-celled bridge cross section



Example: three-celled bridge cross section

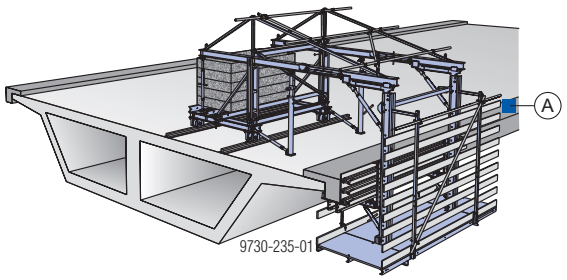
A Concremote slab sensor
B Concremote wall sensing unit
C Measuring point, Concremote cable

For cycles of up to 10 linear metres in length, measure the critical points in at least two cross-sectional planes.

Further sensors are recommended to be used every additional 5 linear metres.

Bridge edge beams

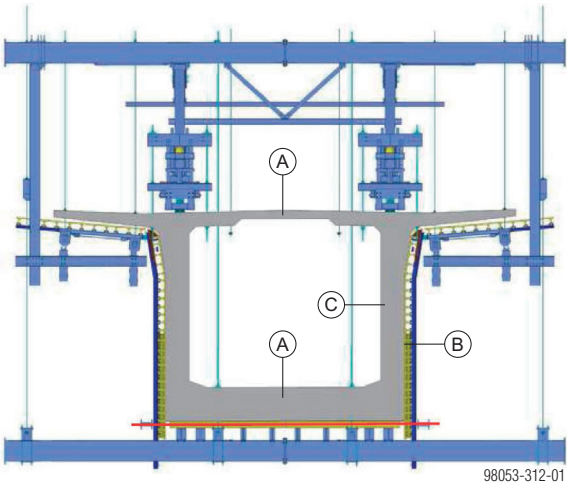
Slab sensors can be used in the manufacture of edge beams. For up to 15 linear metres, 2 sensors are necessary.
Further sensors are recommended to be used every additional 10 linear metres.



A Concremote slab sensor

Free cantilever construction

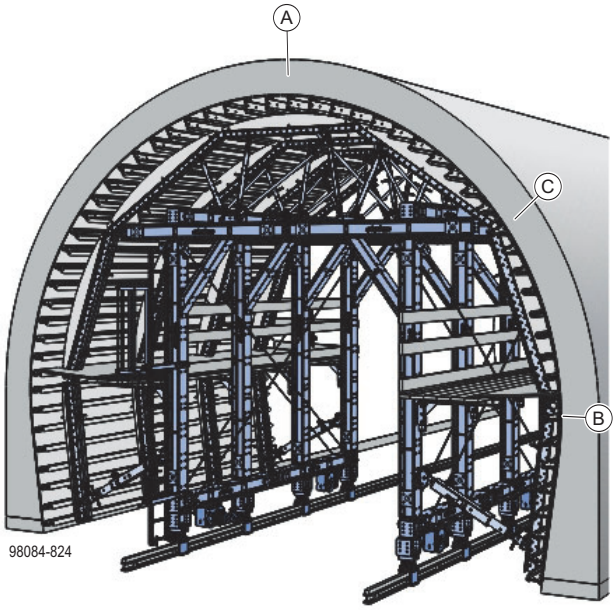
Concremote helps you determine the earliest possible time of pre-stressing the concrete or of stripping the cantilever forming traveller.



A Concremote slab sensor (floor-slab / roadway slab)
B Concremote wall wall sensing unit (walls)
C Measuring point of the Concremote cable (walls)

Tunnel formwork

In tunnel forming, Concremote is used for determining early concrete strengths as well as to ensure sufficient strength of the concrete in the bottom slab for the ground anchors.



A Concremote slab sensor
B Concremote wall sensing unit
C Measuring point, Concremote cable

NOTICE

The smallest compressive concrete strength that can be measured using Concremote is 5 N/mm².

For bored tunnels, check in advance that network connectivity will be maintained.

Other areas of use

- Pre-stressing applications
- Monolithic concrete tanks
- Temperature measurement
- Curing
- Road construction
  - Saw cutting
- Hall floors

Maintenance / inspection / storage

- Repairs may only be carried out by the manufacturer!
- Doka accepts no liability for products that have been altered!

Before every use

➤ Check for any signs of damage or visible deformation.

Concremote articles that do not meet the following criteria must be withdrawn from use immediately:

- No deformation.
- No cracks or notches.
- No damage due to the influence of heat.

Storage

- Store Concremote articles at a constant temperature between 0 and 30°C.
- Store Concremote articles in a dry, well ventilated and frost-proof place, protected from climatic influences and aggressive substances.
- The state of charge (SoC) of the lithium battery should be kept between 30 % and 50 % and be regularly monitored (at least every 3 months) to avoid exhaustive discharge.

Disposal

For more information on the disposal of articles, consult your Doka contact partner.

Use of Concremote

The use of Concremote can be split into three stages:

1st Preparation → **2nd** Calibration of the concrete mixtures → **3rd** Monitoring on site

NOTICE

- Concremote in no way replaces the prescribed concrete tests.
- If you have any questions, please ask your Doka contact person!

Preparation

➤ Plan what the sensors will be used for (see the section Areas of use).

➤ Specify the target value in consultation with the structural engineer (for more detailed information see the section Reshoring props, concrete technology and stripping out).

➤ Decide on the calibration measurements to be made for the concrete mixtures used, and choose a test laboratory (see the 'Concremote calibration box' Operating Instructions).

NOTICE

Check the measuring devices (sensors, calibration boxes) regularly, at least once a year, to ensure that they are in full working order. Compare the values measured by Concremote with those of a calibrated temperature sensor.

Calibration of the concrete mixtures

Each different concrete mixture needs to be calibrated with the Concremote calibration box so that its strength development in the structure can be calculated, based on the temperature data measured by the Concremote sensors.

2 calibration boxes cube (= 6 samples) are needed for calibration of a concrete mixture by the de Vree weighted maturity method.

Prior to using the sensors for the first time, a calibration measurement must be made for each concrete mixture to be measured with Concremote.

Follow the directions in the 'Concremote calibration box' Operating Instructions.

After completion of all the compressive strength tests, the calibration curve for the concrete that has been tested is generated automatically. From this point on, the data is available in the Concremote Web portal.

For more detailed information on use of the calibration box, please refer to the Operating Instructions supplied with the calibration box.

NOTICE

In some special cases, calibration and installation of the sensors can be done at the same time. Please ask your Doka contact person if you have any questions regarding this!

Monitoring on site

Performing a measurement involves two steps:

- Positioning the sensor in the structure member
- Adding the measurement in the Concremote software (app or web portal)

Positioning the sensor in the structure member

➤ Position the sensor in the structural member and make sure it does not disrupt any further building processes or subsequent work steps (e.g. travelling of tables, mounting of plumbing accessories, the projecting reinforcement etc.).

➤ Record a name for the structural member in question (e.g. floor-slab above GF house 1), the installation time and the sensor's serial number. These data will be entered in the Concremote software later.

Adding the measurement in the Concremote software

➤ A new structural member or new measurement is added in the Concremote software.

➤ Sensors are assigned to a structural member by their serial number and the recorded installation time.

Validation of calibration curves

To ensure the currency, correctness and correspondence of calibration with the concrete mixture used in the structural member, validation (by site) has to performed at regular intervals.

In this validation, the maturity and compressive strength of at least one sample (cube or cylinder) are compared with the data of the existing calibration curve.

The calibration curve can continue to be used as long as the compressive strength values of the samples are in range of the calibration curve and within a defined range, including tolerances for deviations.

If the compressive strength values of the samples are outside the defined range of calibration, re-calibration of the mixture is recommended.

The documents regulating the boundary conditions and the procedure for validation include the following standards:

- NEN 5970
- ASTM C1074

NOTICE

The **Validation manager** function in the Concremote software provides an easy and convenient tool for performing these tests.

WARNING

➤ Failure to carry out standards-compliant validation can result in injury to persons and damage to property.

Steps in the validation procedure:

1) Produce (fill and compact) at least one sample, and position a Concremote slab sensor on a sample. Alternatively, a Concremote cable sensor or the calibration box can be used instead.

NOTICE

➤ Post-production care of the samples: Protect from direct sunlight and cover with a piece of formwork sheet or foil, for example, to prevent drying out.

2) Start a 'Validation' measurement in the Concremote software.
3) Set notification for a target value within the calibration curve.
4) As soon as notification is received: Strip out sample(s) and measure compressive strength.
5) Then send the data - strength and maturity (from measurement) - to the Validation manager in the software.
6) As the result, the system shows whether the calibration curve is still suitable or whether appropriate measures (e.g. calibration of new mixture) are necessary.

Follow the directions in the 'Concremote Software' Operating Instructions.

LED status indicator on the sensor

State-of-charge indicator:

Condition	Situation	LED	LED behaviour	Seconds							
				1	2	3	4	5	6	7	8
Charging 0-24 %	On docking station, connected to power supply		1 flash in 4 seconds, followed by 3-second pause								
Charging 25-49 %	On docking station, connected to power supply		2 flashes in 2 seconds, followed by 2-second pause								
Charging 50-74 %	On docking station, connected to power supply		3 flashes in 3 seconds, followed by 1-second pause								
Charging 75-99 %	On docking station, connected to power supply		4 flashes in 4 seconds								
Charging 100%	On docking station, connected to power supply		Continuously ON								
Charging 0-99 %	On docking station without power supply		Red flash (1 second) followed by green flash (1 second) followed by 2-second pause								
Charging 100 %	On docking station without power supply		Directly to standby mode								

Data transmission:

Condition	Situation	LED	LED behaviour	Seconds							
				1	2	3	4	5	6	7	8
Bluetooth Low Energy (BLE)	Connection		Activated continuously for the duration of the BLE connection								
Communication	Phase of initialisation with the Concremote cloud		Alternating								
Communication	Data transfer with Concremote cloud		Continuously ON								
Communication	Set the Concremote device (sensor) on the docking station		Alternating at first to start the connection, followed by continuously ON during data transmission								
	Lift the Concremote device (sensor) off the docking station										

In use on the structural member:

Condition	Situation	LED	LED behaviour	Seconds							
				1	2	3	4	5	6	7	8
Operating mode	Measuring cycle		1 weak flash in 4 seconds, followed by 3-second pause								
Measurement	Temperature measurement		Steady green for 2 seconds								

Malfunction:

Condition	Situation	LED	LED behaviour	Seconds							
				1	2	3	4	5	6	7	8
Malfunction	Temperature too high		2 seconds alternating								

Note:

- Concremote devices (sensors) start transmitting data via the mobile telephone network when they are lifted off the docking station or set down.
- When the equipment is used for the first time in a country, it can take longer for data transfer to start because a data roaming connection has to be established.
- Use the docking station only inside enclosed spaces. Green LED status indicator on the docking station shows that the station is operational.
- If the state of charge drops below 20%, no further data are transmitted via the mobile telephone network. However, data are still measured and saved to local memory in the device.

Data analysis with the Concremote software

The measured data is automatically processed.

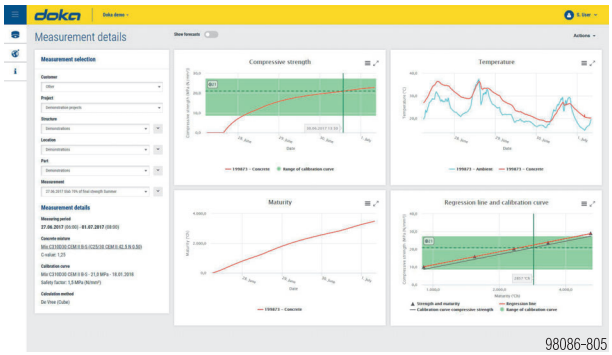
Users can access various graphs (temperature, maturity and compressive strength development over time, temperature differences), or alternatively view this data in list form.

The measurement results can be printed and exported.

The Concremote web portal and app are described in detail in the 'Concremote Software' User Manual or at www.doka.com/concremote!

Data analysis takes place in the Concremote software, which is also the user interface for data entry and output.

The sensors are activated in the Concremote software on their delivery. The login data is sent to the users by e-mail.



- ➤ Log in at concremote.doka.com by entering the login data you have received by e-mail.
- ➤ Add the project (e.g. House 1).
- ➤ Add the location (e.g. Level 1).
- ➤ Add the structural member (e.g. Floor-slab).
- ➤ Create the measurements (e.g. floor slab, section 1) and set the notification parameters.
- ➤ Read the data.

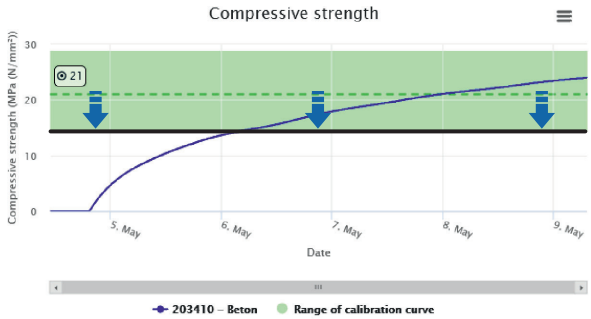
NOTICE

- If a battery fails, data will be lost.
- The measured data are sent automatically as soon as the data connection is re-established.

Concremote shows the strength development of a specific, previously calibrated concrete mixture in the area surrounding the sensors.

1. Optimising the target value

The compressive strength target value can be optimised in consultation with the structural engineer / designer. For assistance, please refer to the section Reshoring props, concrete technology and stripping out.



2. Improving strength developments

Optimising the concrete mixture

- Increase the fresh concrete temperature in mixing (heating of aggregates and/or of mixing water)
- Modification of the binder and/or cement
- Modification of chemical and mineral admixtures

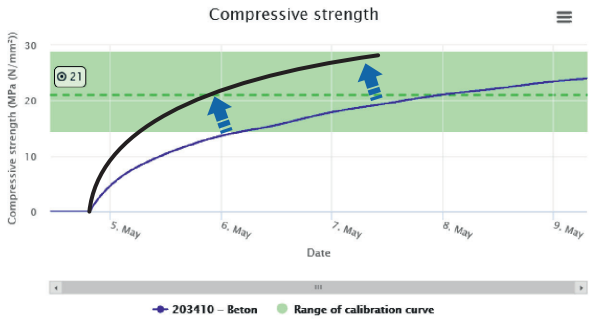
CAUTION

Injury to persons and/or damage to property.

➤ If the composition of the concrete is changed after calibration of the mixture, calibration must be repeated for the new mixture!

Preventing heat loss of the structural member

- By covering the structural member with sheeting or insulation
- By providing enclosures and/or by heating the member



NOTICE

All of these measures must comply with the relevant standards and rules, and may be taken only after consultation with the concrete supplier and the structural engineer / designer.

Concremote 2.0

Concremote sensors can be used anywhere and enable recording and monitoring of temperature and strength development at or in the concrete structural member.

The choice of ideal sensor/monitoring solution depends on:

- Measuring point positions (concrete surface or in the concrete structural member)
- Construction procedure (e.g. wall sensing unit is repositioned together with the formwork)
- On-site conditions (e.g. weather, heating appliances, enclosure)

Note:

Your Doka contact person will be happy to provide advice and assistance for selecting the ideal sensor solution.

Left: Concremote cable sensor 2.0
Right: Concremote slab sensor 2.0

Features:

- 2G, 3G and 4G data transmission
  Different versions (modems) available.
- Bluetooth BLE
- Rechargeable battery
- LED status indicator on the sensor
- IP67 certification

IP code

IP	6	7
Protection against penetration	1st digit: protection against foreign matter and touch	2nd digit: protection against water
	Dustproof	Immersion to a depth of 1 metre
	No dirt penetration; complete protection against touch (dustproof).	Ingress of water in health-endangering quantity is not possible when the housing is immersed in water under defined pressure and time conditions (depth of immersion up to 1 metre).
	A vacuum must be created. Test duration up to 8 hours based on the airflow.	Test duration: 30 minutes Tested with the lowest point of the housing 1000 mm below the surface of the water.

Technical data

Range of use	-20 to +60°C / -4 to +140°F
Accuracy	± 1°C / ± 1.8°F
Battery type	Lithium ion (integral)
Charging time	Up to 24 hours (depending on residual charge, actively controlled). Charging with AC adapter supplied (12 V / 1A DC output) in dry environment.
Battery runtime	Up to 90 days*)
Measuring interval	10 minutes (default)
Data transmission interval	60 minutes (default)

*) Battery runtime depends on network reception and on measuring and data transmission intervals. Battery status can be monitored in the Concremote software.

Note:

The built-in battery has to be fully charged prior to use.

Positioning the sensors

Positioning relative to the area:

The positioning of the sensor on the concrete surface (slab) depends primarily on statical loading and on the construction process (concreting sequence). As a rule, at least one sensor should be placed in the area of the highest statical load, and another sensor at the end of the concreting section.

Positioning relative to the cross-section:

In most cases with slabs between 20 and 40 cm in thickness, positioning the sensor on the top surface or underside of the slab has no significant effect on the result of measurement for determining strength development. This is because generally, the difference in the daily mean ambient temperature at the top of the slab and the air temperature at the underside (structure shell, interior rooms) is <8°C.

If the difference in mean air temperature at the top surface and underside of the slab is more than 8°C, it is advisable to measure with a sensor positioned where worst case conditions prevail:

- **Winter:** Perform measurement at the top surface of the slab (inside temperature in the shell structure is greater than outside temperature by a difference >8°C)
- **Summer:** Perform measurement at the underside of the slab (average outside temperature is greater than the cooler inside temperature in the shell structure by a difference >8°C)

Use the table below for assistance in positioning the sensors.

Recommended positioning of sensors on slab structural members (cement types CEM I, CEM II, CEM III)

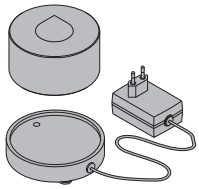
Time of year (daily mean ambient temperatures at the top surface of the slab)	Constant temperatures inside the structure shell (interior rooms) = underside of slab				
	≥25°C	20°C	15°C	10°C	≤5°C
Summer (~25°C)	Underside/ top surface	Underside/ top surface	Underside	Underside	Underside
Spring/autumn (~15°C)	Top surface	Underside/ top surface	Underside/ top surface	Underside/ top surface	Underside
Winter (~0°C)	Top surface	Top surface	Top surface	Top surface	Underside/ top surface

CAUTION

Decisions based on results obtained from unsuitable measuring points can lead to injury and damage!

➤ Consult your structural engineer regarding positioning of the measuring points.

Concremote slab sensor 2.0



Features:

- Sensor for horizontal concrete members
- As-delivered condition: Slab sensor including docking station and power supply unit with set of international AC adapters.
- Power supply by battery (rechargeable)
- Rechargeable battery (battery life up to 3 months) built into the sensor
- For multiple use, with no lost parts
- Easy to install – 'floats' when set on top of the concrete
- Sturdy design for site use

Storage with minimal battery drain:

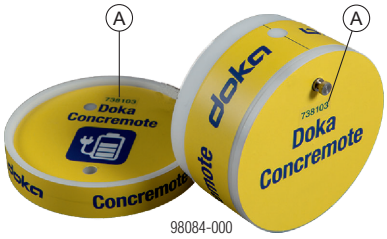
When not in use the battery can be sat on the docking station, where it switches to energy-saving mode.

Slab sensor docked into docking station

Use

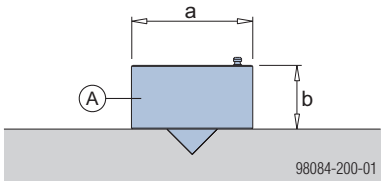
NOTICE

- Sensors and accessories must be installed and mounted from safe workplaces only.
- Wet concrete areas on each slab sensor to have **release agent applied**.
- Do not apply force to the sensors when installing or removing them.
- Protect the sensors against theft and mechanical damage.
- Each sensor has its own serial number **(A)** . This is visible on the housing.



- Check at regular intervals if all components work properly. Any technical problems must be reported to us immediately.

➤ Immediately after pouring and levelling / trowelling the concrete, place the sensor on the concrete surface with its tip pointing downwards.
The sensor may sink into the concrete, depending on the texture. There is no need to push the sensor down into the concrete. The insertion depth is sufficient when the sensor's tip is immersed in the concrete.



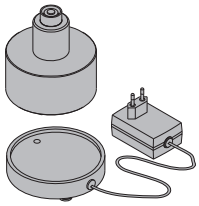
a ... 12 cm
b ... 6.3 cm

A Concremote slab sensor 2.0

Transport and storage

Up to 3 slab or cable sensors 2.0, complete with accessories, can be stored in the Concremote transport box M G2.

Concremote cable sensor 2.0



Features:

- Possible ways of connecting:
  - Concremote wall sensing unit (can be used many times over)
  - Concremote cable with one or several measuring point(s) (lost part)
- Measuring points inside the structural member can be chosen freely
- As-delivered condition: Cable sensor including docking station and power supply unit with set of international AC adapters.
- Power supply by battery (rechargeable)
- Rechargeable battery (battery life up to 3 months) built into the sensor
- Sturdy design for site use

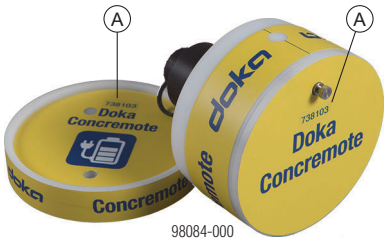
Storage with minimal battery drain:
When not in use the battery can be sat on the docking station, where it switches to energy-saving mode.

Cable sensor docked into docking station

Use

NOTICE

- Sensors and accessories must be installed and mounted from safe workplaces only.
- Do not apply force to the sensors when installing or removing them.
- Protect the sensors against theft and mechanical damage.
- Each sensor has its own serial number.
- The sensor number **(A)** is visible on the housing.

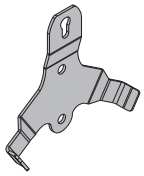


- Check at regular intervals if all components work properly. Any technical problems must be reported to us immediately.
- When the connector is not in use the protective cap must always remain installed to prevent the ingress of water.

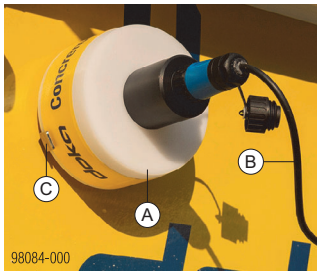
The cable sensor can be fixed in different positions, depending on the specific application:

- to the formwork
- to the projecting reinforcement

Note:
The Concremote cable sensor mounting-plate 2.0 is required for attachment to a formwork sheet.



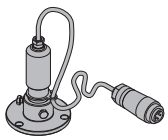
Practical examples



A	Concremote cable sensor 2.0
B	Concremote wall sensing unit or Concremote cable
C	Attachment with Concremote cable sensor mounting-plate 2.0

Concremote cable sensor 2.0 accessories

Concremote wall sensing unit



Features:

- Designed for repeated measurement at the concrete surface
- Reusable
- Adapts to the form-ply thickness down to the millimetre (9 to 70mm)

Use

The wall sensing unit is designed to be used many times over. It can be used only in combination with the Concremote cable sensor.

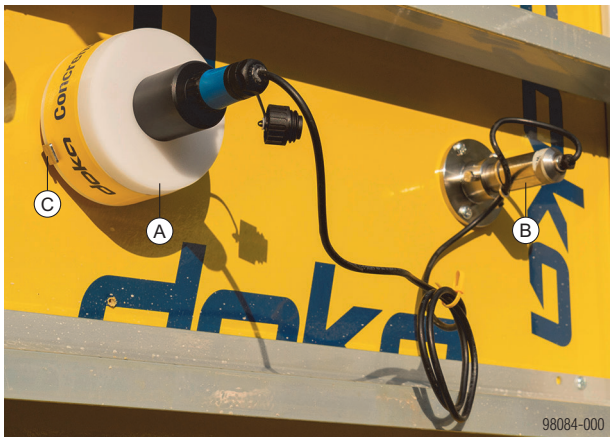
➤ Determine the position of the cable sensor and the measuring point and fix the sensor in place.

➤ At the measuring point, drill a hole 25 mm in diameter in the formwork sheet.

➤ Fit the cable and fasten the sensing unit to the formwork sheet using three suitable screws.

➤ Connect the cable of the sensing unit by screwing it into the cable sensor to start concrete temperature monitoring.

Practical example



A	Concremote cable sensor 2.0
B	Concremote wall sensing unit
C	Concremote cable sensor mounting-plate 2.0

➤ Clean the measuring point on the sensing unit after each use.

➤ When the connector is not in use the protective cap must always remain installed to prevent the ingress of water.

Concremote cable

Features:

- Different kinds of Concremote cables are available, depending on the specific application.
- Measuring points inside the concrete (e.g. sensors fixed to reinforcement).

- Non-reusable part
- The cable can be installed in the structural member from above or below or can be inserted through the formwork.
- The cable length is chosen separately for each project.
- Special lengths are available if needed. (Longer delivery time!)

Concremote cable, 3 sensors	Concremote special cable
	
Number of measuring points	
3	up to 6
Available lengths	
8 m (6-1-1 m)*) 10 m (6-2-2 m)*)	special length

*) The values in brackets are the cable lengths between the measuring points, starting at the screw connection of the cable sensor.

Use

The Concremote cables can be used only in combination with the Concremote cable sensor.

Note:
Make sure that the cables do not get damaged during concreting operations (e.g. by internal vibrators).

Measurement at exposed positions in the structural member may require an auxiliary construction to be fitted by the user (e.g. additional brackets).

Installation:

➤ Determine the position of the cable sensor and fix the sensor securely/properly.

➤ Fit the cable and fasten it to the reinforcement using cable ties.

➤ Bundle the excess cable together and fix with cable ties.

➤ Connect the cable to the cable sensor by turning it in the socket to start concrete temperature monitoring.

➤ If the cable sensor is not immediately connected, the plug of the measuring cable must be protected against water.

Removal:

➤ Disconnect the cable from the cable sensor.

➤ When the connector is not in use the protective cap must always remain installed to prevent the ingress of water.

➤ Cut the cable flush with the concrete surface.

Transport and storage

Up to 3 slab or cable sensors 2.0, complete with accessories, can be stored in the Concremote transport box M G2.

What to do in the event of sensor malfunction

Correct functioning of the sensors depends on battery power, good network connectivity and smooth functioning of the Concremote Web portal.

If data transfer is interrupted, persons with write access are automatically notified to this effect by email.

Failure due to connectivity problems

In areas with a poor or with no network connection, a microwave link can be set up by the user.

If wireless transmission temporarily fails, the sensor will buffer the measured data for at least 24 hours, and subsequently transmit them when the wireless connection is restored.

In some cases it may be sensible to remove the sensor from where it is installed, and to temporarily put it in a location with better connectivity for data transmission. After this, the sensor can be fitted back onto the structural member.

Failure due to low battery power

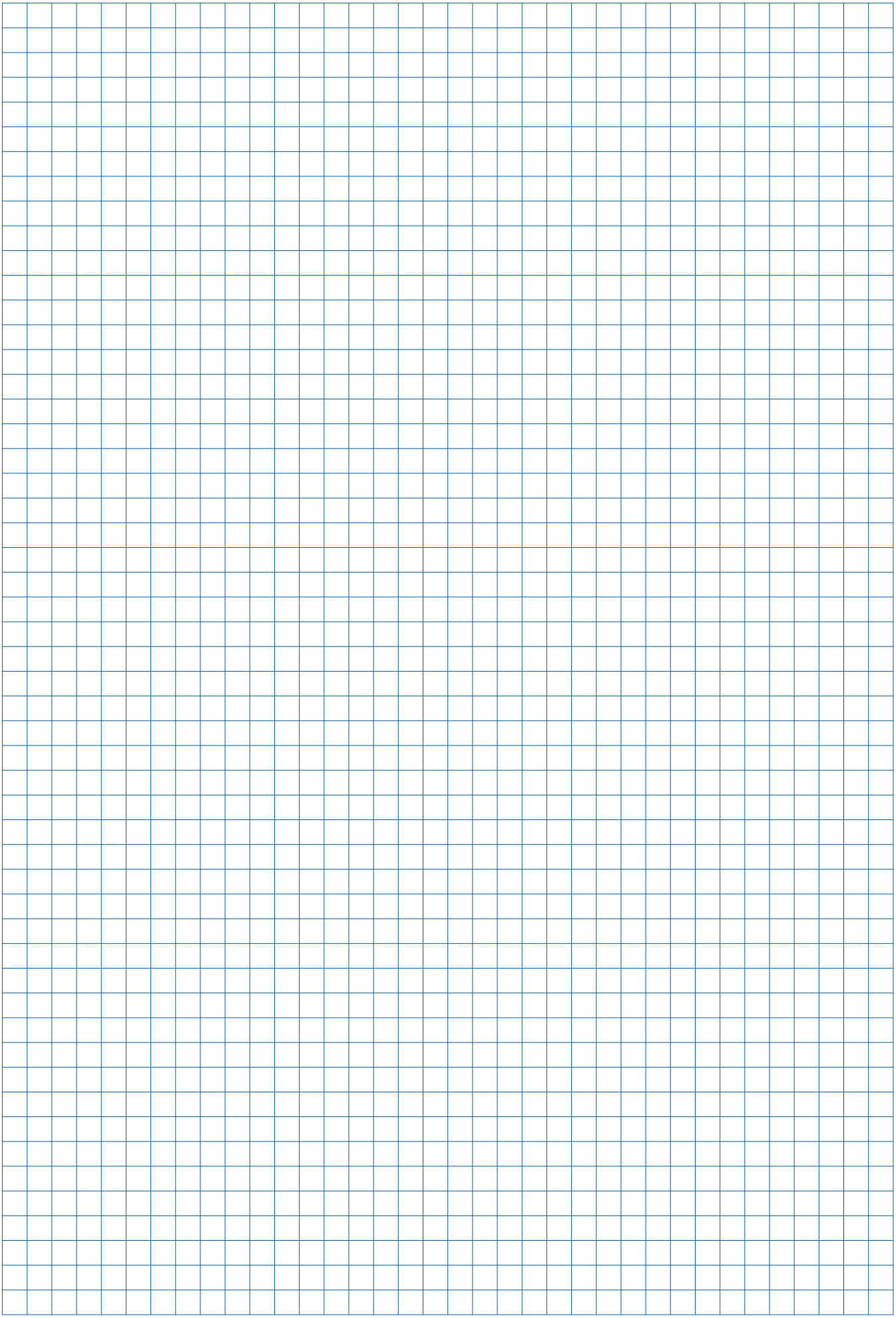
A sensor with a discharged battery cannot save data. In the event of a failure due to low battery power, the battery must be recharged as quickly as possible.

Battery charge state can be monitored on the Concremote Web portal

Other failures

In the event of a failure which is not due to connectivity problems or low battery power, resetting the sensor may solve the problem:

- ➤ Set the sensor on the docking station for 10 minutes (= hibernation mode). For this initial step, make sure that the docking station is not connected to the AC supply.
- ➤ Connect the docking station to the AC supply. If necessary, leave it connected for 24 hours, if necessary (Periodically check the battery charge level in the sensor via the LED's.)
- ➤ Remove the sensor from the docking station.
- ➤ The sensor will now restart the connection and resume working in the normal operating mode.



General

Reshoring props, concrete technology and stripping out

Follow the directions in the Calculation Guide entitled 'Stripping out formwork from floors in building construction', and/or ask your Doka technician.

When is the best time to strip out the formwork?

The concrete strength needed before the formwork can be stripped out will depend upon the load factor α. This can be read off from the following table.

Load factor α

This is calculated by:

$$\alpha = \frac{DL_{concrete} + LL_{construction\ state}}{DL_{concrete} + DL_{finishing} + LL_{final\ state}}$$

Slab thickness 'd' [m]	Dead load $DL_{concrete}$ [kN/m²]	Load factor α $LL_{final\ state}$ 2.00 kN/m²	3.00 kN/m²	4.00 kN/m²	5.00 kN/m²
0.14	3.50	0.67	0.59	0.53	0.48
0.16	4.00	0.69	0.61	0.55	0.50
0.18	4.50	0.71	0.63	0.57	0.52
0.20	5.00	0.72	0.65	0.59	0.54
0.22	5.50	0.74	0.67	0.61	0.56
0.25	6.25	0.76	0.69	0.63	0.58
0.30	7.50	0.78	0.72	0.67	0.62
0.35	8.75	0.80	0.75	0.69	0.65

Valid for a finishing-load $DL_{finishing}$ = 2.00 kN/m² and a live load in the early-stripped state of $LL_{construction\ state}$ = 1.50 kN/m²

$DL_{concrete}$: calculated with $\gamma_{concrete}$ = 25 kN/m³
$DL_{finishing}$: load for floor finish, etc.

Example: Slab thickness 0.20 m with a final live load of 5.00 kN/m² results in a load factor α of 0.54.

This means that formwork removal / stress-release can take place once the concrete has reached 54% of its 28-day strength. The load-bearing capacity will then correspond to that of the finished structure.

NOTICE

If the floor props are not stress-relieved, meaning that the slab has not been activated, then the props will remain loaded with the dead weight of the floor-slab.

When the floor above is concreted, this may lead to a doubling of the load that is being applied to the floor props.

The floor props are not designed to cope with such an overload, and the result may be damage to the formwork, the floor props and the structure.

Why put up reshoring props after stripping out the formwork?

After the formwork has been stripped and the floor-slab has been stress-relieved or dismantled, the floor-slab is able to bear its dead load and live loads resulting from the construction state, but not the concreting loads from subsequent floor-slabs.

The temporary reshoring serves to support the floor-slab and distribute the concreting loads across several floors.

Positioning the reshoring props correctly

Reshoring props have the job of spreading loads between the new floor-slab and the floor beneath it. The load distribution will depend on the relationship between these two floor-slabs and their rigidity.

NOTICE

Ask an expert!

As a rule, the question of using reshoring props should be referred to the responsible experts, regardless of the information given above.

Observe all local standards and regulations!

Deflection of the new concrete

The concrete's modulus of elasticity develops faster than compressive strength. At 60 % of its compressive strength f_{ck}, the concrete has already reached approximately 90% of its modulus of elasticity $E_{c(28)}$.

The increase in the elastic deformation taking place in the new concrete is thus only negligible.

The creep deformation, which only finally ceases after several years, is several times more than the elastic deformation.

Early striking – e.g. after 3 days instead of 28 – thus only leads to an increase in the total deformation of less than 5%.

The part of this deformation accounted for by creep deformation, however, may be anything between 50% and 100% of the standard value, due to such variable influences as the strength of the aggregates, and the atmospheric humidity. This means that the total deflection of the floor-slab is practically independent of the time at which the formwork was struck.

Cracks in new concrete

The bonding strength between the reinforcement steel and the concrete develops more rapidly in the new concrete than does its compressive strength. This means that early stripping does not have any negative influence upon the size and distribution of cracks on the tension side of reinforced concrete constructions.

Other cracking phenomena can be countered effectively by appropriate curing methods.

Curing of new concrete

New site-placed concrete is exposed to influences which may cause cracking and slow down its strength development:

- premature drying
- over-rapid cooling in the first few days
- excessively low temperatures or frost
- mechanical damage to the surface of the concrete
- hydration heat
- etc.

The simplest precaution is to leave the formwork on the concrete surface for longer. As well as the familiar extra curing measures, this measure should be carried out in any case.

Removing the load from the formwork from wide-spanned floor-slabs with support centres of over 7.5m

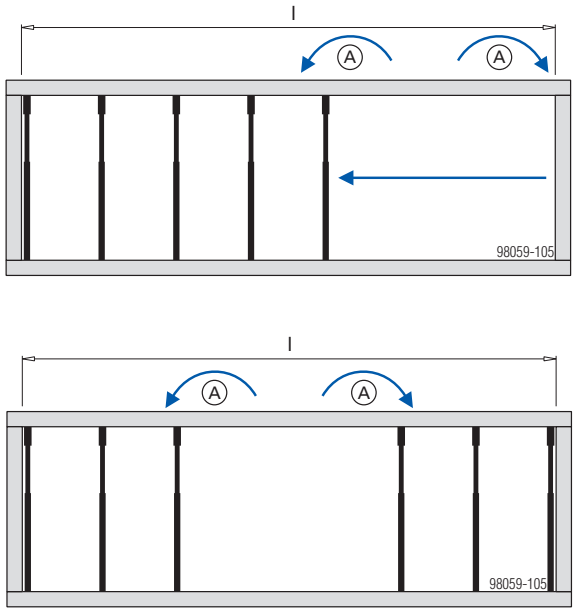
In the case of thin, wide-spanned concrete floor-slabs (e.g. in multistorey car parks), the following points must be remembered:

- When the formwork beneath these floor-slab spans is released (i.e. when the load is taken off the floor props), the floor props that are still in place are briefly subjected to additional loads. This may lead to overloading, and to the floor props being damaged.
- Please consult your Doka technician.

NOTICE

As a basic rule:

- Stress-release should always be carried out working **from one side towards the other, or from the middle of the floor slab (mid-span) towards the slab-edges**.
  For wide spans, this procedure MUST be followed!
- Stress-release must **NEVER** be carried out **from both sides towards the middle**!



I ... Effective floor-slab spans of 7.50 m and over

A Load redistribution

Weighted maturity method

This procedure for determining the strength of the concrete with reference to its maturity has been technically established for several decades. By default, Concremote uses the maturity determination method developed by De Vree. Calculation of the De Vree weighted maturity is performed as follows:

$$Rg = 10 \cdot \frac{[C^{(0.1T-1.245)} - C^{(-2.245)}]}{\ln C}$$

Rg ... weighted maturity per hour [C°h]
T ..... mean hardening temperature of the concrete in one hour
C .... reactivity coefficient of the binding agent
Concrete maturity is calculated by totalling the weighted maturities per hour.

On the basis of the strength values from the calibration measurement, each maturity level has a particular compressive strength assigned to it.

This method for determining the concrete strength with reference to the maturity-level is addressed in the following technical documents and standards:

- DBV Code of Practice, 'Concrete formwork and stipulated stripping times', edition 06/2013
- DIN 1045-3, Concrete, reinforced and prestressed concrete structures - Part 3, edition 03/2012 with DIN EN 13670:2011-03

Note:

On customer request, Concremote can also be used with other methods of calculation (Arrhenius, Nurse-Saul, etc.). For more information, please consult your Doka contact person.

Use and benefits

Based on the measured strength data, the Concremote concrete monitoring system allows you to assure, optimise and speed up your building process by taking the appropriate measures.

Concremote can be used for the following:

- Determining stripping times in a reliable and precise manner – cycle time optimisation – cycle time reduction
- Process reliability – decisions are based on measured rather than estimated values
- Determining curing times by means of the measured strength development
- Safety in using climbing formwork
- Measurement of the hydration heat development in structural mass elements
- Seasonal adjustment and optimisation of the concrete mixture based on the continuous measurement of the compressive strength development (e.g. slow strength development in the winter period – change of the concrete mixture for faster strength development)

Declaration of conformity

fresh thinking for construction

concrefy

Hoofdstuk: Certificates

Document: 01-11 Concremote Sensor DoC -Plug.in

EU Declaration of Conformity (DoC)

Hereby we,

Company name of Manufacturer	Concrefy
Address	Olivier van Noortweg 10
Zip code & city	5928 LX Venlo
Country	The Netherlands
Telephone number	+31 77 850 7222

declare that this DoC is issued under our sole responsibility and that these products:

Article description	Article number
Concremote slab Sensor 2.0 E	583064000
Concremote cable Sensor 2.0 E	583067000

are in conformity with the relevant Union harmonization legislation: Radio Equipment directive: 2014 / 53 / EU

Concremote slab sensor 2.0 E

Concremote cable sensor 2.0 E

Device	Frequency
GSM850/GSM900	33dBm±2dB
DCS1800/PCS1900	30dBm±2dB
GSM850/GSM900 (8-PSK)	27dBm±3dB
DCS1800/PCS1900 (8-PSK)	26dBm±3dB
WCDMA-bands B1,B2,B4,B5,B8	24dBm+1/-3dB
LTE-FDD bands B1,B2,B3,B4,B5,B7,B8,B12,B13,B18,B19,B20,B26,B28	23dBm±2dB
LTE-TDD-band B40	23dBm±2dB
BLE 2,4GHz	+4dBm

fresh thinking for construction

concrefy

Hoofdstuk: Certificates

Document: 01-11 Concremote Sensor DoC -Plug.in

With reference to the following standarts applied:

EN 301 489-1 V2.2.0
EN 301 489-3 V2.1.1
EN 301 489-17 V3.2.0
EN 301 489-52 V1.1.0
EN 301 511 v12.5.1 Clauses 5.3.16 and 5.3.17
EN 301 908-1 v11.1.1 clause 4.2.2
EN 300 328 v2.2.0 clause 4.3.2.8 and 4.3.2.10
EN 303 413 v1.1.1 clause 4.2.2.2
FCC Part 15 Subpart C §15.209, §15.207
RSS-GEN Issue 5

The Notified Body Telefication B.V., with Notified Body number 0560 performed:
Module: B

Where applicable:
The issued EU-type examination certificate: 182140242/AA/00

Description of accessories and components, including software, which allow the radio equipment to operate as intended and covered by the DoC:
Wall adapter: GE12I12-P1J
Software version: 2.3.12

Signed for and on behalf of:

Venlo, 1th October 2018

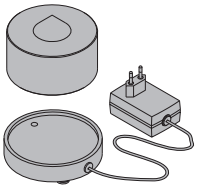
(Place, date)

Ir. A.J.E.J. van Casteren Managing Director
Concrefy
(autorised signature)

Concremote 2.0

	[kg]	Article N°
Concremote slab sensor 2.0 E	**1.5**	**583064000**
Concremote slab sensor 2.0 AU	**1.5**	**583065000**
Concremote slab sensor 2.0 A	**1.5**	**583063000**

Concremote-Deckensensor 2.0

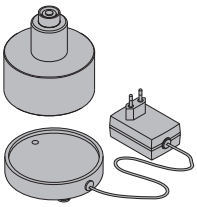


Height: 8.8 cm
Diameter: 12 cm
Follow the directions in the "Operating Instructions"!

CE

Concremote cable sensor 2.0 E	**1.5**	**583067000**
Concremote cable sensor 2.0 AU	**1.5**	**583068000**
Concremote cable sensor 2.0 A	**1.5**	**583066000**

Concremote-Kabelsensor 2.0

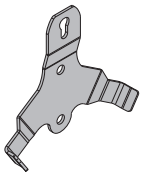


Height: 12.6 cm
Diameter: 12 cm
Follow the directions in the "Operating Instructions"!

CE

Concremote cable sensor mounting-plate 2.0	**0.09**	**583069000**

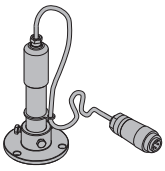
Concremote-Montageplatte Kabelsensor 2.0



Length: 10 cm

Concremote wall sensing unit 9-70mm	**0.77**	**583062000**

Concremote-Messfühler Wand 9-70mm



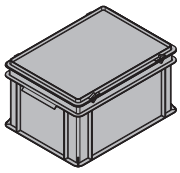
Height: 17 cm
Diameter: 8 cm

Concremote cable, 3 sensors 8.00m	**0.27**	**583043000**
Concremote cable, 3 sensors 10.00m	**0.33**	**583044000**

Concremote-Kabel, 3 Messfühler

Concremote transport box M G2	**1.9**	**583060000**

Concremote-Transportbox M G2



Length: 40 cm
Width: 30 cm
Height: 23.5 cm

Formwork & Scaffolding.
We make it work.

www.doka.com/concremote