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**Digital Concrete Test Hammer
CN652**

Impact Test Equipment Ltd
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User Guide
User Guide
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Contents

1 Safety

1.1 General Information

1.1.1 Basic Information

The concrete test hammer is designed according to state-of-the-art technology and the recognized safety regulations.
Please read through these operating instructions carefully before initial startup. They contain important information about safety, use and maintenance of the DIGISCHMIDT 2000 concrete test hammer.

1.1.2 Designated Use

The concrete test hammer is a mechanical device used for performing rapid, non-destructive quality testing on materials in accordance with the customer's specifications; in most cases, however, the material involved is concrete. The device is to be used exclusively on the surfaces to be tested and on the testing anvil.

1.2 Liability

Our "General Terms and Conditions of Sale and Delivery" apply in all cases. Warranty and liability claims arising from personal injury and damage to property cannot be upheld if they are due to one or more of the following causes:
- Failure to use the concrete test hammer in accordance with its designated use -
Incorrect performance check, operation and maintenance of the concrete test hammer
- Failure to adhere to the sections of the operating instructions dealing with the performance check, operation and maintenance of the concrete test hammer
- Unauthorized structural modifications to the concrete test hammer
- Serious damage resulting from the effects of foreign bodies, accidents, vandalism and force majeure

1.3 Safety Regulations

1.3.1 General Information

- Perform the prescribed maintenance work on schedule.
- Carry out a performance check once the maintenance work has been completed.
- Handle and dispose of lubricants and cleaning agents responsibly.

1.3.2 Unauthorized Operators

The concrete test hammer is not allowed to be operated by children and anyone under the influence of alcohol, drugs or pharmaceutical preparations.

Anyone who is not familiar with the operating instructions must be supervised when using the concrete test hammer.

1.3.3 Safety Icons

The following icons are used in conjunction with all important safety notes in these operating instructions.

⚠️ *Danger!*
This note indicates a risk of serious or fatal injury in the event that certain rules of
behavior are disregarded.

△ *Warning!*
This note warns you about the risk of material damage, financial loss and legal penalties
(e.g. loss of warranty rights, liability cases, etc.)

☞ *This denotes important information.*

1.4 Standards and Regulations Applied

- DIN 1048, part 2
- ASTM C 805
- B 15-225
- NEN 3880 A 607
- PN-74B 06262
- C 30-67 BDS 3816-72
- HS 201/1-72
- ISO/DIS 8045
- EN 12398
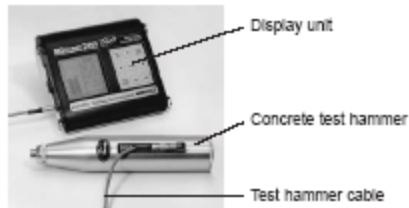- ENV 206

2   Product Description

Fig. 2.1   *Display unit with concrete test hammer (Model ND/LD)*

The DIGI-SCHMIDT 2000 concrete test hammer comprises the actual concrete test hammer and the display unit.

Both components belong together and are calibrated as one unit.

The impact bolt of the concrete test hammer strikes the surface of the concrete with a defined force. After the impact, a metal body, the so-called hammer (see pos. 14 in Fig. 6.2, page 16), rebounds. The rebound distance is measured by a sensor and passed on to the display unit as an electrical signal. The signal converted by the electronics is shown on the display unit as rebound value R and, if necessary, displayed together with the corresponding compressive strength of the concrete, **f**ck.

There is a specific relationship between the rebound value R and the hardness and strength of the concrete. The following factors must be taken into account when ascertaining rebound values R:

- Impact direction: horizontal, vertically upwards or downwards
- Age of the concrete
- Size and shape of the comparison sample (cube, cylinder)

Model ND can be used for testing:

- Concrete items 100 mm or more in thickness
- Concrete with a maximum particle size < 32 mm

Model LD can be used for testing:

- Items with small dimensions (e.g. thin-walled items with a thickness from 50 to 100 mm)

     With Model LD, it may be necessary to clamp the items to be tested prior to measurement in order to prevent the material from deflecting.

- Items made from artificial stone which are sensitive to impacts

3 Startup

3.1 Connecting the Components

• Connect the Test hammer cable to the concrete test hammer and to the display unit at input B.

• Connect the transfer cable for data transmission to the PC, and for transmission to the printer, connect the printer cable to interface RS232.

3.2 Putting the Display Unit into Operation

• Press the ON/OFF key.

The following data are briefly displayed:

- Device model (Model ND or LD)
- Serial number of the concrete test hammer on the left and that of the display unit on the right side

☞ *Check whether the serial number of the concrete test hammer on the display corresponds to the number on the device.*

- Installed software version
- Self-test performed: "Test o.k."
- Remaining battery life

Then the measuring display of the previously measured object appears (see Fig. 3.1, but without values).

☞ *If no display appears, replace the batteries.*

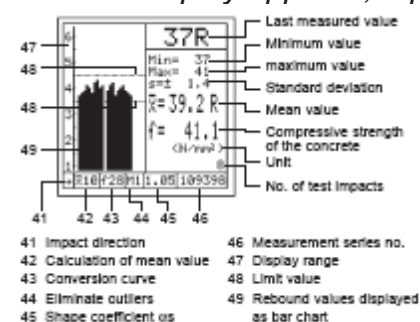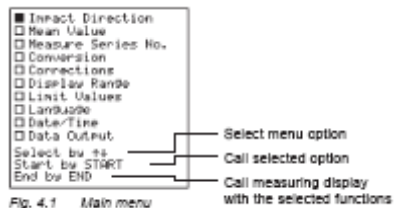| 41 | Impact direction | 46 | Measurement series no. |
42	Calculation of mean value	47	Display range
43	Conversion curve	48	Limit value
44	Eliminate outliers	49	Rebound values displayed
45	Shape coefficient αs		as bar chart

Fig. 3.1   Measuring display

The symbols and values only appear if they have been set or if a measurement series has been performed.

• Adopting the menu settings from the **previous measurement:**

Continue with "Measuring Process"

• Making **new settings:**

Continue with "Settings"

4 Settings

The display unit has a menu with user navigation. Please follow the instructions in the respective display fields.
• Press the MENU key to display the main menu:

Fig. 4.1   Main menu

⚠ *Warning!*

Check the settings before performing a measurement! This applies in particular for the impact direction and for the shape and time coefficient.

4.1 Impact Direction

• Select the symbol for the desired impact direction.
The rebound value is automatically corrected according to the preselected impact direction.

4.2 Mean Value

The mean value is calculated from the number of test impacts n entered or after a measurement series has been completed by pressing the END key.
• Where possible, enter at least n = 10 or n = 12 (see under "Mx", example).
The actual mean value is displayed after every test impact.

4.3 Measure Series Number

• At the start of a measurement series, you can enter a number (max. 6 figures). The number is automatically incremented by 1 after the first test impact of the new measurement series.

4.3 Conversion

4.4.1 Unit

• Select the unit in which the compressive strength of the concrete is to be displayed (N/mm2, MPa, psi, kg/cm2).

4.4.2 Select Curve

The compressive strength of the concrete **f**ck can be calculated from the rebound value R by means of conversion curves. There are 3 options available for calculating the compressive strength of the concrete:
- No conversion
- Select 5 internal conversion curves, or
- Choose between 2 programmed PROCEQ standard curves (**f**ck 7 days and **f**ck 14 to 56 days).

No Conversion

Select "No Conversion".
At the end of a measurement series, only the average of the rebound values in relation to the impact direction is displayed.
The corresponding compressive strengths of the concrete can be taken from the conversion curves in Fig. 8.1 and Fig. 8.2 under "Standard Conversion Curves".

Internal Conversion Curves

Parameters a, b and c of the curve functions must first be set in the sub-menu "Set up curve".
• Under line number 1 to 5, select the conversion curve.

Select PROCEQ Standard Curves

For the derivation of the PROCEQ Standard curves, refer to "Derivation of the PROCEQ Standard Conversion Curves".
• Select conversion curve A in line no. 7 for concrete with an age of 7 days (**f**ck7) or the conversion curve in line no. 28 for concrete with an age of 14 - 56 days (**f**ck28).

4.4.3 Set up Curve

The curve no. (1 to 5) and the parameters a, b and c (see under "Creating New Conversion Curve") can be set using the arrow keys.

4.5 Corrections

4.5.1 Shape Coefficient ⟨s

The PROCEQ standard curves **f**ck7 and **f**ck28 are valid for sample cubes with a 200 mm side for EPROM versions up to 1.3 or from a 150 mm side from EPROM version 2.0. If test specimens with different dimensions are used for determining the compressive strength in the pressure testing machine, the shape coefficient in the first line is to be set or selected in line 2 to 4.

Shape of the test specimen:
1. Line: "variable", see Table 4.1

Test specimen		Shape coefficients	
	EPROM version	up to 1.3	from 2.0
Cube 300 mm and cylinder Ø 100x100 mm		0,90	0,85
Drill core Ø 100x100 mm		1,07	1,02
Drill core Ø 50x56 mm		1,09	1,04

Tab. 4.1   Shape coefficients

Shape of the test specimen: Shape coefficient also applies for:
2nd Line: 200/200/200 Cylinder Ø 200 x 200 mm
3rd Line: 150/150/150 Cylinder Ø 150 x 150 mm
4th Line: Ø 150/300 mm Cylinder Ø 6" x 12"

4.5.2 Time Coefficient ⟨t

There are two options available:
- Determining ones own time coefficient
- Time coefficient as a function of the carbonate penetration depth

Ones Own Time Coefficient

• Select ⟨t, and enter the time coefficient determined. See example under
"Determining Time Coefficient".

Time Coefficient as a Function of the Carbonate Penetration Depth

The reduction factors derived from the Chinese standard, JGJ/T23-92 and based
on the carbonate penetration depth "d" (in mm) provide a further option (from
EPROM version 2.0).
• Select "d", and set a value between 1 and 6 for the defined carbonate
penetration depth (in mm). For carbonate penetration depths over 6 mm, enter 6.
The corresponding reduction factor is set automatically.

4.5.3 Eliminate Outliers

The following 4 functions can be selected: "0", M1, M3 and Mx. Using function
"0", individual values can be deleted manually. Using the functions M1, M3 and
Mx, values are eliminated automatically.

"0": Eliminating Individual Values

Individual values can only be deleted with this function. • Too high or too low
measured values can be eliminated directly during the measurement process
with the PRINT key.

M1: Eliminate Highest and Lowest Value

The highest and lowest measured values are deleted provided at least 6
measured values are present.

M3: Delete Values with Deviations of over 20 %

Values which deviate 20 % or more from the mean value after completion of a
measurement series are deleted. The number of test impacts shown on the
display is reduced by the number of deleted test impacts. Four beeps are output
to request replacement of the test impacts deleted by new ones. The result of the
measurement appears on the display as soon as "n" test impacts have been
successfully performed.

Mx: Delete the Lowest and Highest Values
Only possible from EPROM version 2.0. The amount "m" of both the lowest and highest values are deleted.
• Under "m", enter the number of measured values to be eliminated. See also the number of test impacts "n" set, under "Mean Value".
Example: If "m" = 3, then at least 12 should be set for "n".

4.6 Display Range
The display range for the rebound value R on the display can be adapted to the testing range.
• Enter R_{min} and R_{max}.

4.7 Limit Values
The limit marks on the display serve to aid fast recognition of deviations from the measured values. The range within which the rebound values R are to lie can be selected (see Fig. 3.1 "Measuring display").

    ☞   *The selected limit values are not saved!*
• Enter R_{min} and R_{max}.

4.8 Language
• The display texts can be selected in the language required.

4.9 Date / Time
The inbuilt clock saves the measured values together with the test date and time.
Correct the values set, if necessary.

4.10 Data Output
See under "Data Output".
When all the settings have been made on the display unit, press the END key.
The device is ready to continue with the "Measuring Process".

5 Measuring Process
5.1 Measuring Procedure

👉 *Preferably perform measurements at temperatures between 10 °C and 50 °C only.*

The items in (brackets) are illustrated in Fig. 5.4. Perform test impacts with the concrete test hammer on a smooth, hard surface, without the cable connected to the display unit, before taking any measurements you are going to evaluate.

- Enter the basic settings as described under "Settings".
- Use a grindstone to smoothen the test surface.

Fig. 5.1 Preparing the test surface

⚠️ **Warning!**

The impact plunger (1) generates a recoil when it deploys. Always hold the concrete test hammer in both hands!

- Position the concrete test hammer perpendicular to the test surface.
- Deploy the impact plunger (1) by pushing the concrete test hammer towards the test surface until the pushbutton (6) springs out.

Fig. 5.2 Deploying the impact plunger (1)

⚠️ **Danger!**
Always hold the concrete test hammer in both hands, perpendicular to the test surface, before you trigger the impact!

👉 *Each test surface should be tested with at least 10 impacts. The individual impact points must be spaced at least 20mm apart.*

- Position the concrete test hammer perpendicular to and against the test surface. Push the concrete test hammer against the test surface at moderate speed until the impact is triggered (a high beep acknowledges registration).
- Repeat this procedure for the whole measurement series.

• Obvious outliers can only be eliminated directly after the particular test impact with the PRINT/STORE key.

End Measurement Series:
• After the last impact of a measurement series has been carried out, a low beep sounds. If n = 0 was set under "Calculation of Mean Value", you must end the measurement series with the END key.

New Measurement Series:
The measured values set remain unaltered:
• Continue from Fig. 5.1 on page 10 with "Preparing the test surface with a grindstone". The measurement series number is automatically incremented by 1 after the first test impact of the new measurement series.
Setting new values:
• Press the MENU key.
• Enter the new values as described under "Settings".

Complete Measurements:
• Push the concrete test hammer against a hard surface at moderate speed. When the impact is triggered, press push button (6). Impact plunger (1) is locked in a retracted position and the impact spring is under no load.

Fig. 5.4 Locking the impact plunger (1)

5.2 Data Output
The data is saved automatically in the display unit (max. 500 measurement series of 10 measurements).
When the memory is full, the oldest data is overwritten.

5.2.1 Transfer Memory
The data can be transferred to an MS Excel format under Windows.
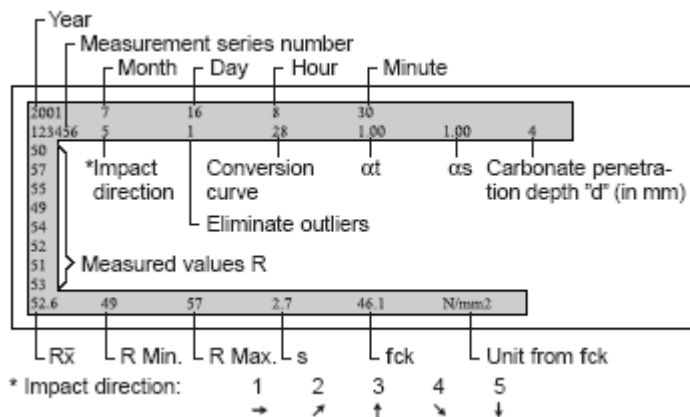• Connect the display unit using the transfer cable (Order No. 330 00 456) to the PC.

Fig. 5.5 Transferring data to an MS Excel format

5.2.2 Clear Memory
Objects cannot be deleted individually.

☞ *You can only delete the entire memory contents. This action cannot be undone after it has been confirmed.*

5.2.3 Display Memory
The measurement series number, the impact direction of the concrete test hammer and the measured rebound values R after deletion of the outliers, as well as the average of the rebound values $\bar{R}$ or of the compressive strength of the concrete are displayed.

5.2.4 Output on the Printer
For data transmission, use the printer cable Art. No. 330 00 460. Printing can be performed on all commercially available printers with a serial port. The following printing options are available:

- Printer is connected to the display unit during measurement
(online):
After completion of a measurement series (the preselected no. of test impacts has been performed), the data are sent to the printer. Transmission is also possible at any time by pressing the PRINT key.

- Printing via memory:
In the sub-menu "Display memory" the desired measurement series can be selected with the ↓, ↑ keys.
Printing is performed by pressing the PRINT key.

```
*******************************
*    DIGI-SCHMIDT 2000        *
*    ND-1-1055/082-0001       *
*******************************

11.7.2001  9:30
#109397/Horiz./M1
f28/αs1.05/αt1.00/d0

39 41 39 40 41 39 38 37

    Mean: 39.2R    41.1N/mm²
       s: +/- 1.4
Min/Max: 37/41
-------------------------------
```

Fig. 5.6 Example of a print protocol

6 Maintenance and Care

6.1 Cleaning After Use

⚠️ *Warning!*
Never immerse the concrete test hammer in water or clean it under a running tap! Use neither abrasives nor solvents for cleaning!

6.1.1 Concrete Test Hammer
• Deploy the impact plunger (1) as described in Fig. 5.2.
• Wipe the impact plunger (1) and housing (3) using a clean, dry cloth.

6.1.2 Display Unit
• Clean the display unit and measuring equipment with a clean, dry cloth after use.
• Clean the input sockets and connectors with a clean, dry brush.

6.2 Performance Check

6.2.1 Concrete Test Hammer
If possible, carry out the performance check every time before you use the device, however at least every 1000 impacts or 3 months.

- Put the concrete test hammer into operation as described in "Startup".
- Place the testing anvil on a hard, smooth surface (e.g.
- stone floor).
- Clean the contact surfaces of the anvil and the impact plunger.
- Perform about 10 impacts with the concrete test hammer and check the result against the calibration value specified on the testing anvil.

Fig. 6.1 Performance check of the concrete test hammer

👉 *Proceed as described in "Maintenance" if the values are not within the tolerance range specified on the testing anvil.*

6.2.2 Display Unit
• Check the surface of the outer sheath of the cable and the connector for damage.
• Check the life of the batteries.
• If a battery life of 4 to 6 hours is indicated on the display unit, you should take a new set of batteries to the measuring site.

6.3 Storage
• Store the concrete tester and accessories in the original case in a clean, dust-free room.
• If the unit is not used for a long period of time, remove the batteries.

6.4 Maintenance
We recommend checking the concrete test hammer for wear after 2 years at most and clean it. Do this as described below.

👉 *The concrete test hammer can either be sent to a service center authorized by the vendor or else it can be maintained by the operator according to the following description.*
The items in (brackets) are illustrated in Fig. 6.2, "Lengthways section through the concrete test hammer".

6.4.1 Stripping Down

⚠ *Warning!*
Never strip down, adjust or clean the slider and guide rod (4) (see Fig. 6.2), otherwise the slider friction may change. Special tools are required to readjust it.
• Position the concrete test hammer perpendicular to the surface.

⚠ *Danger!*
The impact plunger (1) generates a recoil when it deploys. Therefore always hold the concrete test hammer with both hands!
Always direct the impact plunger (1) against a hard surface!

• Deploy the impact plunger (1) by pushing the concrete test hammer towards the surface until the push button (6) springs out.
• Unscrew the cap (9) and remove the two-part ring (10).
• Unscrew the rear cover (11) and remove the compression spring (12).
• Press the pawl (13) and pull the system vertically up and out of the housing (3).
• Lightly strike the impact plunger (1) with the hammer mass (14) to release the impact plunger (1) from the hammer guide bar (7). The retaining spring (15) comes free.

• Pull the hammer mass (14) off the hammer guide bar together with the impact spring (16) and sleeve (17).
• Remove the felt ring (18) from the cap (9).

6.4.2 Cleaning
• Lay all parts except for the housing (3) in kerosene and clean them using a brush.
• Use a round brush (copper bristles) to clean the hole in the impact plunger (1) and the hammer mass (14) thoroughly.
• Let the fluid drip off the parts and then rub them dry with a clean, dry cloth.
• Use a clean, dry cloth to clean the inside and outside of the housing (3).

6.4.3 Assembly
• Before assembling the hammer guide bar (7), lubricate it slightly with a low viscosity oil (one or two drops; viscosity ISO 22, e.g. Shell Tellus Oil 22).
• Insert a new felt ring (18) into the cap (9).
• Apply a small amount of grease to the screw head of the screw (20).
• Slide the hammer guide bar (7) through the hammer mass (14).
• Insert the retaining spring (15) into the hole in the impact plunger (1).
• Slide the hammer guide bar (7) into the hole in the impact plunger (1) and push it further in until noticeable resistance is encountered.

Prior to and during installation of the system into the housing (3), make sure that the hammer mass (14) does not get held by the pawl (13).
Hint: Press the pawl (13) briefly.

• Install the system into the housing (3).
• Insert the compression spring (12) and screw the rear rear cover (11) into the housing (3).
• Insert the two-part ring (10) into the groove in the sleeve (17) and screw on the cap (9).
• Carry out a performance check.

Send in the device for repair if the maintenance you perform does not result in correct function and of the calibration values specified on the testing anvil are not achieved.
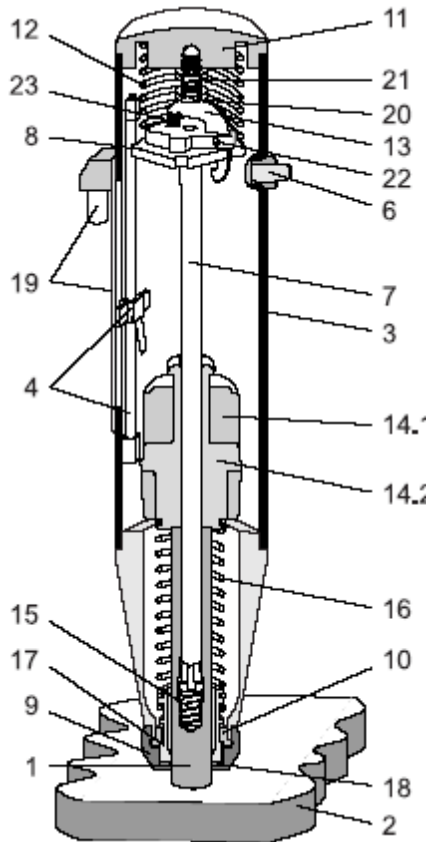
6.4.4 Concrete Test Hammer Model ND/LD

Fig. 6.2 Lengthways section through the concrete test hammer

Key:

1 Impact plunger
2 Test surface
3 Housing, complete
4 Slider with guide rod
5 Not used
6 Push button, complete
7 Hammer guide bar
8 Guide disk
9 Cap (for model LD red)
10 Two-part ring
11 Rear cover (for model LD red)
12 Compression spring

13 Pawl
14 Hammer mass: 14.1 model ND,
14.2 model LD
15 Retaining spring
16 Impact spring
17 Guide sleeve
18 Felt washer
19 Resistance element with input socket
20 Trip screw
21 Locknut
22 Pin
23 Pawl spring

7 Data

7.1 Form of Delivery

Model ND / LD

Contents of Package

Concrete test hammer
Display unit
Carrying strap
Test hammer cable
Transfer cable
Grindstone
Protection sleeve for
display unit
Operating instructions
Calibration certificate
Carrying case
325 x 295 x 105 mm
Total weight 3 kg

7.2 Accessories / Spare Parts

Designation	Article no.
Protection sleeve for display unit	330 00 470
Transfer cable 9/9-position	330 00 456
Printer cable 9/9+25-position for printer with serial port	330 00 460
Test hammer cable	380 02 510
Grindstone	310 99 037
Carrying case	340 00 281

7.3 Technical Data

7.3.1 Display Unit
- Measuring range from 10 to 70 N/mm^2 compressive strength of the concrete
- Non-volatile memory for max. 500 measurement series of 10 measurements each
- Graphics LC display, 128 x 128 pixels
- Interface RS232
- Power supply with 6 batteries, 1.5 V, LR6 design for an operating time of approx. 60 hours
- Permissible ambient conditions of -10 °C to +60 °C

7.3.2 Concrete Test Hammer

	Model ND	Model LD
Impact energy:	2.207 Nm	0.735 Nm

8 Appendix

8.1 Derivation of the PROCEQ Standard Conversion Curves

The conversion curves Fig. 8.1 and Fig. 8.2 for the concrete test hammer are based on measurements taken on very many sample cubes. The rebound values R of the sample cubes were measured using the concrete test hammer. The compressive strength was then determined with the pressure testing machine. In each test, at least 10 test hammer impacts were performed on one side of the sample cube which was lightly clamped in the press.
Material of the sample cubes:
All cubes were made from concrete consisting of good quality fine gravel (maximum particle size Ø 32 mm) and Portland cement.

Empirical values:
The conversion curve is practically independent of the:
- Cement content of the concrete
- Particle gradation
- Diameter of the largest particle in the fine gravel mixture, providing the diameter of the maximum particle is < 32 mm
- Water/cement ratio

8.2 Standard Conversion Curves

Standard Conversion Curve for Concrete Test Hammer Model ND
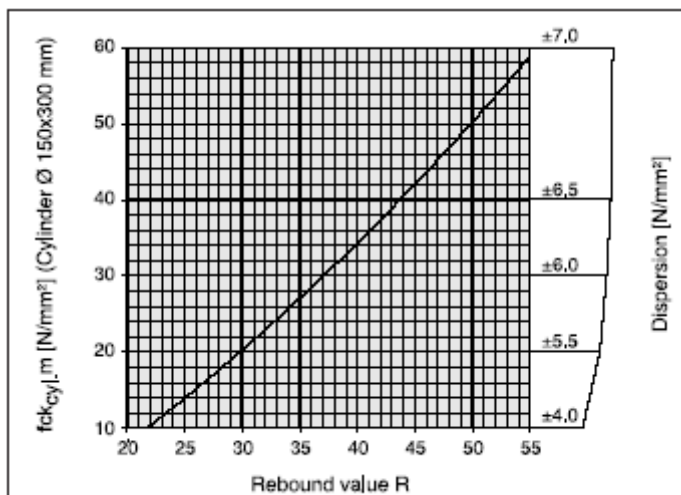Mean value $\bar{R}$ has already been corrected in relation to the impact direction

Fig. 8.1 Model ND: Conversion curve based on the average compressive strength of a cylinder and the rebound value R

$fck_{cyl.}m$: average compressive strength of a cylinder (probable value)

Standard Conversion Curve for Concrete Test Hammer Model LD

Mean value $\bar{R}$ has already been corrected in relation to the impact direction
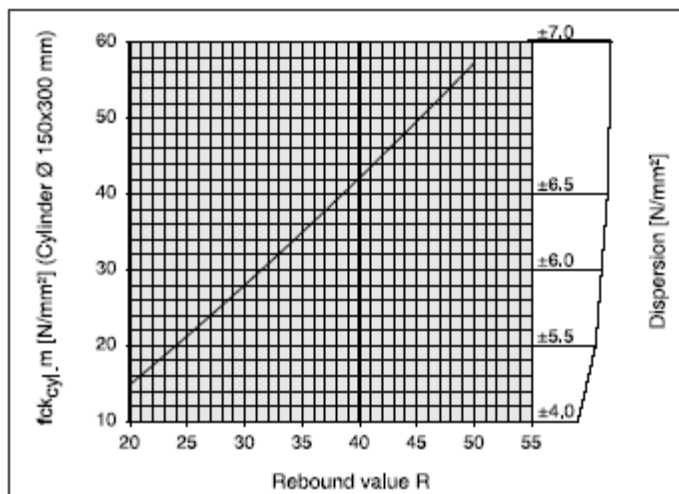

Fig. 8.2 Model LD: Conversion curve based on the average compressive strength of a cylinder and the rebound value R

Limits of Distribution

$fck_{cyl.}$: The max. and min. values are set so that 80 % of all test results are included.

8.3 Creating New Conversion Curve

Experience has shown that deviations from the normal conversion curves occur under the following circumstances:
- Artificial stone products with an unusual concrete composition and small dimensions. It is recommended to perform a separate series of tests for each product in order to determine the relationship between the rebound value R and the resistance to pressure.
- Aggregates made from low strength, lightweight or cleavable stone (e.g. pumice, brick rubble, gneiss) result in a strength value lower than shown on the conversion curve.
- Gravel with a preponderance of smooth, polished surfaces and spherical shape results in values for compressive strength which are lower than those scertained by the rebound measurements.
- A strong, dry mixed concrete (i.e. with low sand content) which has not been worked adequately may contain gravel agglomerations which are not visible from the surface. These affect the strength of the concrete without however influencing the rebound values R.
- The concrete test hammer gives inadequate rebound values R on recently applied, green concrete or concrete which has hardened under water. The concrete must be dried before the test.
- Very high values for compressive strength (> 70 N/mm2) can be achieved by adding pulverized fuel ash or silica. However, these strengths cannot reliably be ascertained using the concrete test hammer.

The relationship between the rebound value R and the compressive strength of the concrete **f**ck is determined using test specimens of a certain type of concrete.

Proceed as follows:
• Take test specimens following the regulations applying in the particular country.
• In a pressure testing machine, apply force on the test specimens with a force of 40 kN, vertical to the direction in which the concrete was poured.
• Then measure the rebound hardness by applying as many test impacts as possible to the sides of the test specimen.

The only way to achieve a meaningful result is to measure the rebound values R and the compressive strength of several test specimens.

☞ *Concrete is a very inhomogeneous material. Test specimens made from the same batch of concrete and stored together can reveal discrepancies of ± 15 % when tested in the pressure testing machine.*

• Take the mean value R_m.
• Determine the compressive strength of the concrete by applying force to the test specimens using the pressure testing machine, until the test specimens break.
Then ascertain the mean value **f**ckm.
The pair of values R_m / **f**ckm applies to a certain range of the measured rebound value R.
It is necessary to test samples of differing qualities and / or ages in order to prepare a new conversion curve for the entire range of rebound values from R = 20 to R = 55.
• Using the pairs of values R_m / **f**ckm, calculate the mathematical shape of the conversion curve, i.e. determine the parameters a, b and c of the x^2 function (e.g. EXCEL in the RGP function).

8.4 Determining Time Coefficient

The age of the concrete and its carbonate penetration depth can significantly increase the measured rebound values R.

It is possible to obtain accurate values for the effective strength by removing the hard, carbonate-impregnated surface layer using a manual grinding machine over a surface area of about Ø 120 mm and performing the measurement on the non-carbonate-impregnated concrete.

The time coefficient, i.e. the measurement of the increased rebound values R, can be ascertained by taking additional measurements on the carbonate-impregnated surface.

$$\text{Time coeff. } Z_f = \frac{R_{m\,carb.}}{R_{m\,n.c.}} \quad \Rightarrow \quad R_{m\,n.c.} = \frac{R_{m\,carb.}}{Z_f}$$

$R_{m\,carb.}$:   Average rebound value R, measured on carbonate-impregnated concrete surface

$R_{m\,n.c.}$:   Average rebound value R, measured on non-carbonate-impregnated concrete surface