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ENGINEERING MEASUREMENTS ENTERPRISE LTD

TECHNICAL DOCUMENTATION

RESULTS OF DEVIATION MEASUREMENTS AND GEOMETRY OF ROTARY KILN No 1

AT

EXEMPLARY CEMENT PLANT

PERIOD OF SURVEY:
30th of March - 16th of April, 2004

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ENGINEERING MEASUREMENTS ENTERPRISE LTD

FINAL REPORT ON KILN No 1

AT EXEMPLARY CEMENT PLANT

I. SCOPE OF WORK:

1. Measurement of kiln axis deformation in horizontal and vertical plane with accuracy +/- 1.0 mm
2. Measurement of roller's horizontal skewings and roller's inclinations with accuracy +/- 0.5 mm
3. Measurement of undertyre clearances
4. Measurement of roller's operating angles
5. Measurement of shell radial and axial deformations (shell profile)
6. Measurement of drive pinion deviations
7. Measurement of supporting rollers mechanial wear
8. Measurement of drive gear run out and wobbling
9. Measurement of tire wobbling
10. Measurement of roller shaft deflections
11. Elaboration, presentation and submission to the Client the complete measurement report.

II. SURVAY OF ROTARY KILN

1. All measurements were taken by GEOSERVEX Hot Kiln Alignment Team – Bydgoszcz, Poland from 30.03.2004. to 16.04.2004.

2. After completing all measurements for the kiln, technical documentation was presented to cement plant representatives and the adjustment program and schedule was discussed and agreed.

III. RESULTS OF MEASUREMENTS

1. Kiln axis

- kiln axis in horizontal plane is deviated by 19 mm on second pier and 11 mm on third pier and require adjustment
- kiln axis in vertical plane is deviated by 12.0 mm on second pier and require adjustment
- undertire clearances are slightly too large for tires No 1,2,4 and it's incorrect for tire No 3 where it rise up to 14 mm. The clearance should be corrected by inserting shims at the nearest kiln stoppage. Too large clearance may cause too high shell ovality and as a result refractory loss.
- kiln slope is 2.50 % and it's correct.

2. Roller's parameters and kiln thrust

- roller’s skewing are correct, it's values are small and do not cause high axial forces
- roller’s inclinations are correct for all rollers
- kiln thrust is correct, kiln is well balanced
- hydraulic system pressure is around 40-50 Bar and it's correct
- roller’s operating angles are correct on piers No 2,3,4 and exceeds tolerance for pier No 1, however it should not cause any problems with kiln's operation
- roller's mechanical wear is not high comparing to other older kilns however it exceeds value of 1 mm for radius

3. Drive station

- drive pinion axis is deviated by 3.5 mm in horizontal plane and by 2.0 mm in vertical plane (reduced for regulation bolts distance), this deviation is higher than expected for this parameter
- gear rim eccentricity is 4 mm what causes 8 mm change of root clearance
- gear rim eccentricity is caused by kiln shell eccentricity at the gear (see cross section No 24), however the gear eccentricity is smaller than eccentricity of shell in this zone
- gear rim wobbling is not high and equal +/- 1.6 mm

- drive gear rim and pinion are mechanically worn, all root's working surfaces are damaged, root clearance and backlash are both incorrect
- there is very high vibration caused by improper mesh of the drive
- the pinion should be replaced as soon as possible
- the gear rim should be also replaced and it can not be installed in opposite position (after turning it by 180 degrees) because the roots are worn both sides, the gear replacement should be performed with consideration on eccentricity reduction

4. Kiln shell

- survey of shell deviation was taken in 35 sections shown on the draft
- maximum deviations of the shell (eccentric) rise up to 64 mm (section No 16) and it exceed tolerance several times, there is a huge "banana" formation in this zone
- deviations of the shell surface (circular deviations) exceed tolerance for cross sections No 5 and No 16 to No 32.
- deviations of the shell surface (circular deviations) from section No 17 to No 22 is critically high and rise up to +/- 35 mm, replacement of this shell portion should be taken under consideration if any refractory loss had place in this zone
- tire wobbling is +/- 1.8 mm for tire No 1, +/- 0.5 mm for tire No 2, 0.3 for tire No 3 and 0.7 mm for tire No 4, tire No 1 wobbling only slightly exceeds tolerance
- roller shaft deflections doesn't exceed value of 0.11 mm (eccentricity) while the tolerance given by kiln producer (FLS) is 0.15 mm
- roller shaft deflection are caused by mechanical crank of the shell however the crank formation in the shell is smaller than that which is normally considered dangerous

IV. ADJUSTMENT OF THE KILN

1. Kiln axis should be adjusted to proper position in horizontal and vertical plane by shifting rollers on first and second piers what has been discussed and agreed with plant representatives.

2. It has been agreed that vertical adjustment axis on second pier should remains 6 mm over straight line connecting remaining axis points (Adjustment program, VERSION I) , what is recommended by the kiln producer (FLS)

3. It has been agreed that the adjustment should be done in small steps by plant crew according to adjustment program prepared by Geoservex

4. First 16 steps (first day of adjustment) has been performed under supervision of Geoservex team, there was no problems with shifting of the rollers, reference system is clearly marked on foundation frames

V. CONCLUSION

The kiln should be adjusted to proper positions of the axis. The most critical point for kiln operation is drive station. The drive gear rim and pinion mesh is critically incorrect and may cause serious problems for the future. There is no possibility to solve this problem by adjusting rollers. It is strongly recommended to replace this worn components as soon as possible.

The kiln shell deformations is very high in several places. This deformations has serious influence on refractory life-time. If refractory loss had place in a zone where shell deformations are serious , this part of shell should be replaced.

VI. THANKS

1. The GEOSERVEX's Hot Kiln Alignment team would like to thank officialy the plant mechanical crew for help and assistance during measurements and adjustment of the kiln

2. We would like to thank Cementos Goliat Plant's Management for choosing our company as the Hot Kiln Alignment Service deliverer. We aprieciate Your confidence to us and we hope for long time cooperation with Your company.

3. In case of any problems with the kiln geometry please contact our company by fax or mail for free consulting.

GEOSERVEX

Dipl. Eng. Zbigniew Krystowczyk (M. Sc.)

Place of measurements:
Date: 16.04.2004.

GEOSERVEX

**ENGINEERING MEASUREMENTS
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POLAND**

TECHNICAL DOCUMENTATION

RESULTS OF DEVIATION MEASUREMENTS
AND
GEOMETRY OF ROTARY KILN No 1

EXEMPLARY CEMENT PLANT

Date of survey : 05.04.2004.

Index

Table of Contents

Symbol and Terms

x	axial coordinates
y	horizontal coordinates
z	vertical coordinates
s	undertire clearance
α	rollers operating angle
η	slope of axis
Δy	horizontal axis correction
Δz	vertical axis correction
ds	skewing correction
δ	ovalization
- - - - - -	reference axis
—·—·—	real axis
———	regulation axis

Measurement Data

Coordinates " x "

feed [m]

x_4 =	101.98
x_3 =	66.04
x_2 =	31.94
x_1 =	0.00

discharge

Coordinates " y "

feed [mm]

y_4 =	0.0
y_3 =	+ 11.0
y_2 =	+ 19.0
y_1 =	0.0

discharge

Coordinates " z "

feed [mm]

z_4 =	0.0
z_3 =	0.0
z_2 =	+ 12.0
z_1 =	0.0

discharge

Undertire clearance " s "

feed [mm]

s_4 =	8.0
s_3 =	14.0
s_2 =	8.5
s_1 =	8.0

discharge

rollers operating angle " α "

feed [° ']

α_4 =	58 ° 40 '
α_3 =	58 ° 29 '
α_2 =	59 ° 16 '
α_1 =	62 ° 53 '

discharge

Slop of axis

η = 2.50 %

EXEMPLARY CEMENT PLANT

Kiln No 1

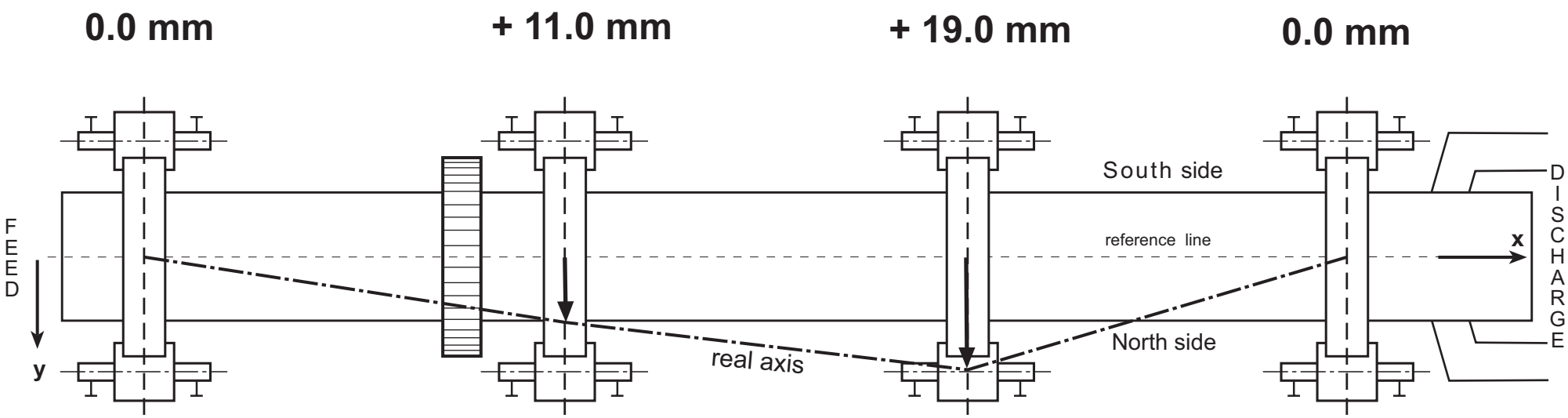
Date of survay: 05.04.2004.

Axial Deviations

In Horizontal Plane

GEOSERVEX - POLAND 3

DEFORMATION SCALE : 1:1



EXEMPLARY CEMENT PLANT

Kiln No 1

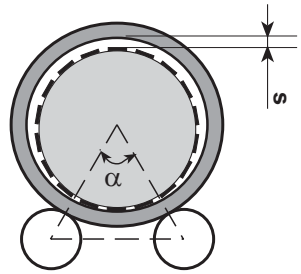
Date of survay: 05.04.2004.

Precision of finding kiln axis: +/- 1 mm

Axial Deviations

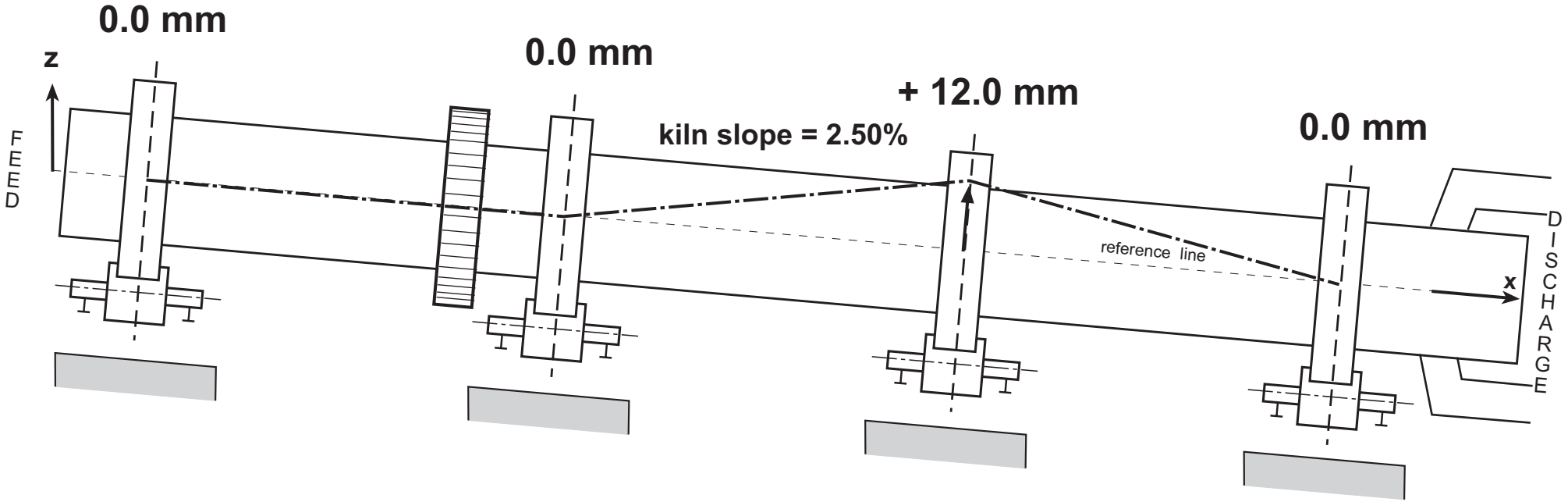
In Vertical Plane

GEOSERVEX - POLAND



DEFORMATION SCALE : 1:1

α = 58 ° 40 '	α = 58 ° 29 '	α = 59 ° 16 '	α = 62 ° 53 '
s = 8 mm	s = 14.0 mm	s = 8.5 mm	s = 8.0 mm



EXEMPLARY CEMENT PLANT

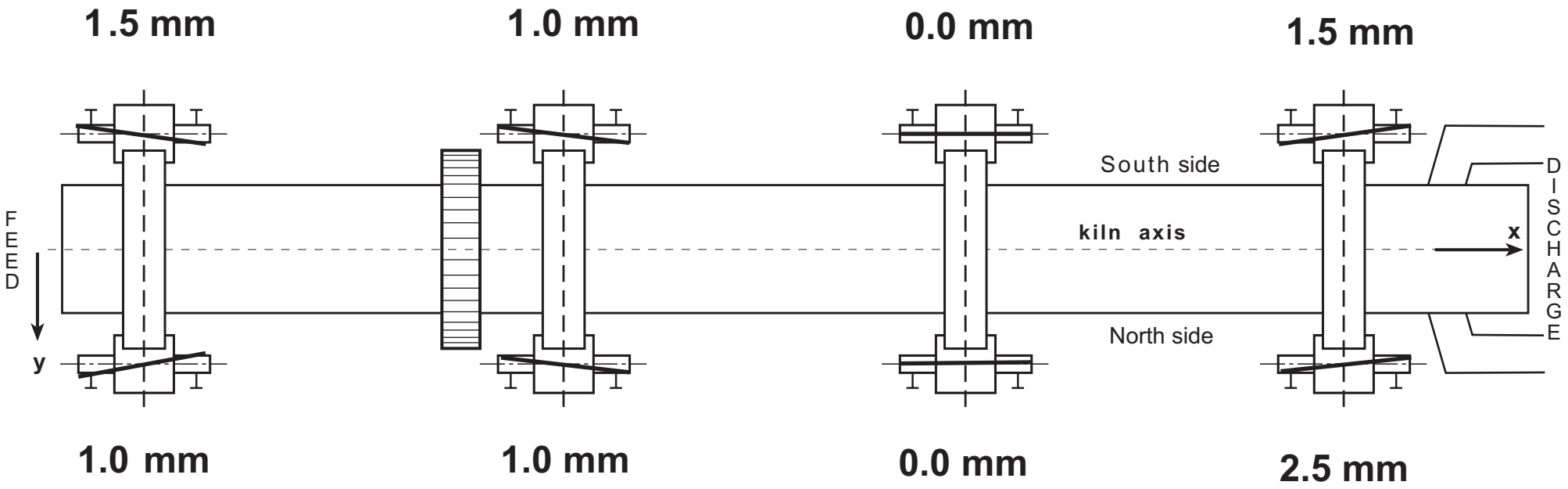
Kiln No 1

Date of survay: 05.04.2004.

Precision of finding kiln axis: +/- 1 mm

Rollers Skewing

In Horizontal Plane



EXEMPLARY CEMENT PLANT

Kiln No 1

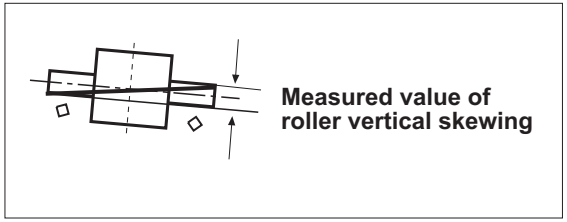
Date of survay: 05.04.2004.

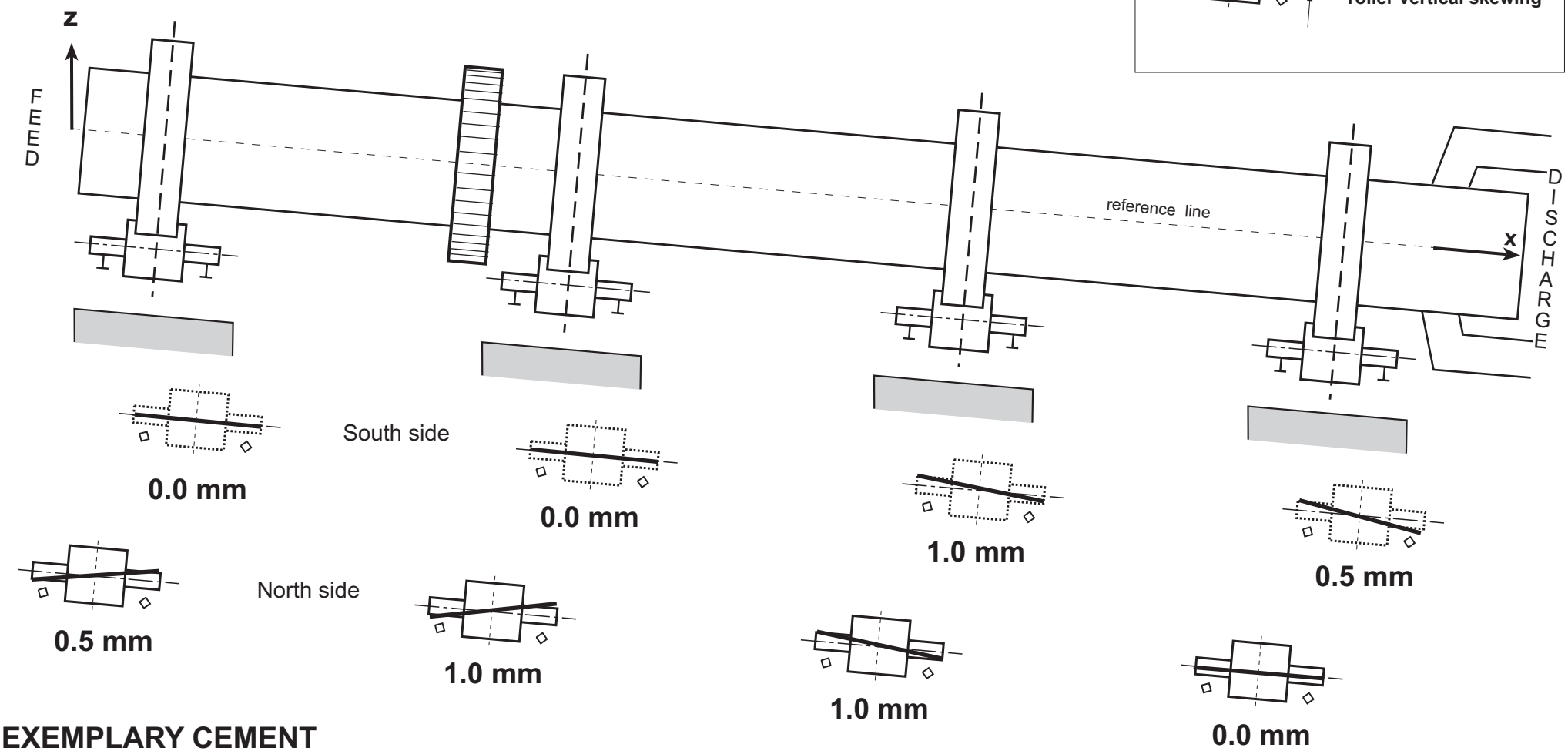
Rollers skewing (Sh) are reduced for screw distance

Rollers Skewing

In Vertical Plane

GEOSERVEX - POLAND **6**





EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

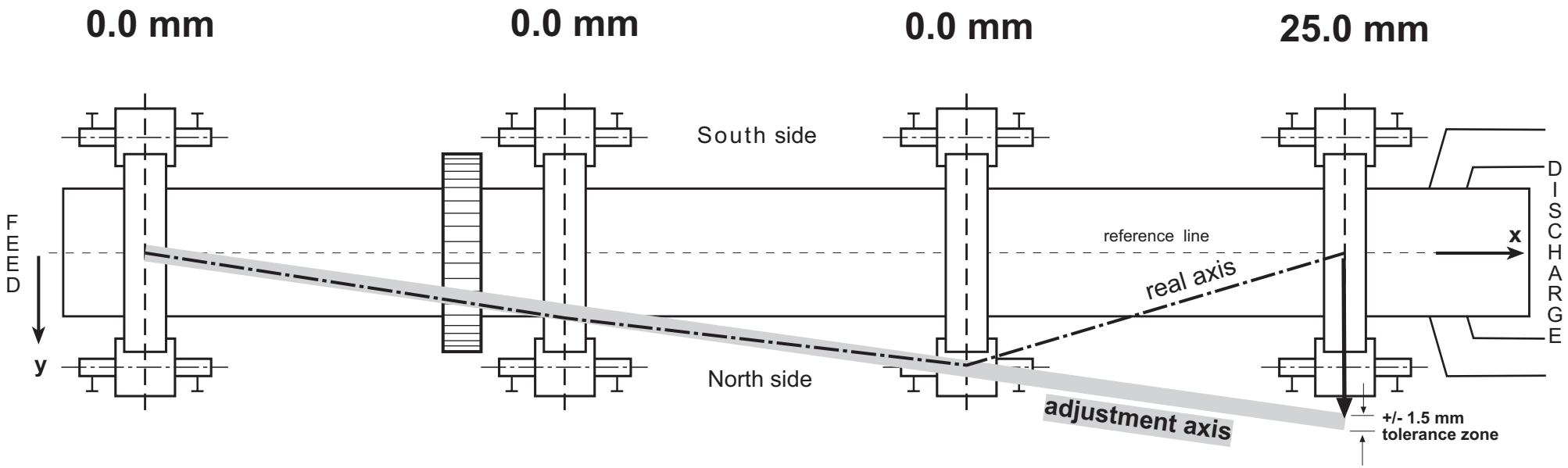
Rollers skewing (Sv) are reduced for screw distance

Adjustment Program

In Horizontal Plane

GEOSERVEX - POLAND **7**

DEFORMATION SCALE : 1:1



EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

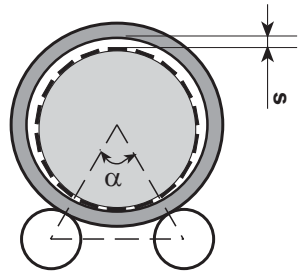
Precision of finding kiln axis: +/- 1 mm

Adjustment Program

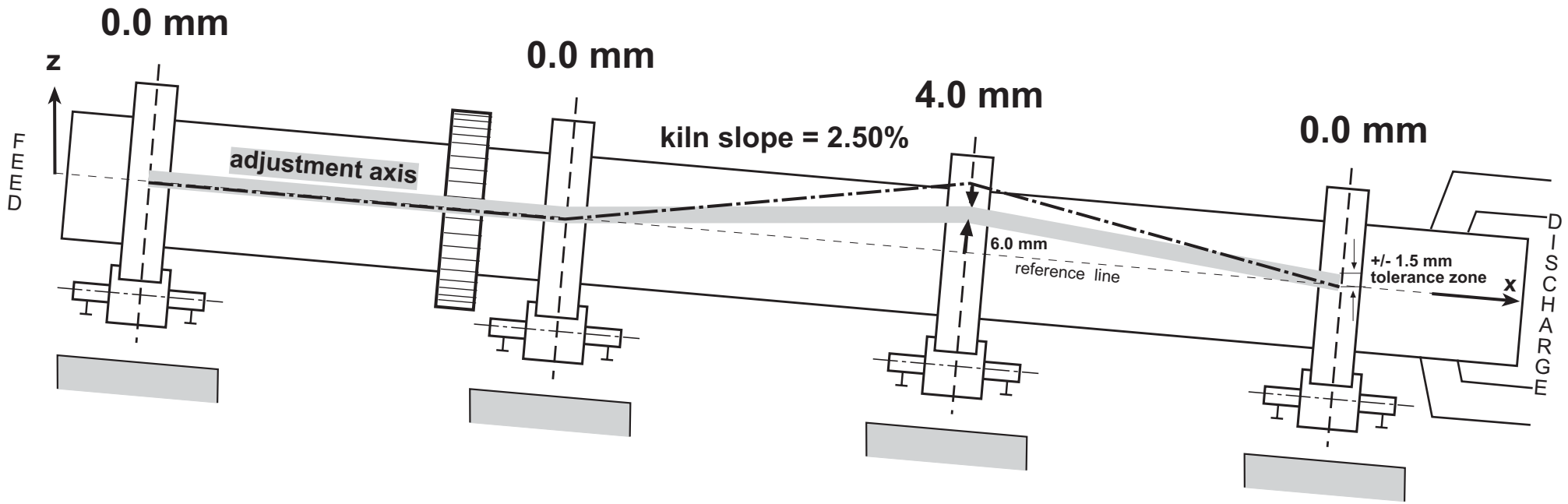
In Vertical Plane

VERSION I

GEOSERVEX - POLAND



DEFORMATION SCALE : 1:1



EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

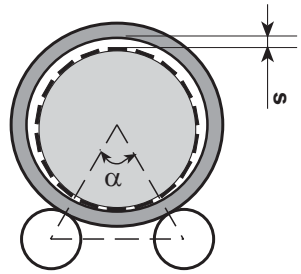
Precision of finding kiln axis: +/- 1 mm

Adjustment Program

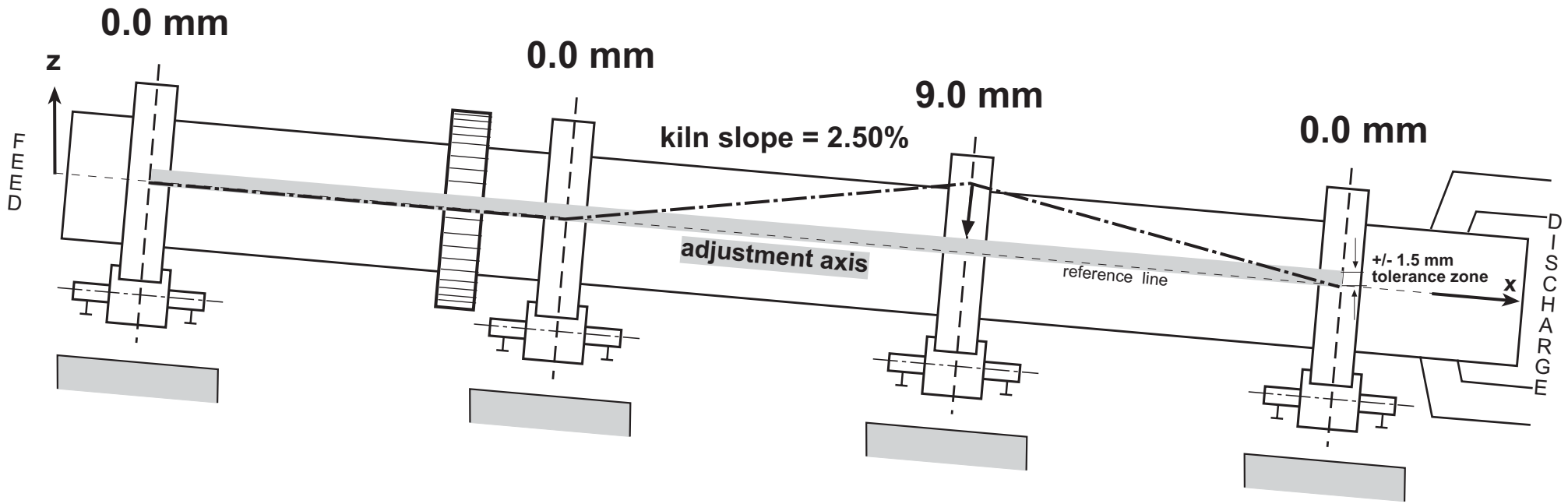
In Vertical Plane

VERSION II

GEOSERVEX - POLAND



DEFORMATION SCALE : 1:1



EXEMPLARY CEMENT PLANT

Kiln No 1

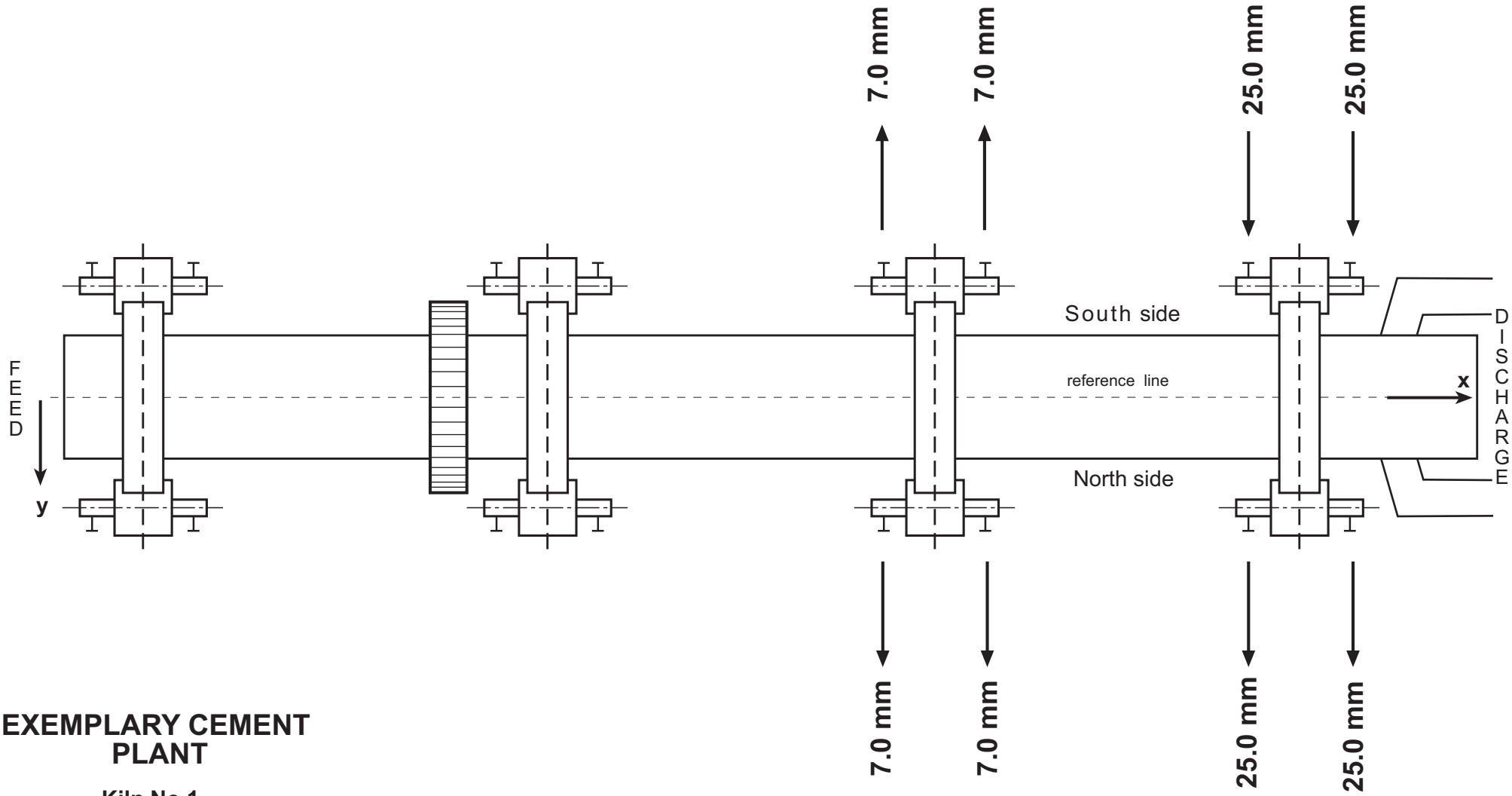
Date of survay: 05.04.2004.

Precision of finding kiln axis: +/- 1 mm

Adjustment Schedule

In Horizontal Plane

VERSION I



EXEMPLARY CEMENT PLANT

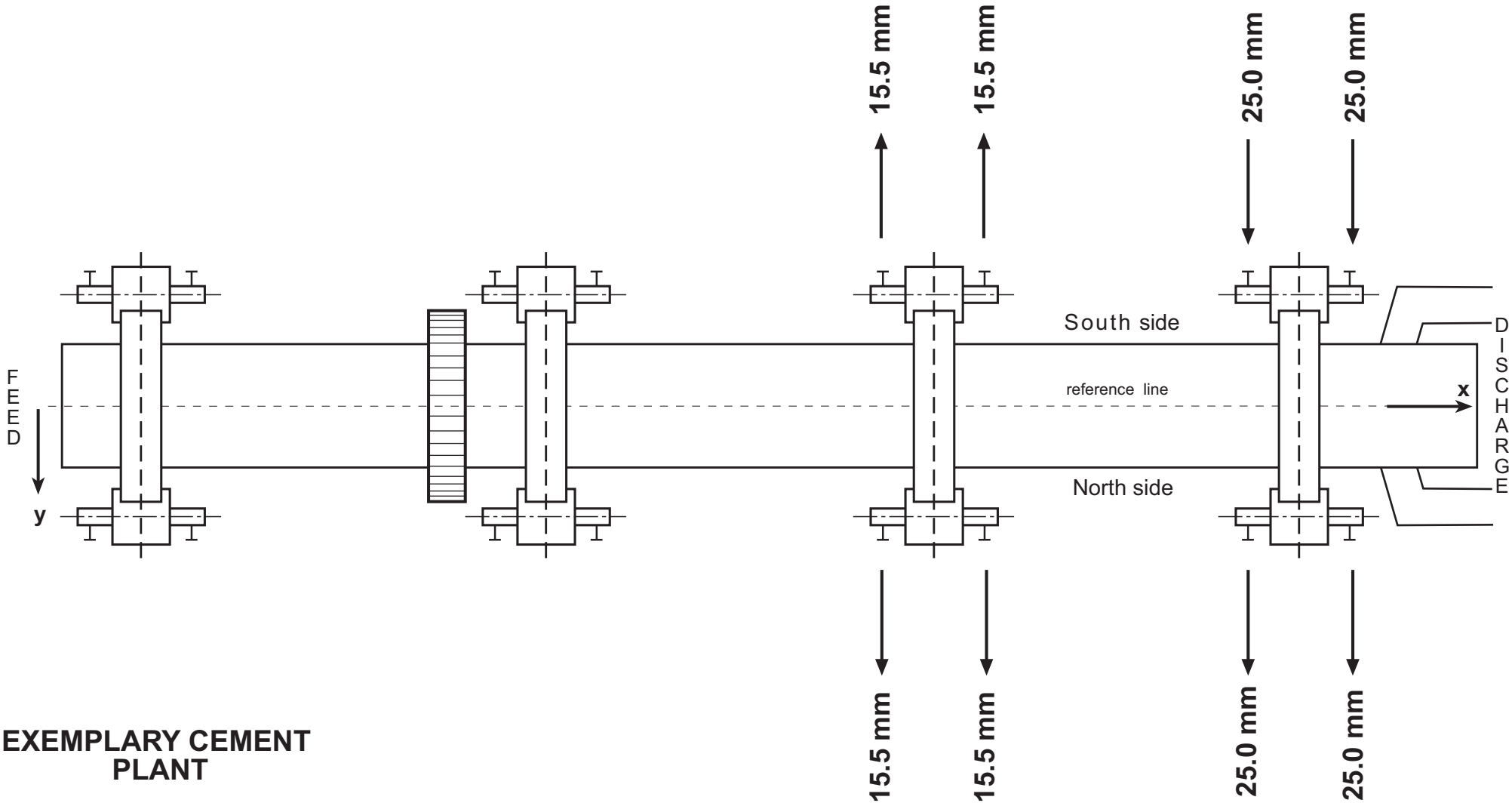
Kiln No 1

Date of survay: 05.04.2004.

Adjustment Schedule

In Horizontal Plane

VERSION II



EXEMPLARY CEMENT PLANT

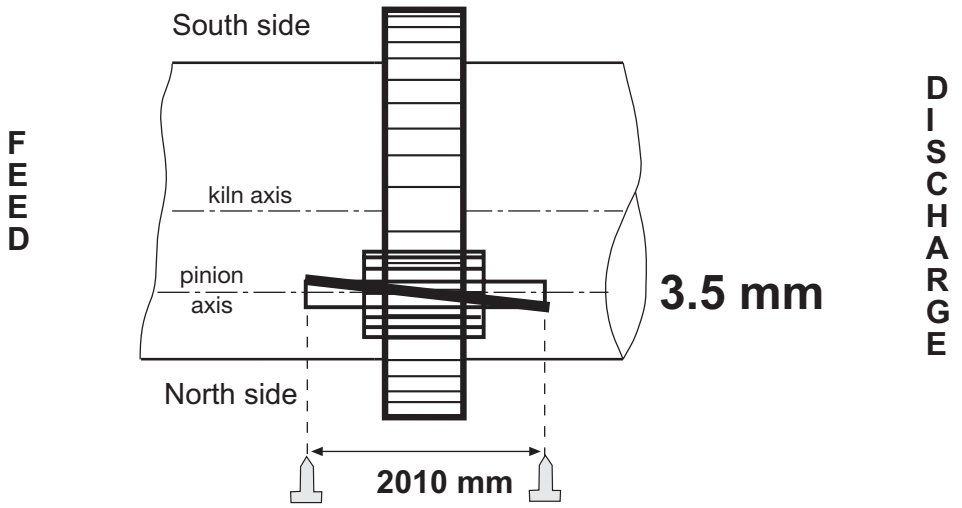
Kiln No 1

Date of survay: 05.04.2004.

Pinion Axis

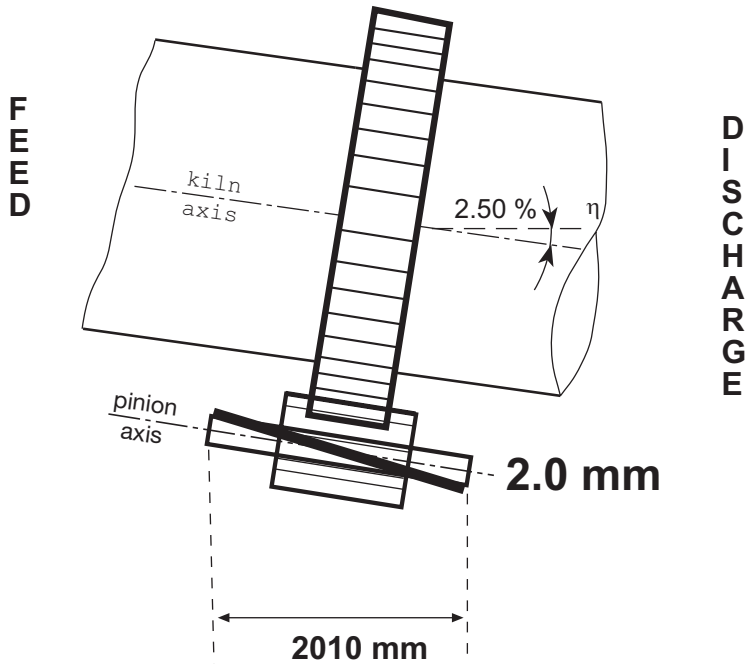
in Reference to Kiln Axis

IN HORIZONTAL PLANE



CAUTION!
Values of pinion axis deviations are calculated for regulation bolts distance

IN VERTICAL PLANE



EXEMPLARY CEMENT PLANT

Kiln No 1

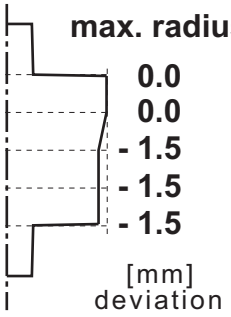
Date of survay: 05.04.2004.

DISCHARGE

Pier I

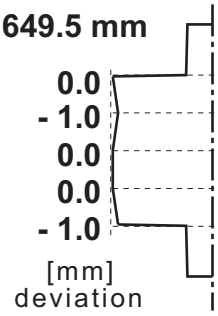
max. radius = 877 mm

max. radius = 890 mm

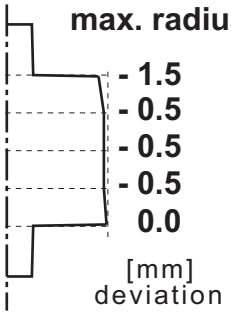


Pier II

max. radius = 649.5 mm

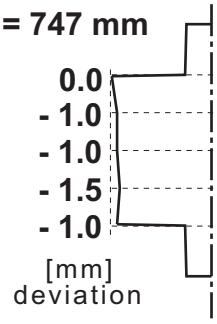


max. radius = 655 mm

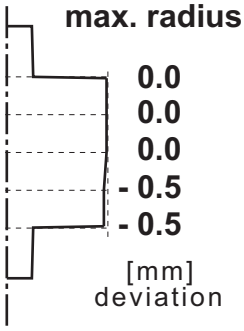


Pier III

max. radius = 747 mm

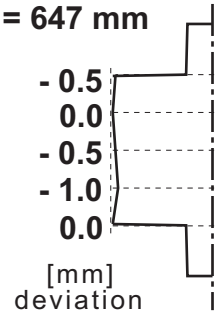


max. radius = 750.5 mm

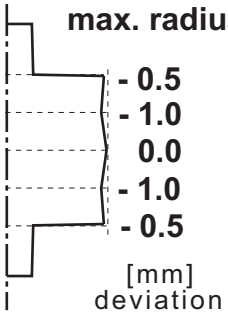


Pier IV

max. radius = 647 mm



max. radius = 647.5 mm



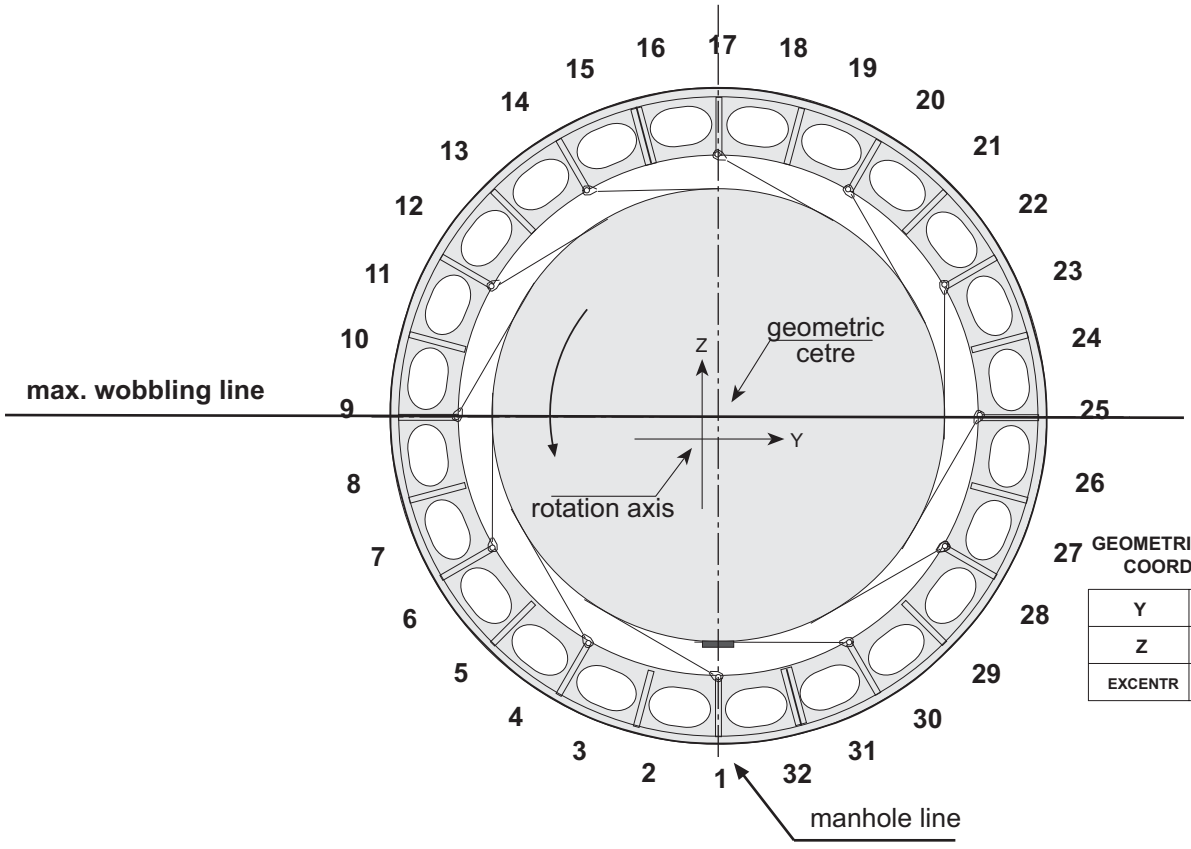
EXEMPLARY CEMENT PLANT

Kiln No 1

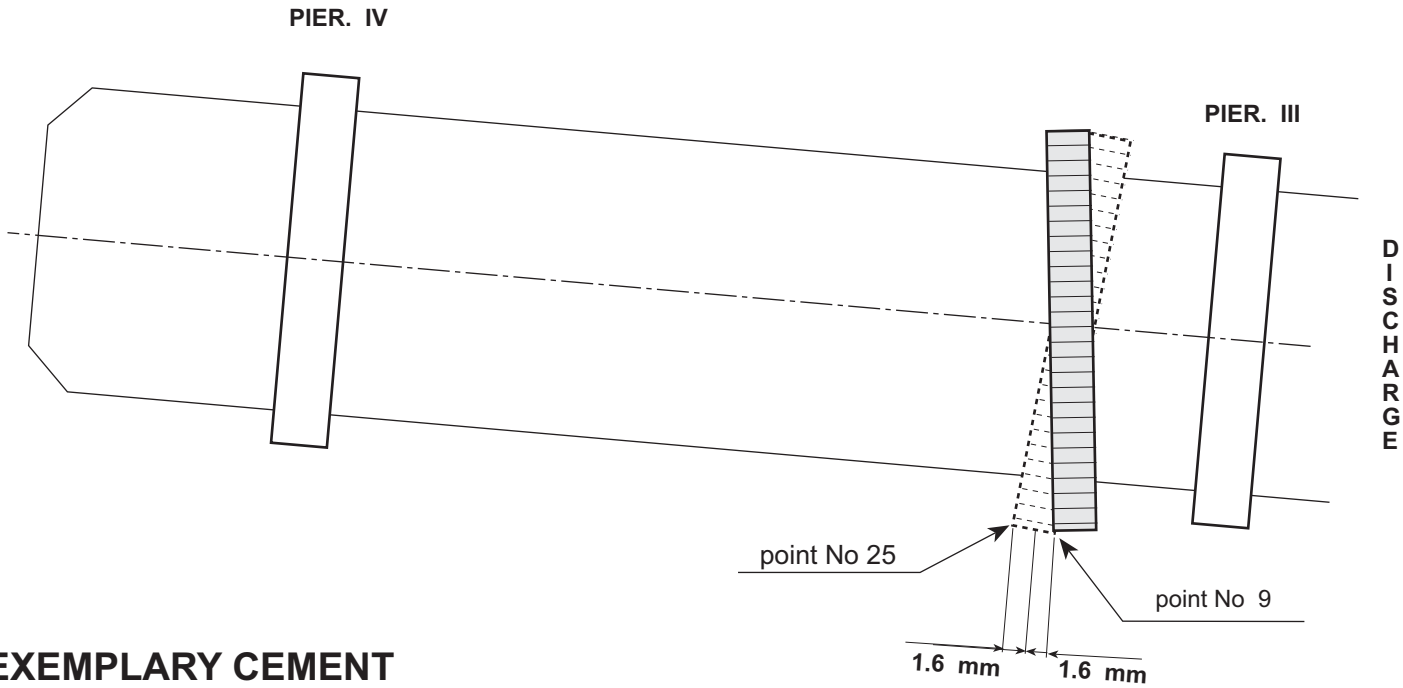
Date of survay: 05.04.2004.

FEED

(viewing from feed end)



GEOMETRIC CENTRE COORDINATES	
Y	+ 2 mm
Z	+ 3 mm
EXCENTR	4 mm



EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

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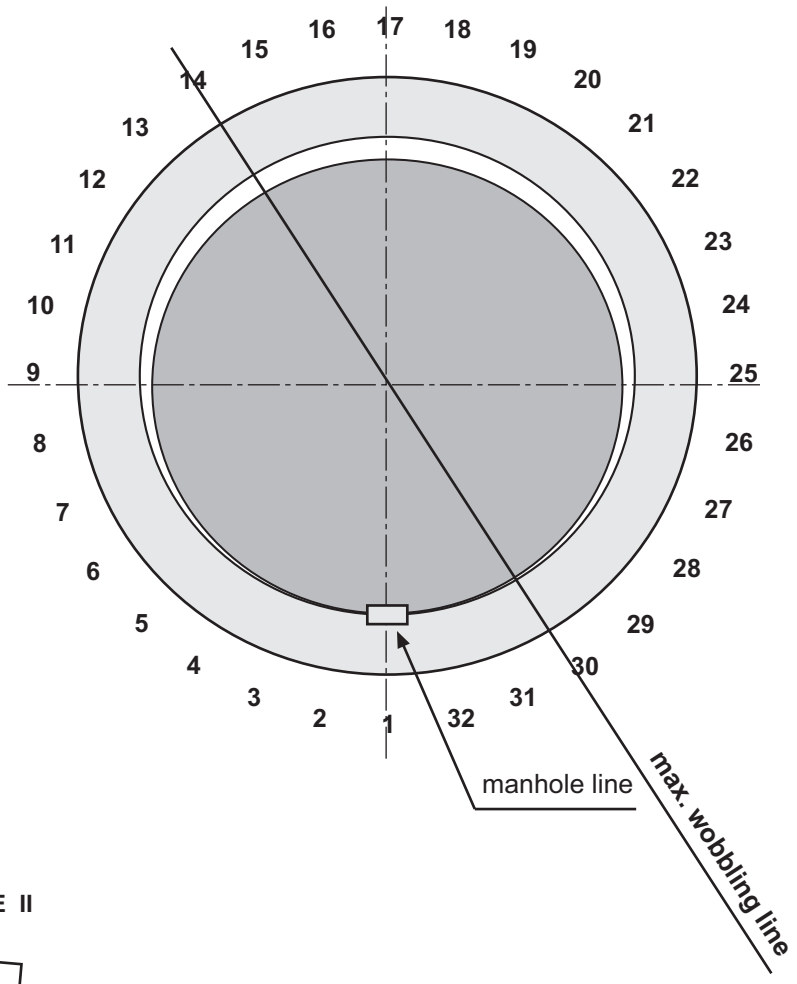
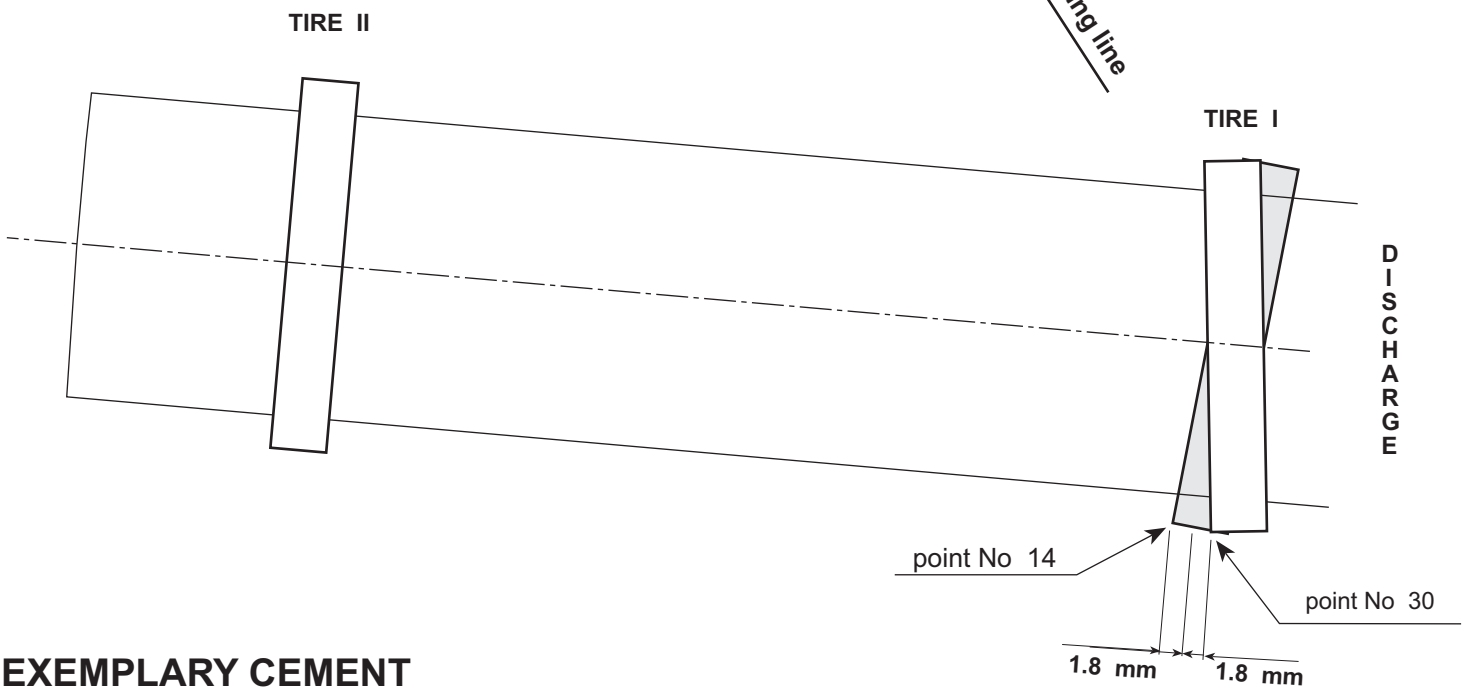


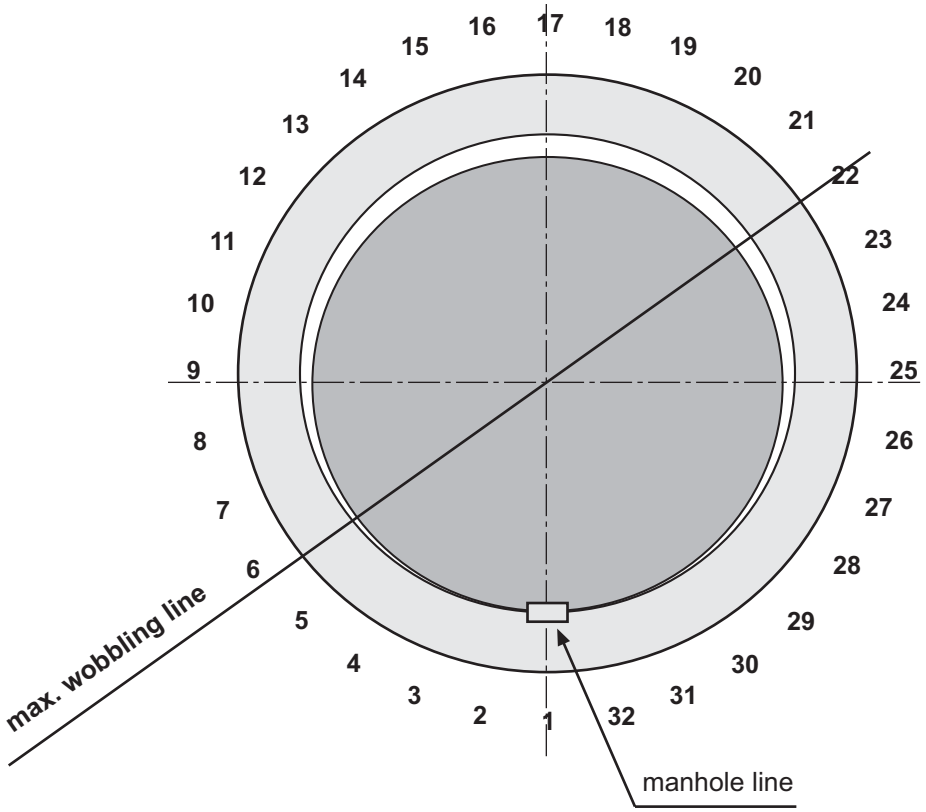


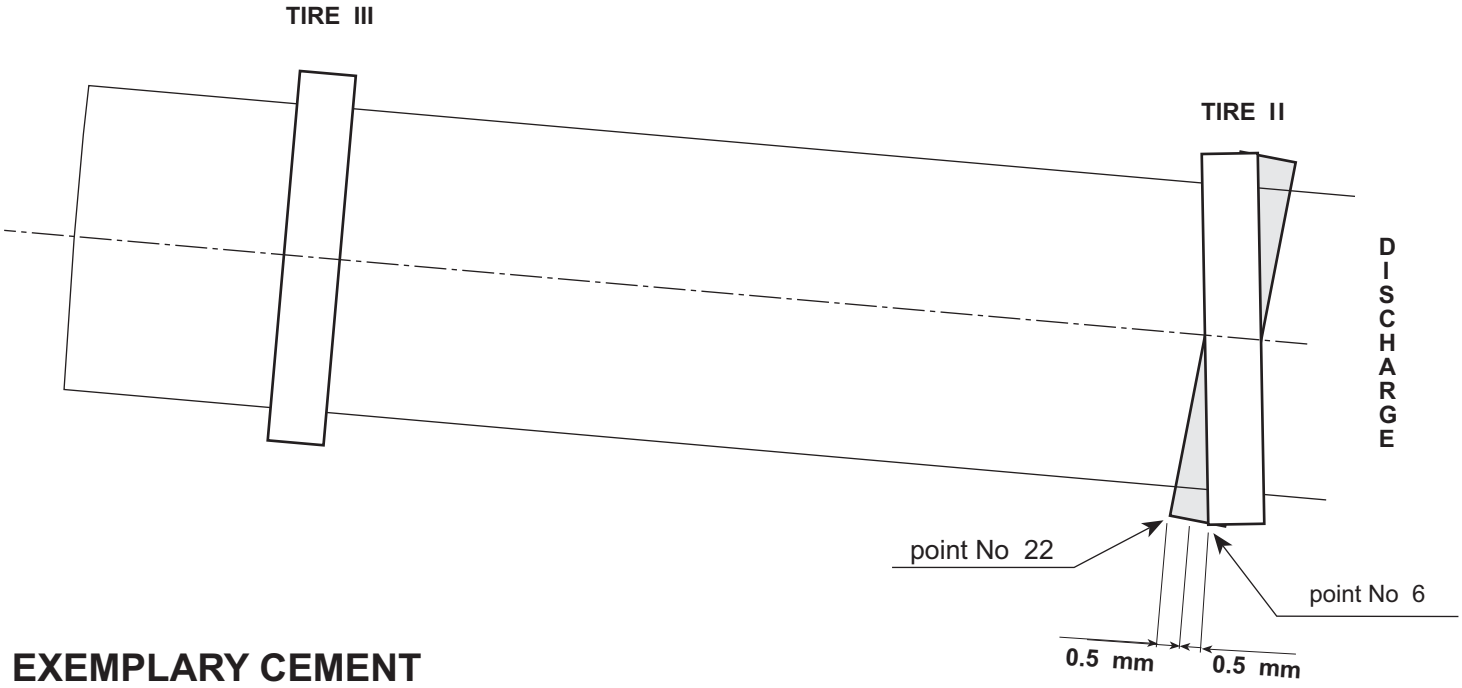
EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

(viewing from feed end)



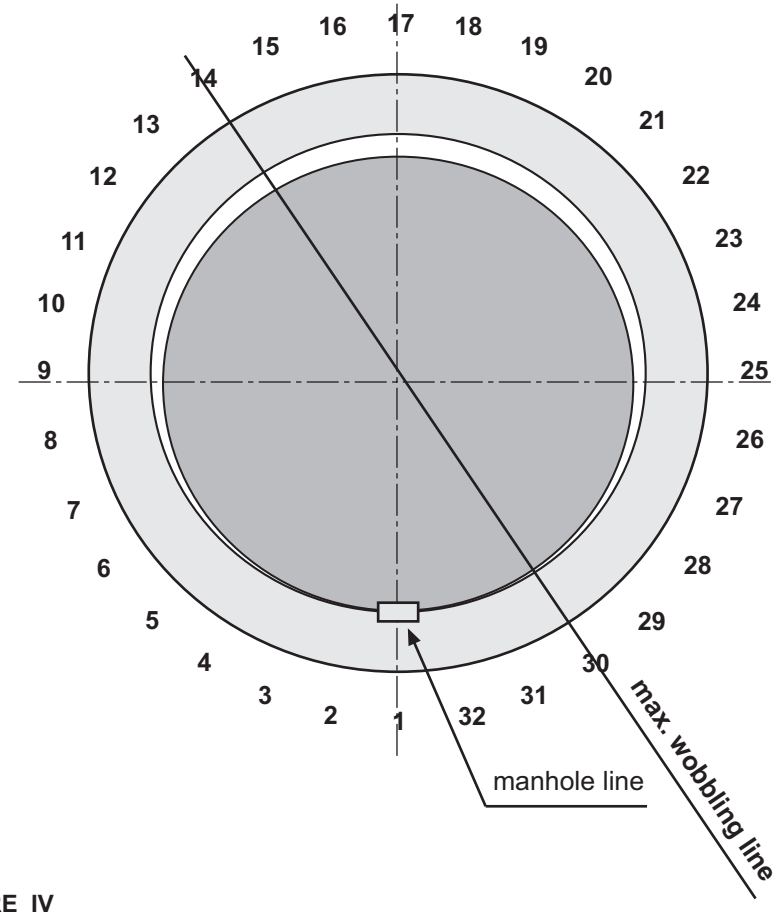


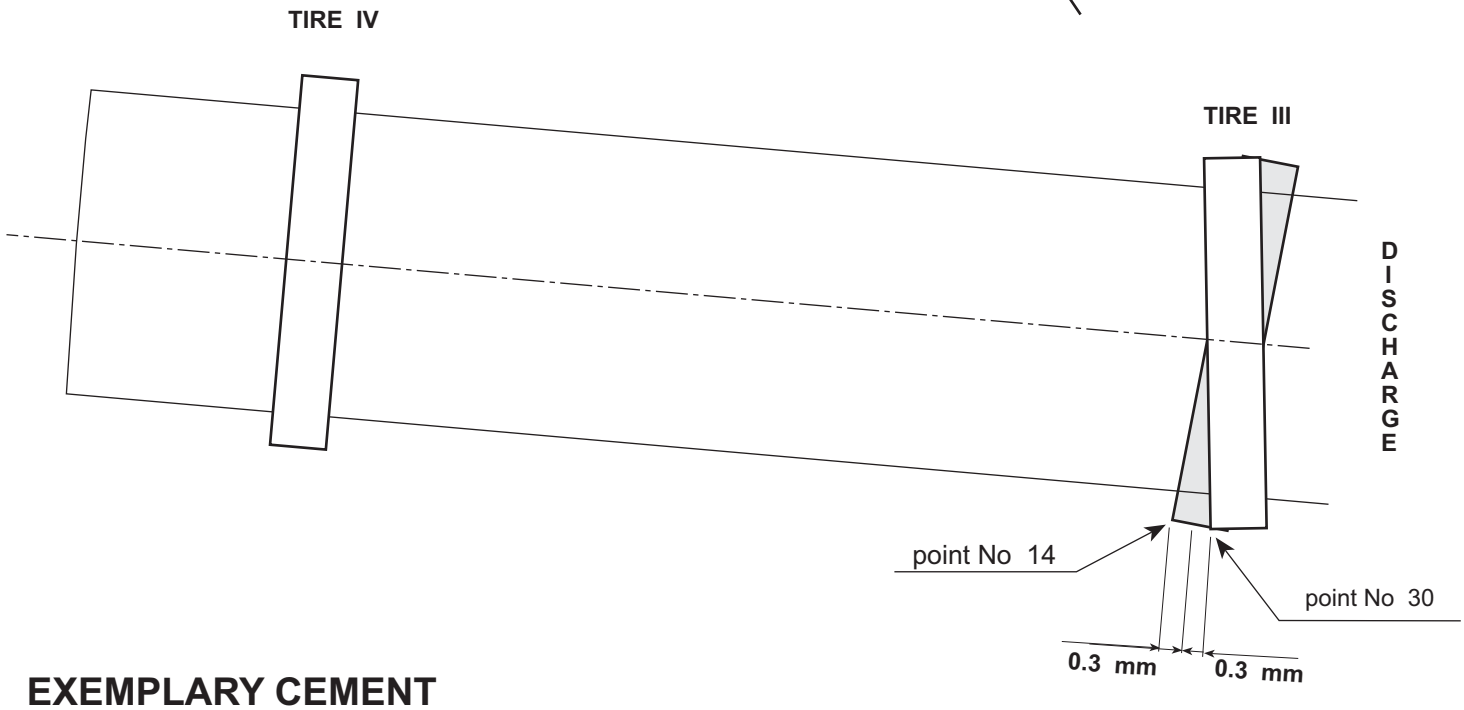
EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

(viewing from feed end)



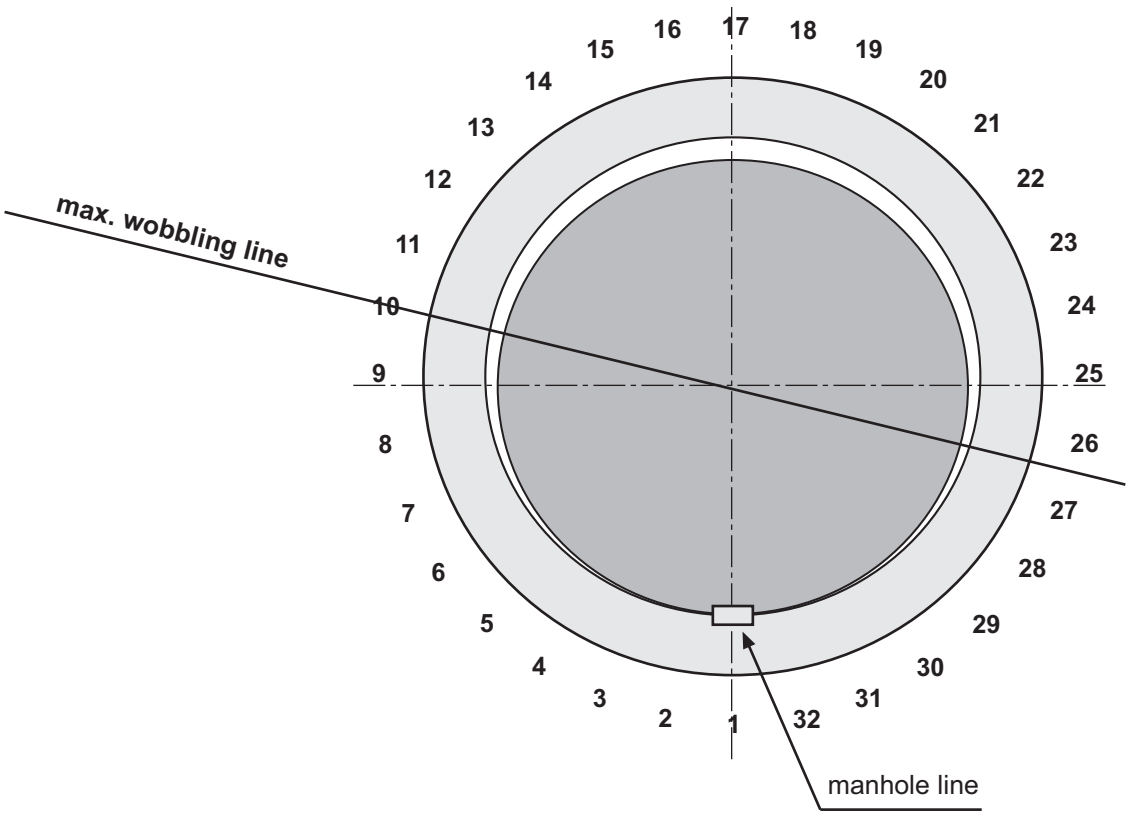


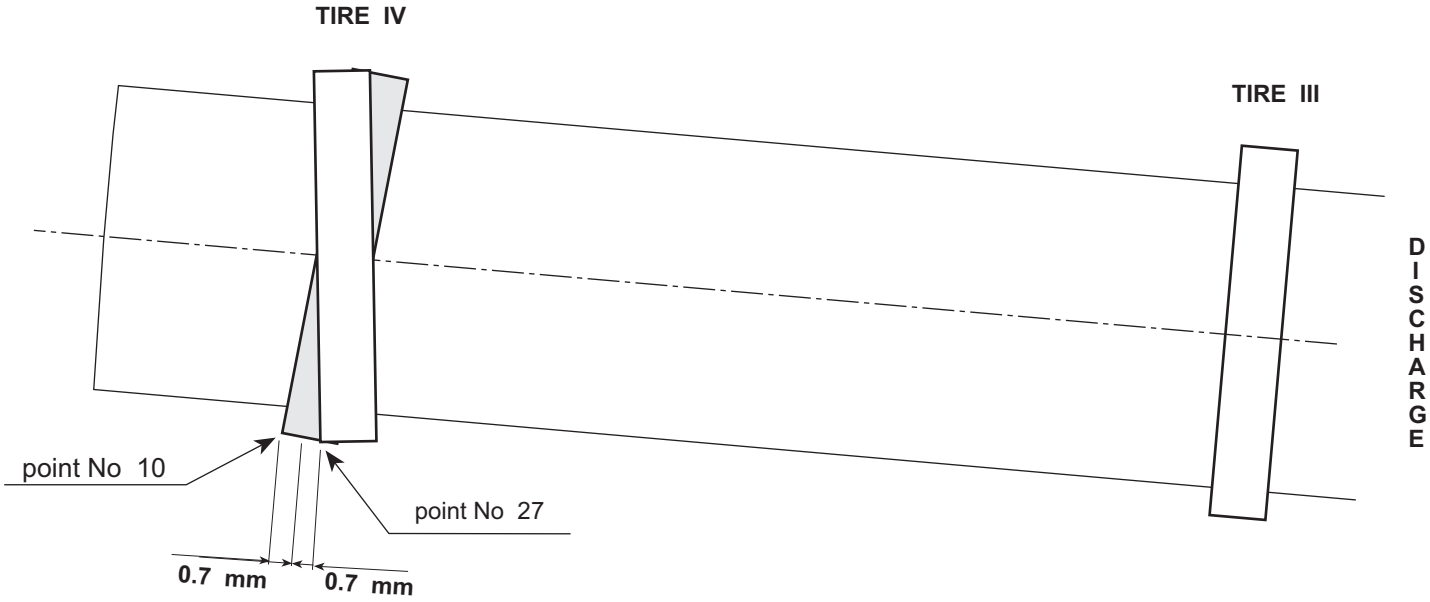
EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

(viewing from feed end)

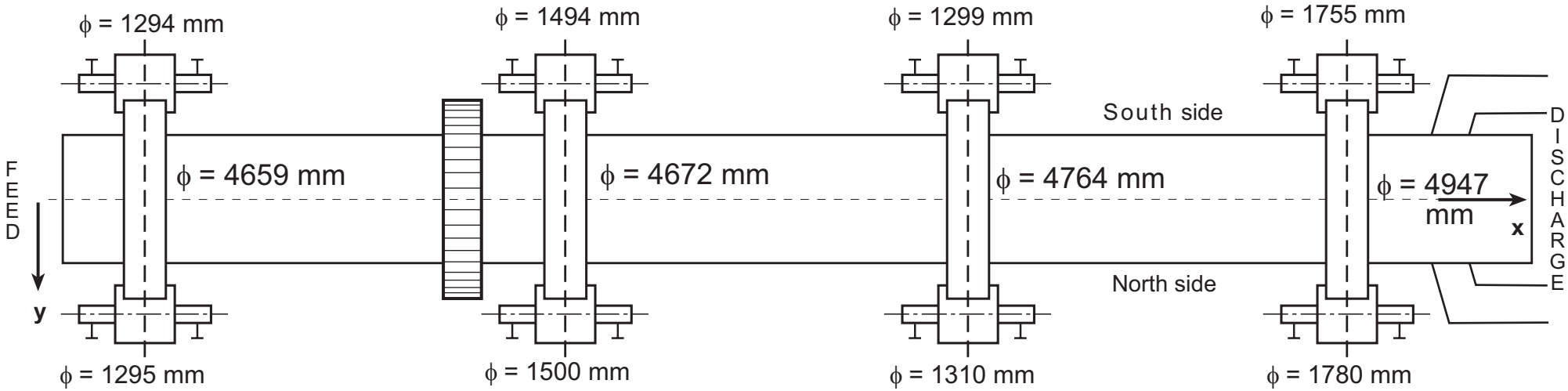




EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.



EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

Precision of finding diameters: +/- 2 mm

Adjustment Schedule

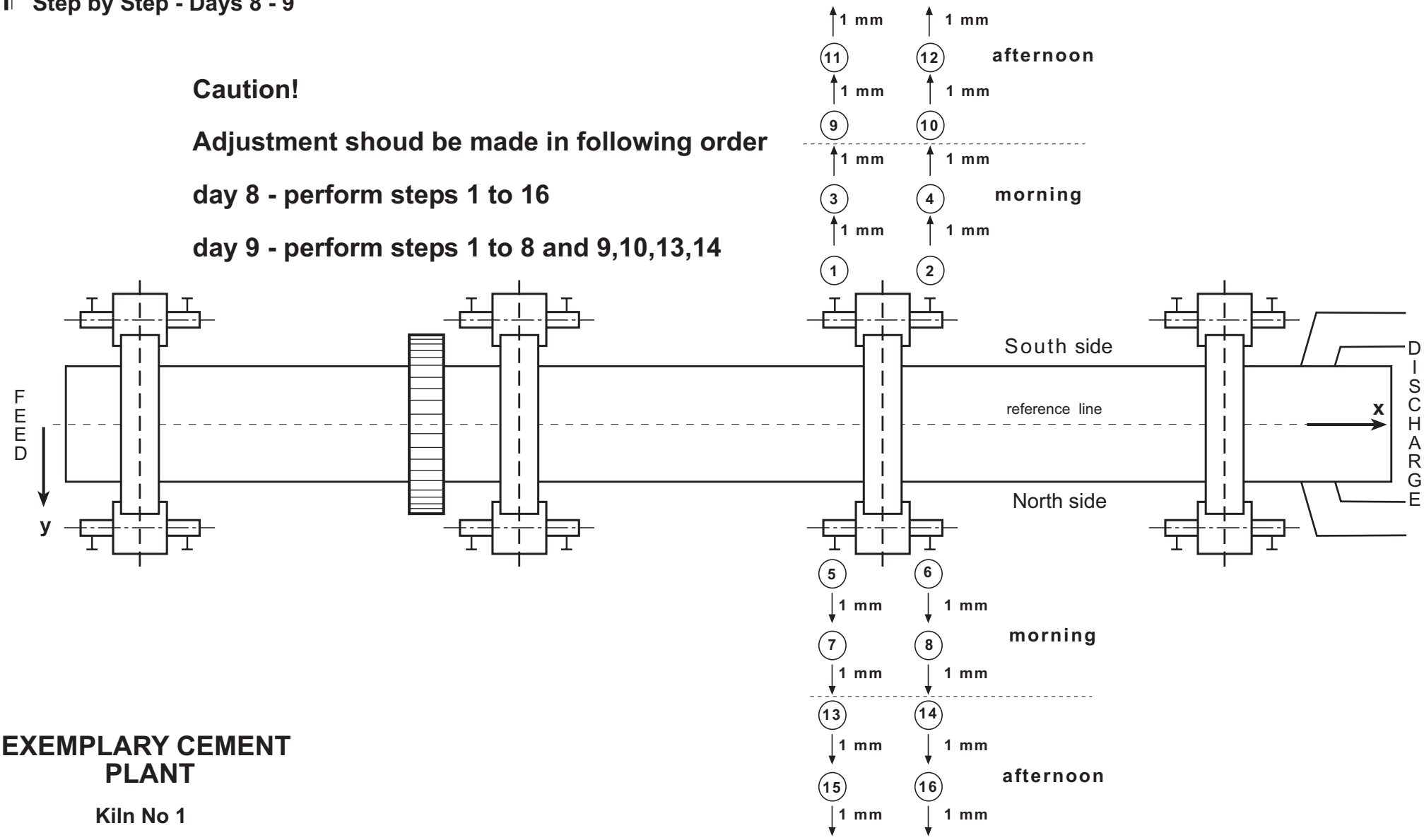
Step by Step - Days 8 - 9

Caution!

Adjustment shoud be made in following order

day 8 - perform steps 1 to 16

day 9 - perform steps 1 to 8 and 9,10,13,14



EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

Adjustment Schedule

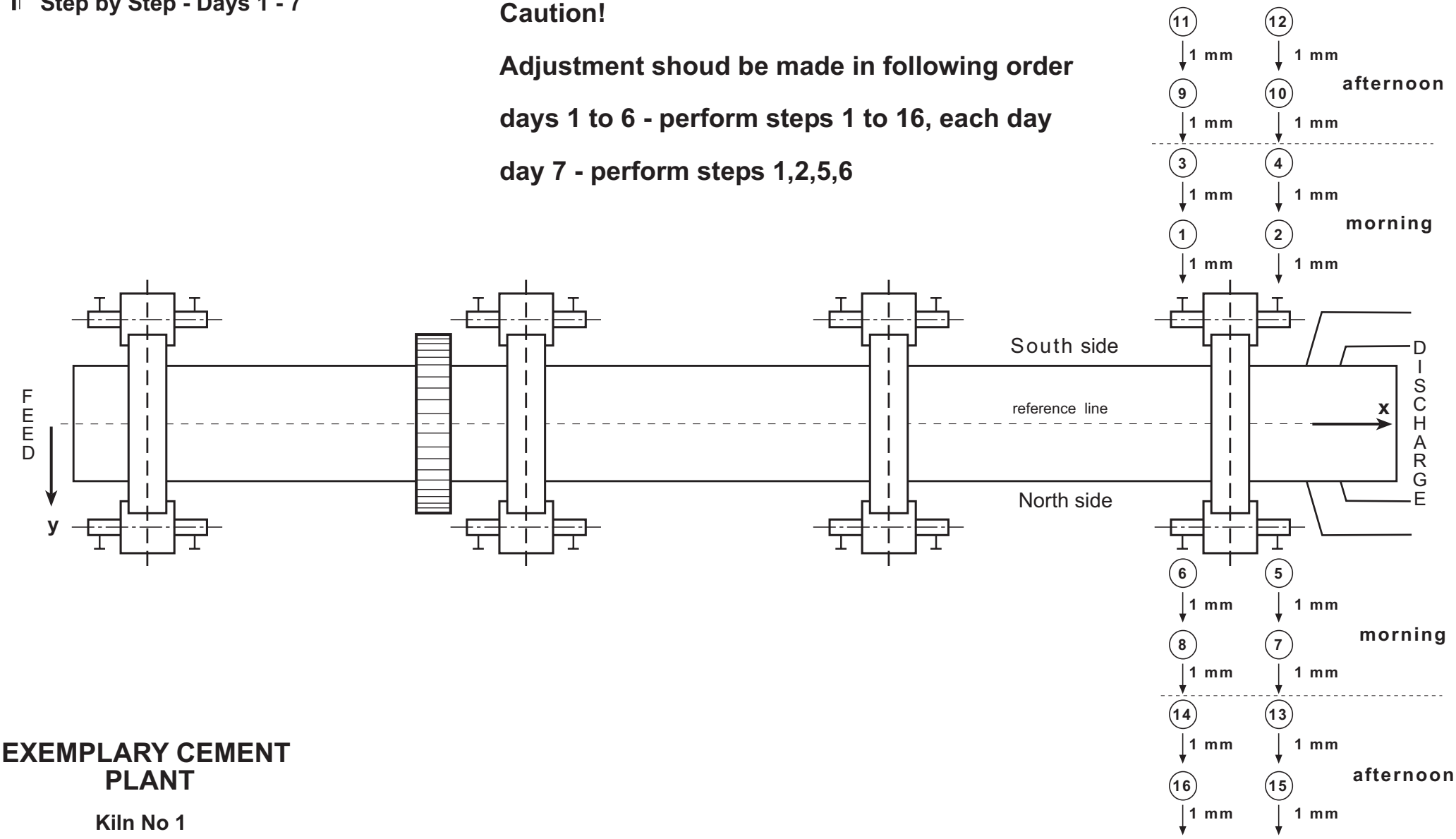
Step by Step - Days 1 - 7

Caution!

Adjustment shoud be made in following order

days 1 to 6 - perform steps 1 to 16, each day

day 7 - perform steps 1,2,5,6



EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

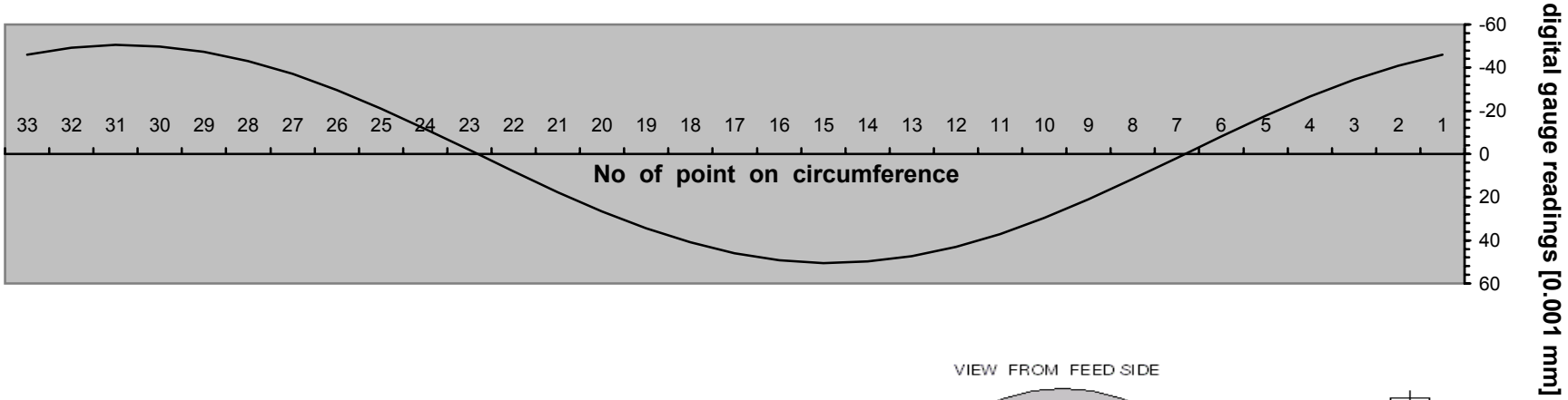
GEOSERVEX - POLAND

EXEMPLARY CEMENT PLANT
KILN No 1

ROLLER SHAFT DEFLECTION

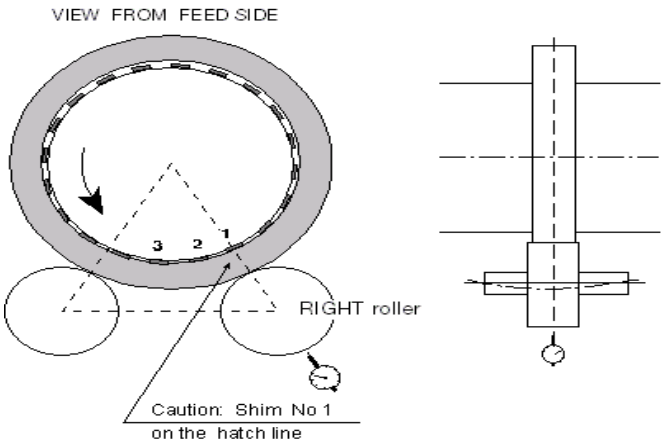
Date of survay: 09.04.2004.

Pier No III - NORTH roller



Eccentricity: 0.05 mm
Total value of deflection: 0.10 mm

Maximum deflection angle: 205 deg



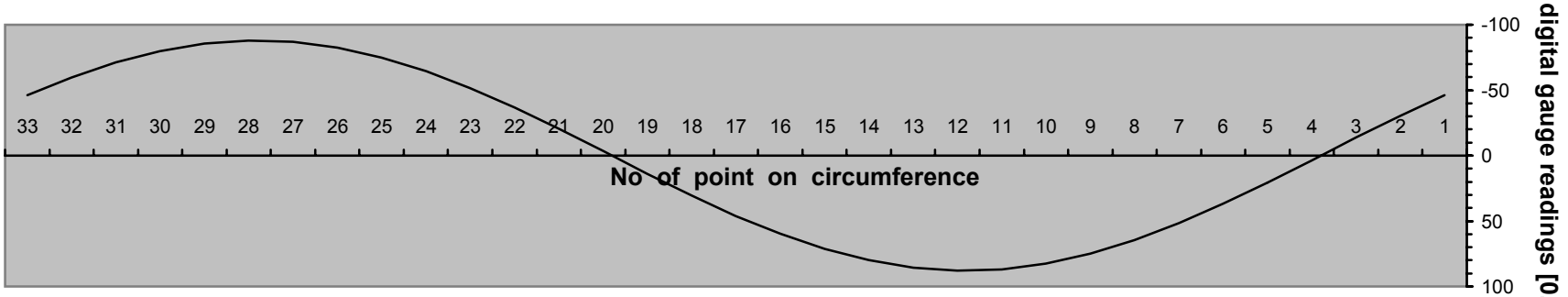
GEOSERVEX - POLAND

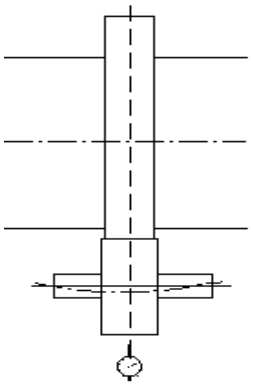
EXEMPLARY CEMENT PLANT
KILN No 1

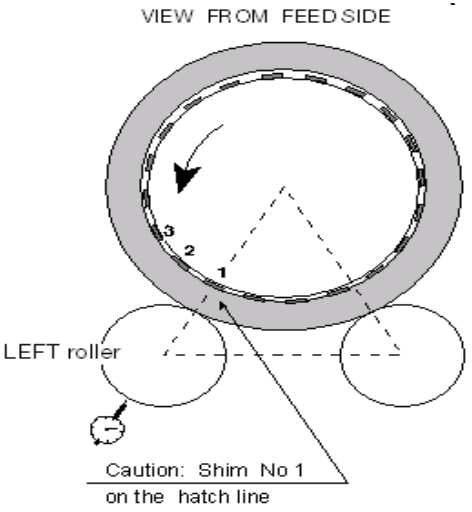
ROLLER SHAFT DEFLECTION

Date of survay: 09.04.2004.

Pier No III - SOUTH roller







Eccentricity: 0.09 mm
Total value of deflection: 0.18 mm

Maximum deflection angle: 238 deg

EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survay: 05.04.2004.

Tire No I

Too big clearance between tire and stopping blocks.

Photo # 1

Lower stopping block

Photo # 2

Upper stopping block

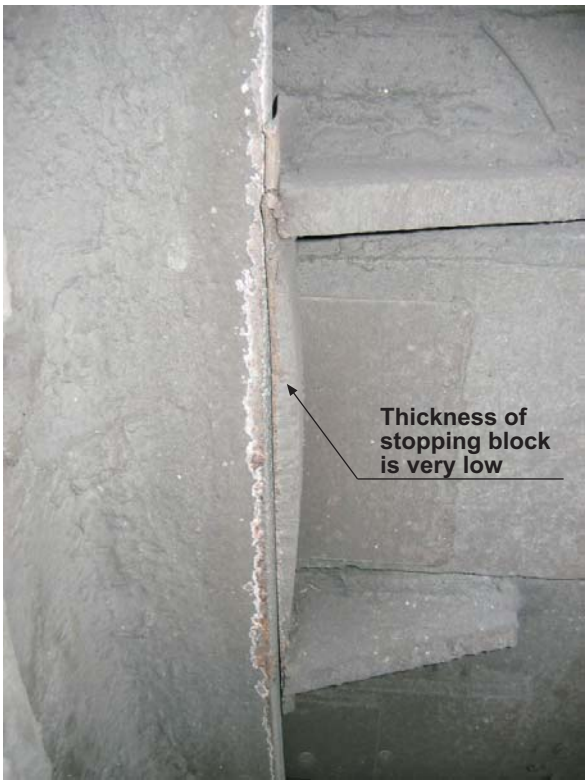


Photo # 3

EXEMPLARY CEMENT PLANT
KILN No #
DATE

Tire No I
Undertire shims are damaged

Small thickness shim should be installed UNDER big shim

Photo # 4

Rollers are lubricated by grease what cause components wear-out

Photo # 5

Drive station

Photo # 6

Weld-joints

Cracks

Drive station

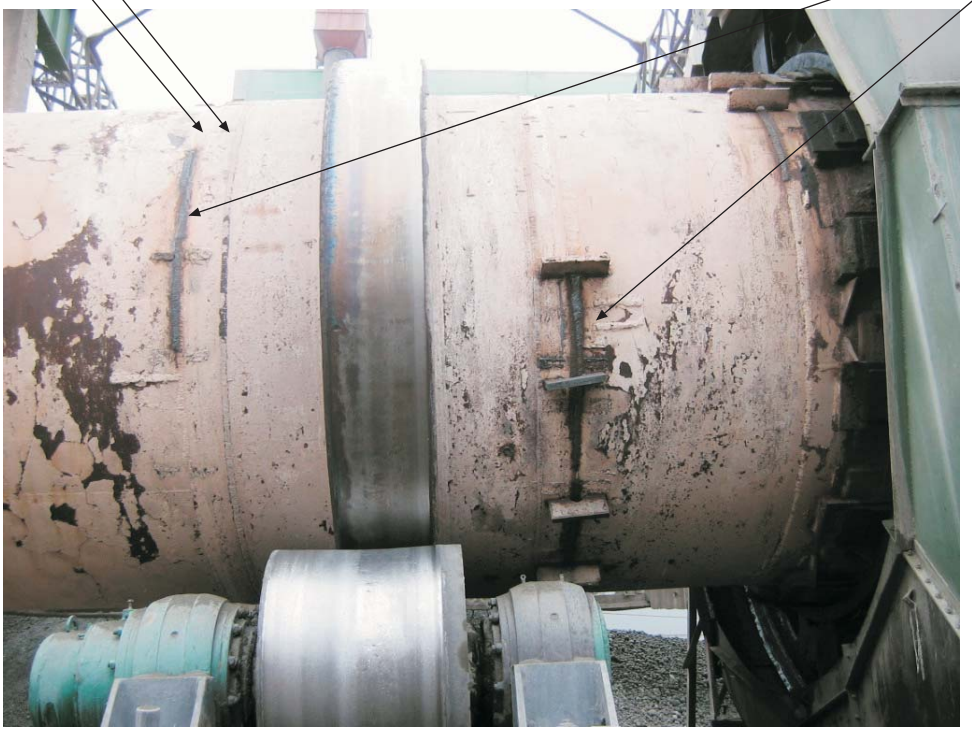


Photo # 7

EXEMPLARY CEMENT PLANT
KILN No #
DATE

Drive station

Photo # 8

Drive pinion's foundation frame is loosed and it move by 5 mm

Photo # 9

Girth Gear Fastening

Girth gear fastening blocks are corroded, plates are loosed, weld joints are ckacked

Photo # 10

Photo # 11

Some fastening bolts have felt down

Photo # 12

Shell section between V and VI tire

Photo # 13

The shell has been overheated

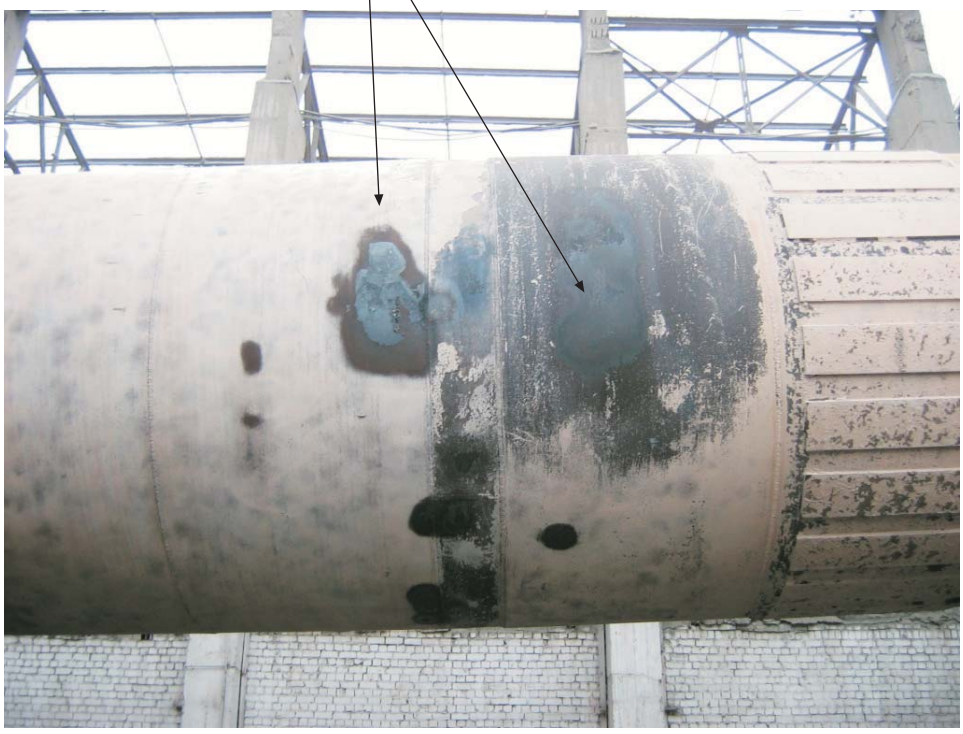


Photo # 14

Sixth pier is permanently covered by clinker dropping from the coolers

Photo # 15

Photo # 16

Clinker stock wall is damaged and kiln piers are surrounded by clinker

Photo # 17

GEOSERVEX

**ENGINEERING MEASUREMENTS
ENTERPRISE LTD
POLAND**

TECHNICAL DOCUMENTATION

SHELL PROFILE MEASUREMENTS

KILN No 1

EXEMPLARY CEMENT PLANT

Date of survey : 06.04.2004.

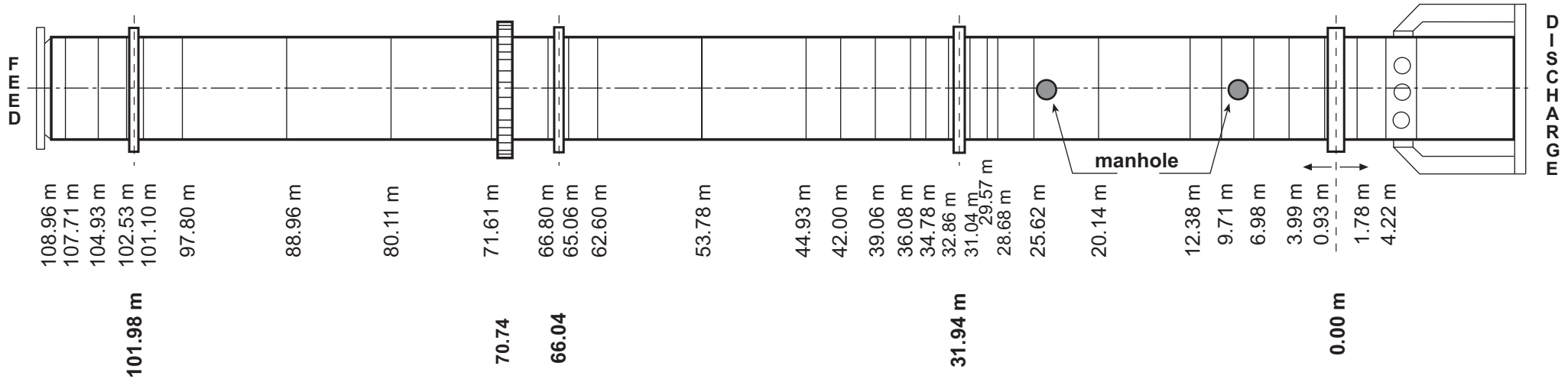
SHELL SECTIONS LENGHTS (HOT CONDITION)

(VIEW FROM THE AIR)

EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survey : 7.04.2004



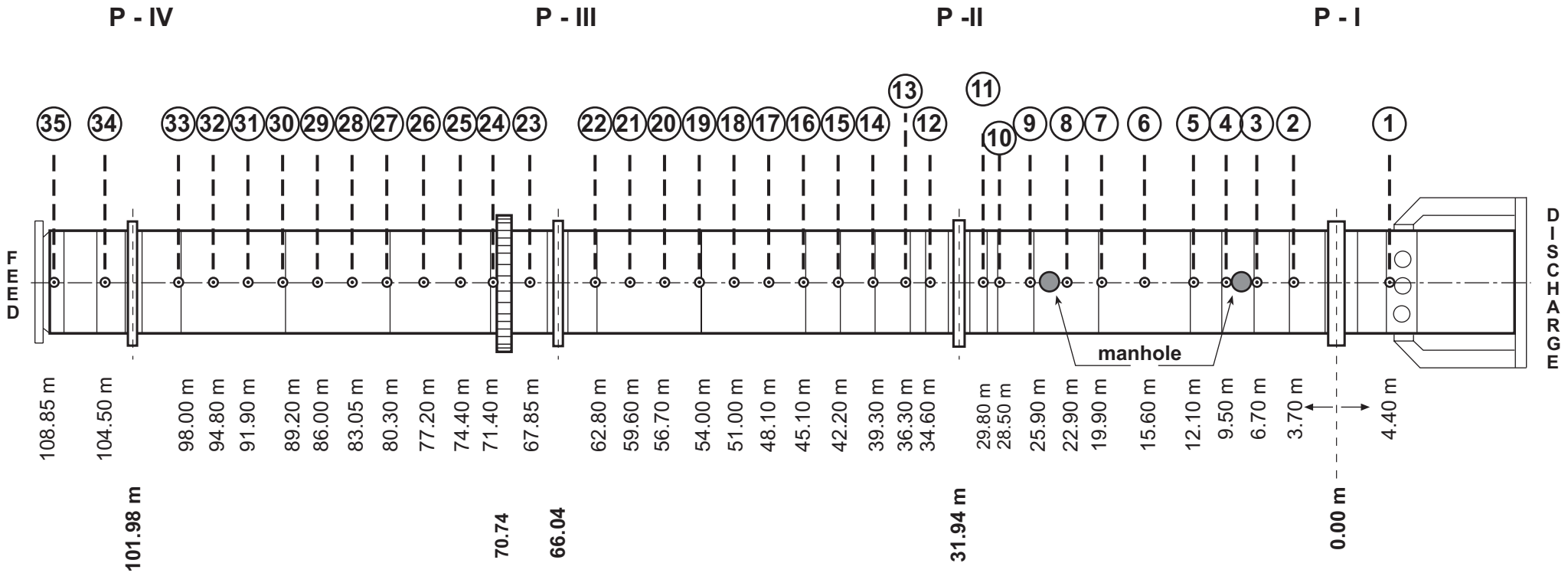
SECTIONS POSITION DRAFT FOR KILN SHELL DEVIATION SURVEY

(VIEW FROM THE AIR)

EXEMPLARY CEMENT PLANT

Kiln No 1

Date of survey : 7.04.2004



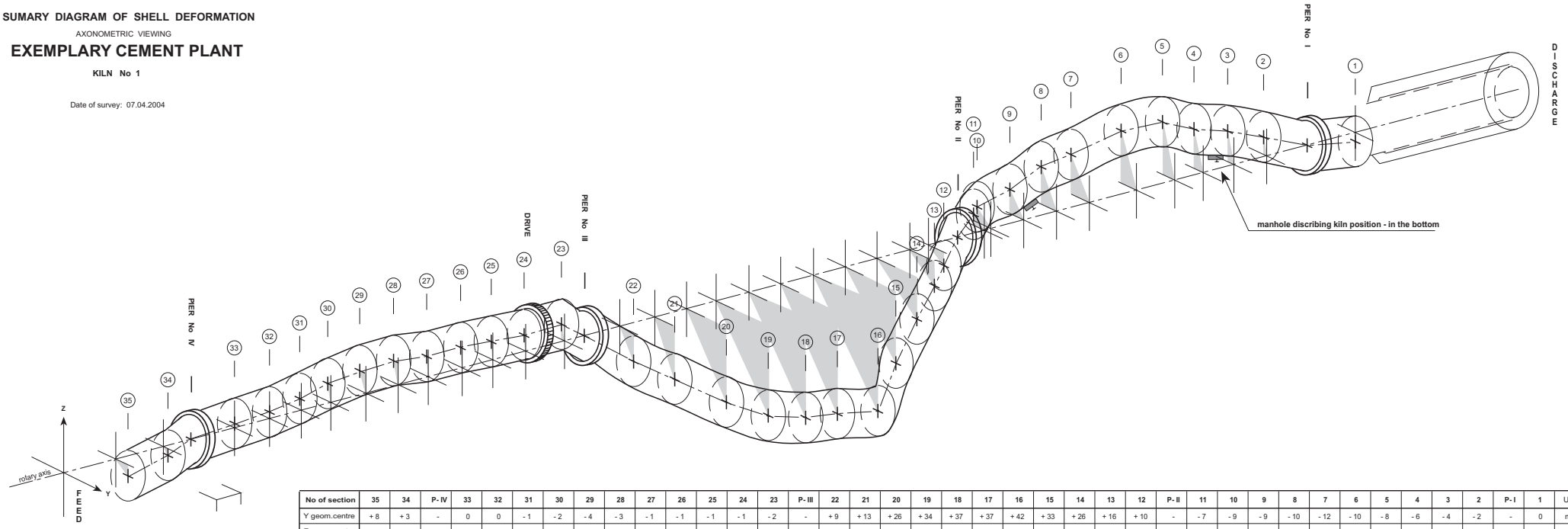
SUMARY DIAGRAM OF SHELL DEFORMATION

AXONOMETRIC VIEWING

EXEMPLARY CEMENT PLANT

KILN No 1

Date of survey: 07.04.2004



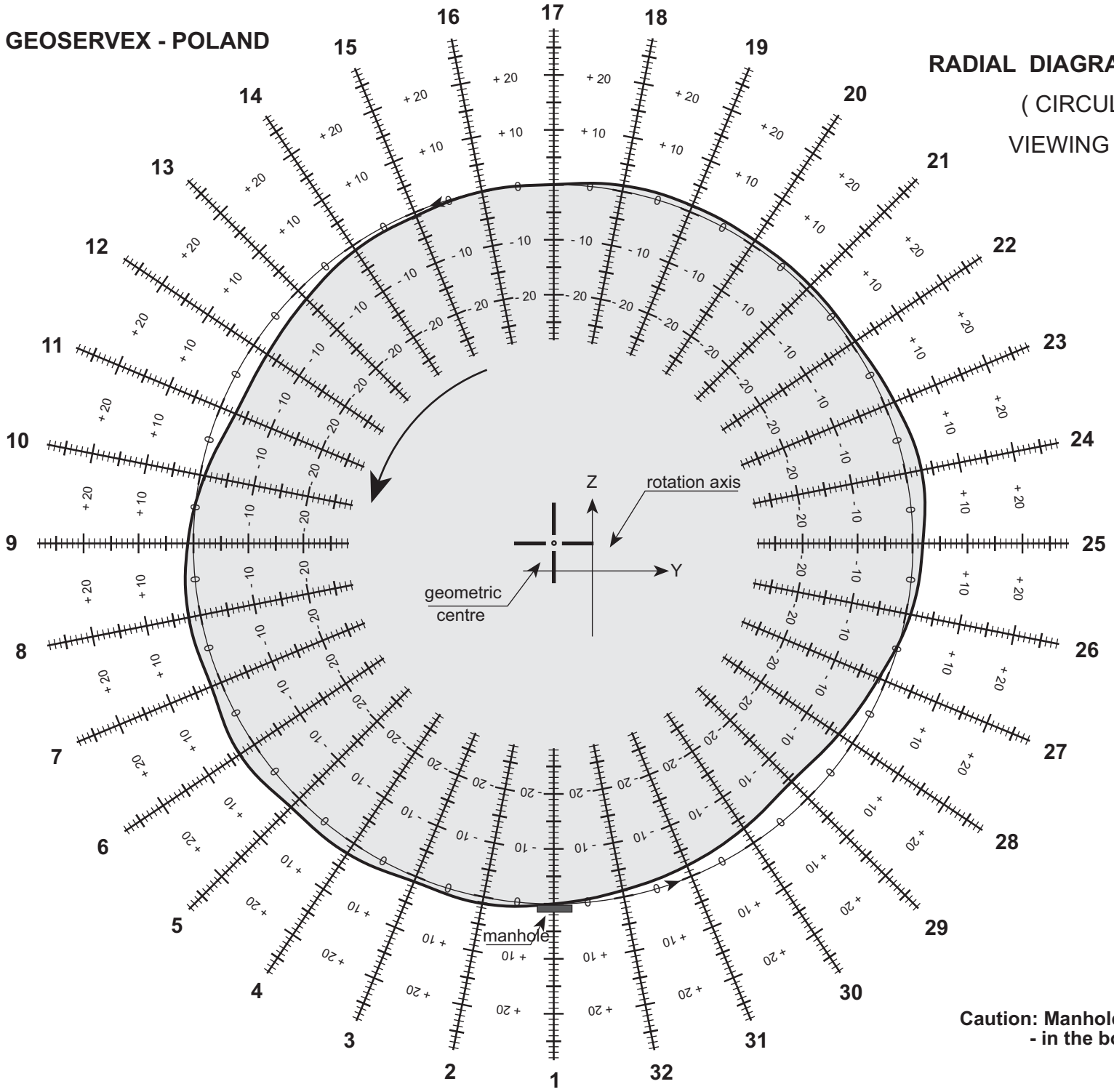
No of section	35	34	P- IV	33	32	31	30	29	28	27	26	25	24	23	P- III	22	21	20	19	18	17	16	15	14	13	12	P- II	11	10	9	8	7	6	5	4	3	2	P- I	1	Unit
Y geom.centre	+ 8	+ 3	-	0	0	- 1	- 2	- 4	- 3	- 1	- 1	- 1	- 1	- 2	-	+ 9	+ 13	+ 26	+ 34	+ 37	+ 37	+ 42	+ 33	+ 26	+ 16	+ 10	-	- 7	- 9	- 9	- 10	- 12	- 10	- 8	- 6	- 4	- 2	-	0	mm
Z geom.centre	- 5	- 3	-	+ 2	+ 3	+ 5	+ 8	+ 9	+ 10	+ 9	+ 9	+ 8	+ 7	+ 7	-	- 13	- 24	- 34	- 41	- 45	- 47	- 48	- 33	- 19	- 11	- 6	-	+ 5	+ 7	+ 11	+ 17	+ 18	+ 24	+ 24	+ 18	+ 14	+ 8	-	- 4	mm
Excentr	**9**	**4**	-	**2**	**3**	**5**	**8**	**10**	**10**	**9**	**9**	**8**	**7**	**7**	-	**16**	**27**	**43**	**53**	**58**	**60**	**64**	**47**	**32**	**19**	**12**	-	**9**	**11**	**14**	**20**	**22**	**26**	**25**	**19**	**15**	**8**	-	**4**	mm

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

VIEWING FROM FEED END



EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 11

DEFORMATION SCALE 1 : 1

GEOMETRIC CENTRE COORDINATES

Y	- 7 mm
Z	5 mm
ECCENTR	9 mm

Date of survey: 07. 04. 2004

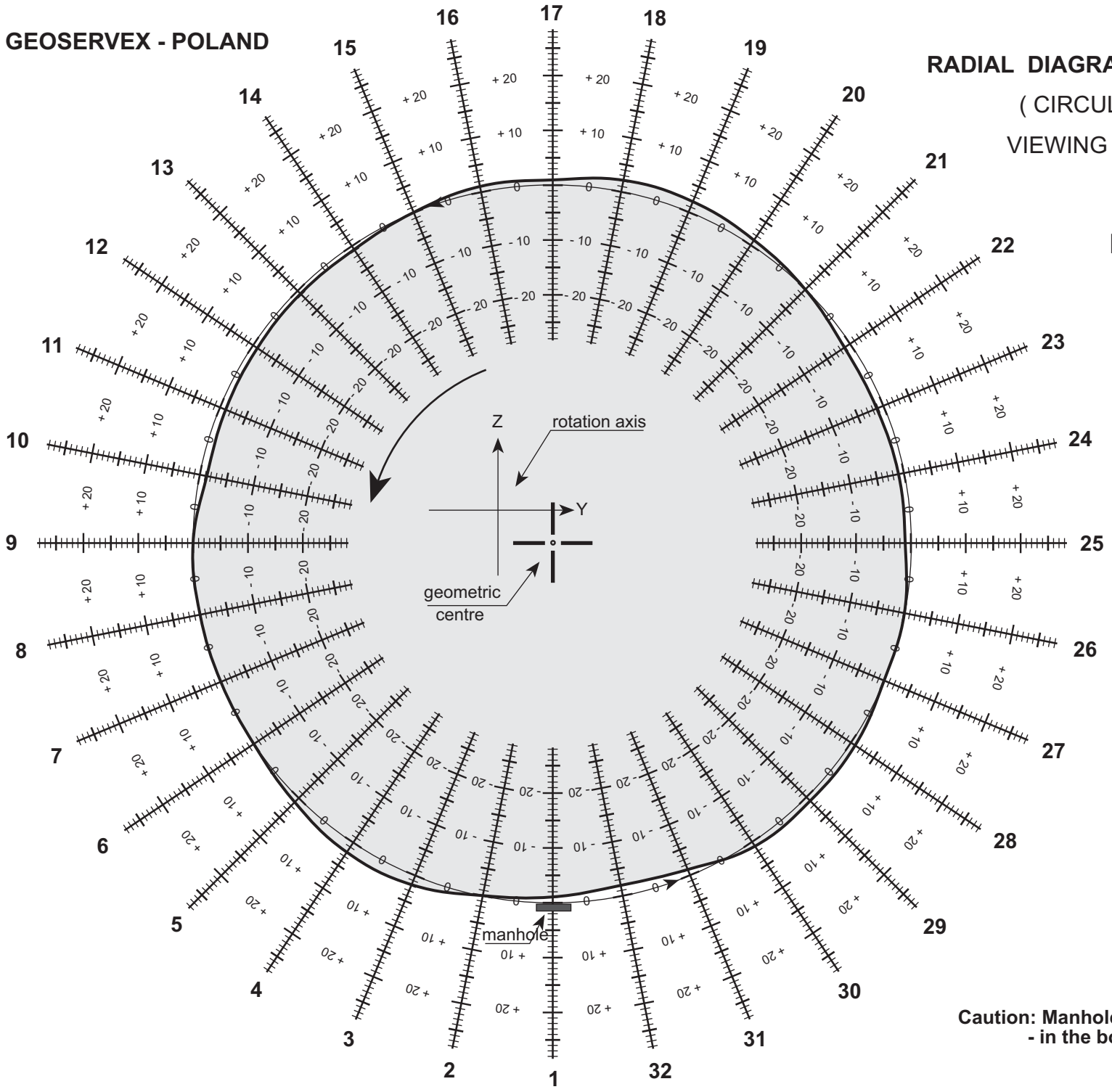
Caution: Manhole discribing kiln position - in the bottom (point No 1)

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

VIEWING FROM FEED END



EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 12

DEFORMATION SCALE 1 : 1

GEOMETRIC CENTRE COORDINATES

Y	10 mm
Z	- 6 mm
ECCENTR	12 mm

Date of survey: 07. 04. 2004

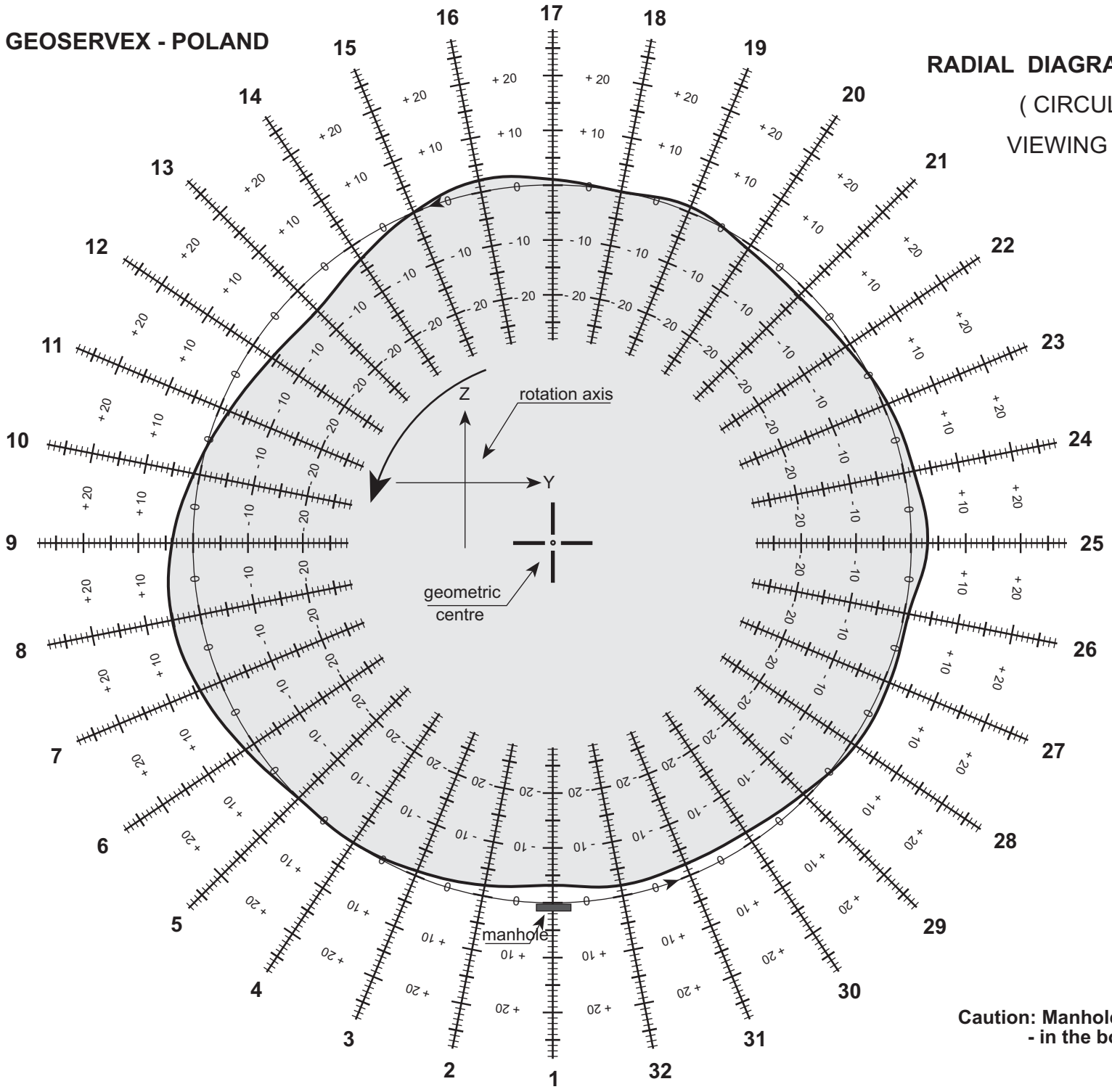
Caution: Manhole discribing kiln position - in the bottom (point No 1)

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

VIEWING FROM FEED END



EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 13

DEFORMATION SCALE 1 : 1

GEOMETRIC CENTRE COORDINATES

Y	16 mm
Z	- 11 mm
ECCENTR	19 mm

Date of survey: 07. 04. 2004

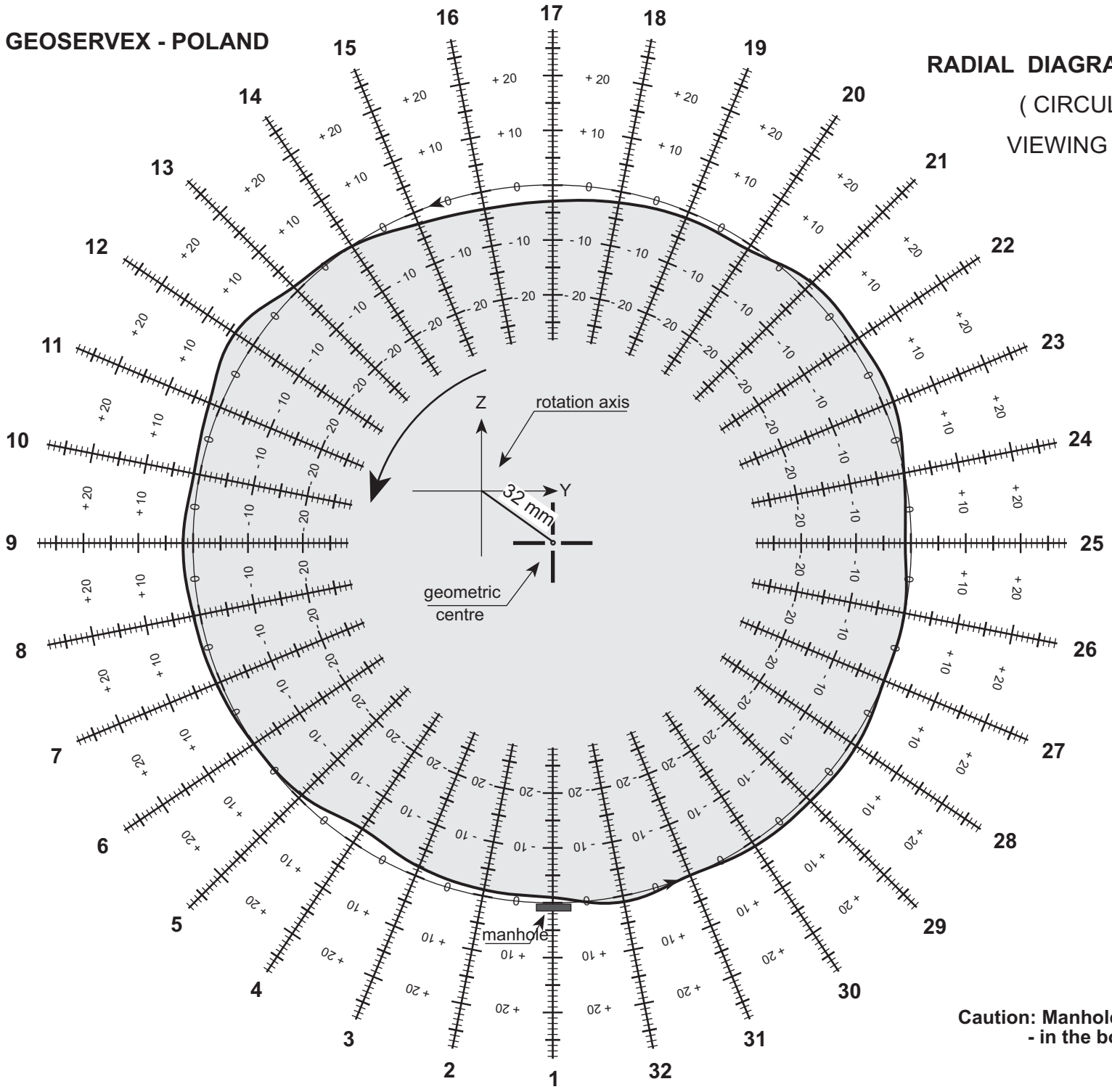
Caution: Manhole discribing kiln position - in the bottom (point No 1)

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

VIEWING FROM FEED END



EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 14

DEFORMATION SCALE 1 : 1

GEOMETRIC CENTRE COORDINATES

Y	26 mm
Z	- 19 mm
ECCENTR	32 mm

Date of survey: 07. 04. 2004

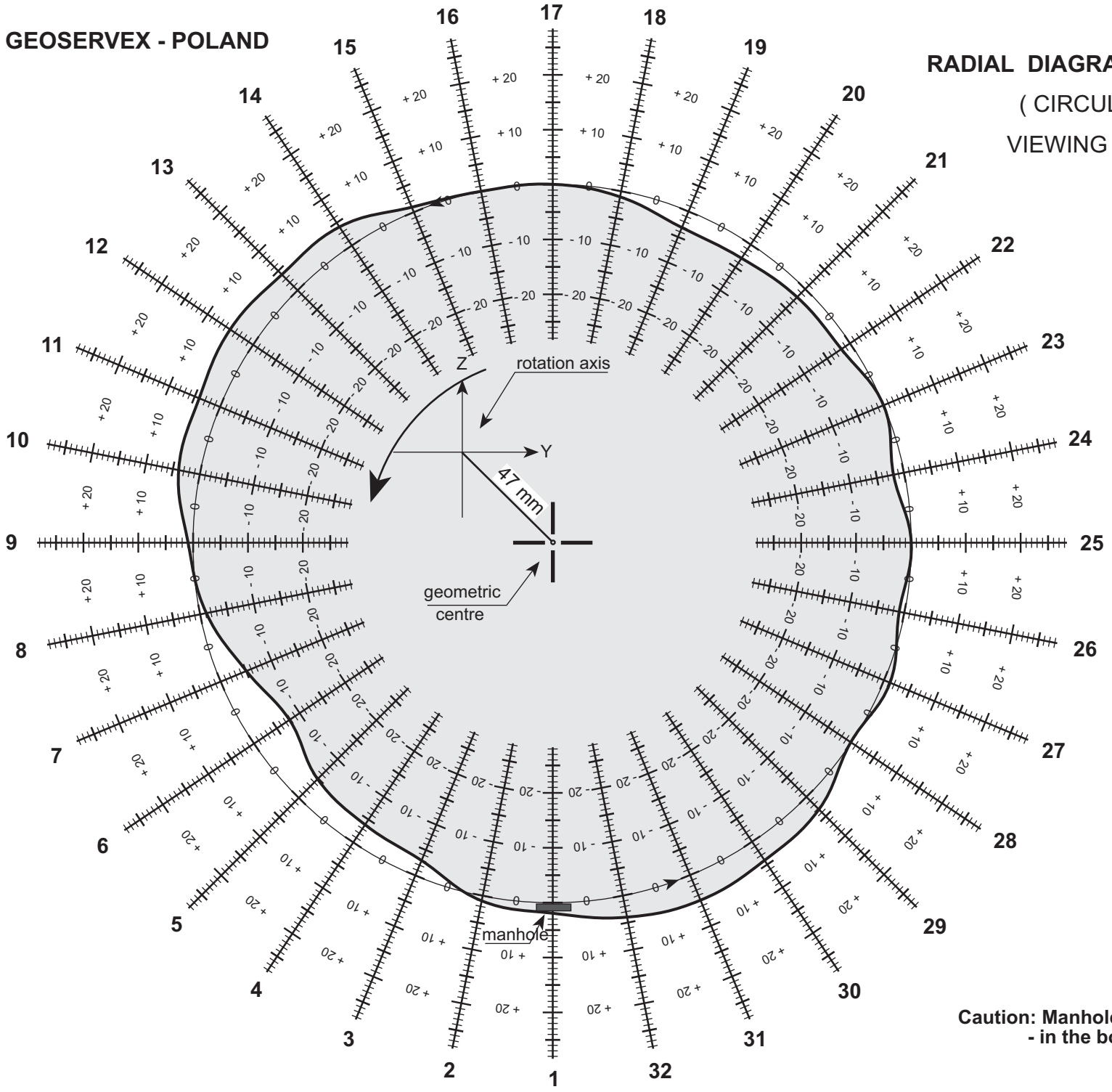
Caution: Manhole discribing kiln position - in the bottom (point No 1)

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

VIEWING FROM FEED END



EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 15

DEFORMATION SCALE 1 : 1

GEOMETRIC CENTRE COORDINATES

Y	33 mm
Z	- 33 mm
ECCENTR	47 mm

Date of survey: 07. 04. 2004

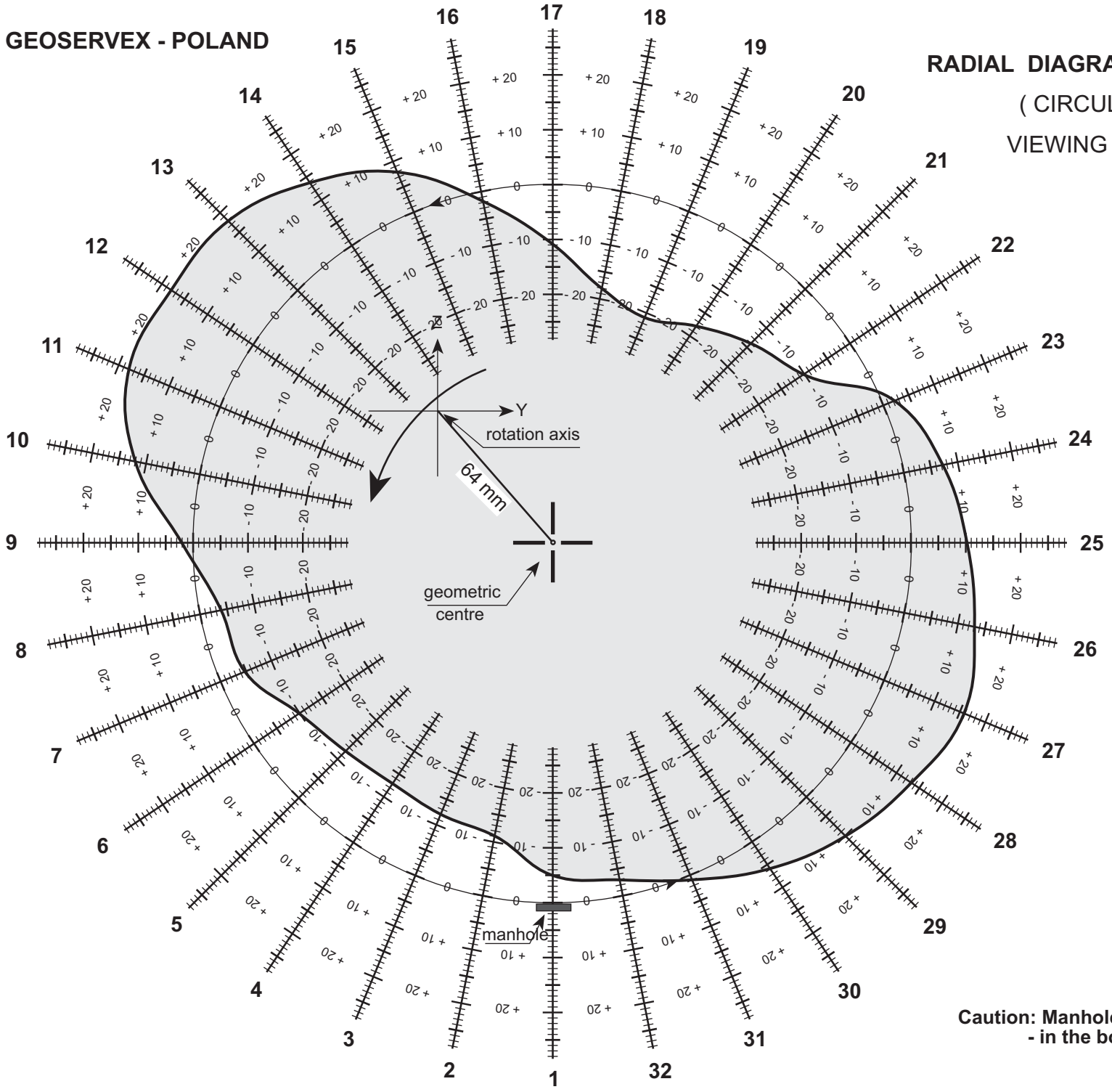
Caution: Manhole discribing kiln position - in the bottom (point No 1)

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

VIEWING FROM FEED END



EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 16

DEFORMATION SCALE 1 : 1

GEOMETRIC CENTRE COORDINATES

Y	42 mm
Z	- 48 mm
ECCENTR	64 mm

Date of survey: 07. 04. 2004

Caution: Manhole discribing kiln position - in the bottom (point No 1)

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

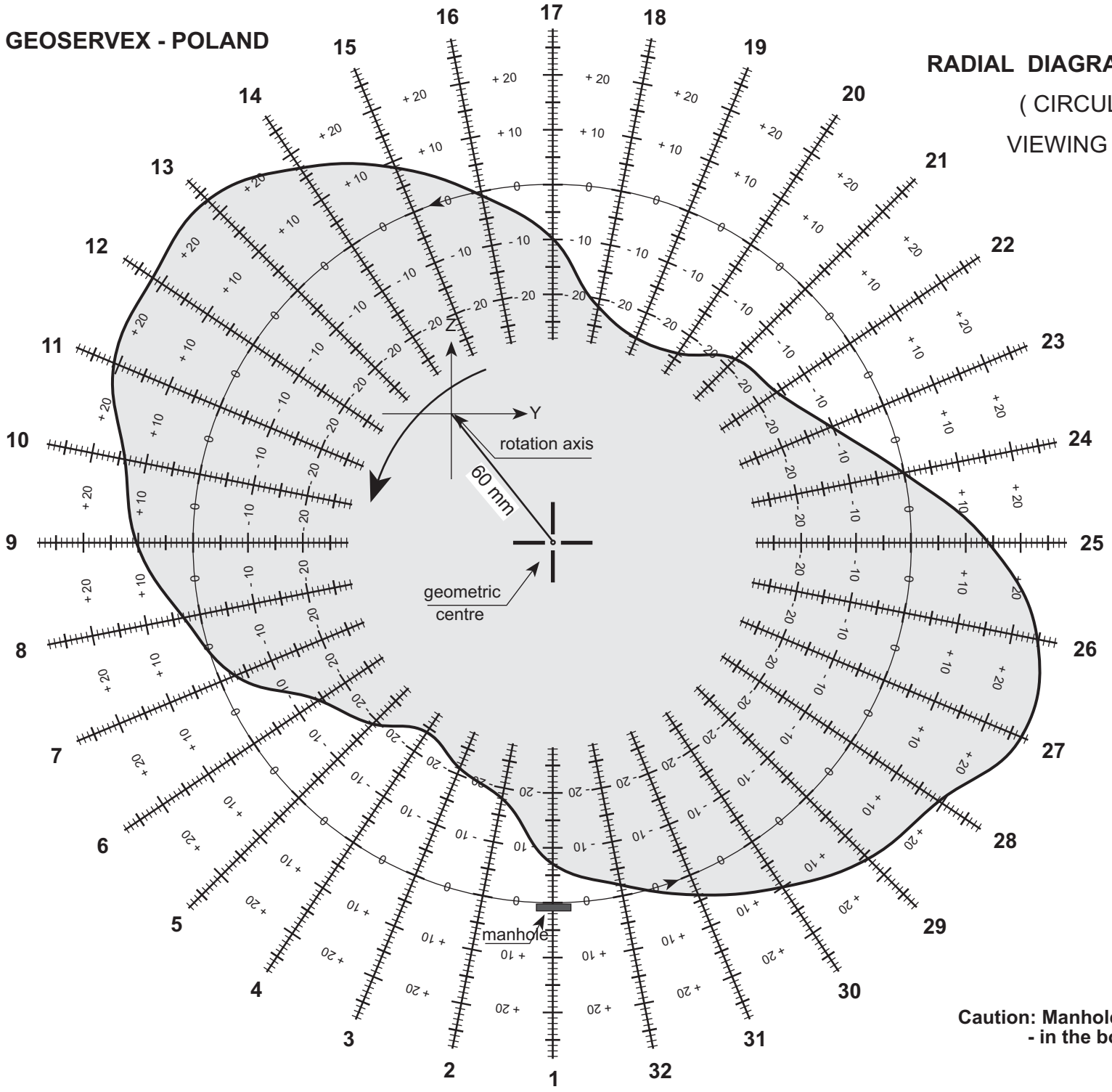
VIEWING FROM FEED END

EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 17

DEFORMATION SCALE 1 : 1



GEOMETRIC CENTRE COORDINATES

Y	37 mm
Z	- 47 mm
ECCENTR	60 mm

Date of survey: 07. 04. 2004

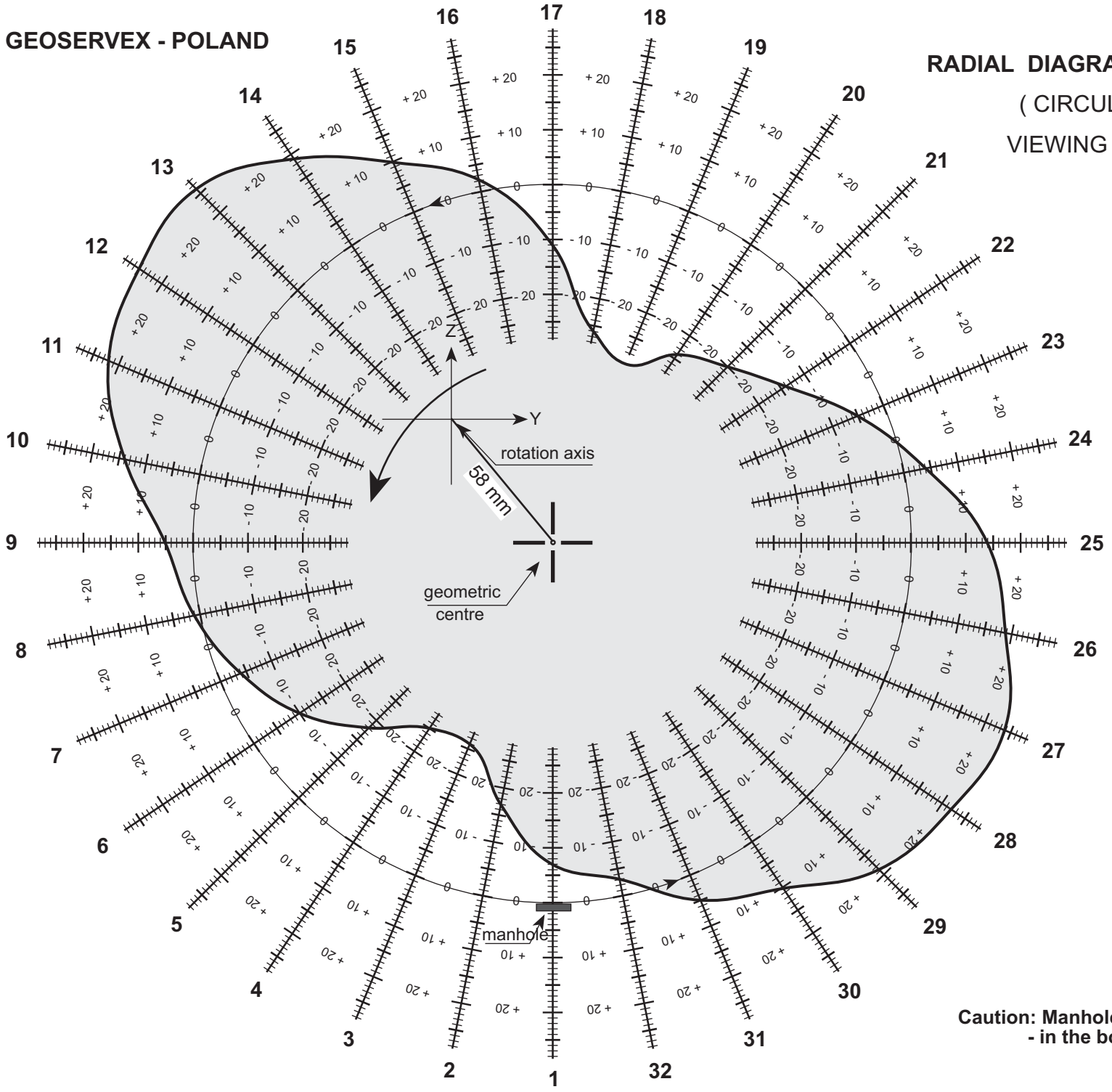
Caution: Manhole discribing kiln position - in the bottom (point No 1)

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

VIEWING FROM FEED END



EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 18

DEFORMATION SCALE 1 : 1

GEOMETRIC CENTRE COORDINATES

Y	37 mm
Z	- 45 mm
ECCENTR	58 mm

Date of survey: 07. 04. 2004

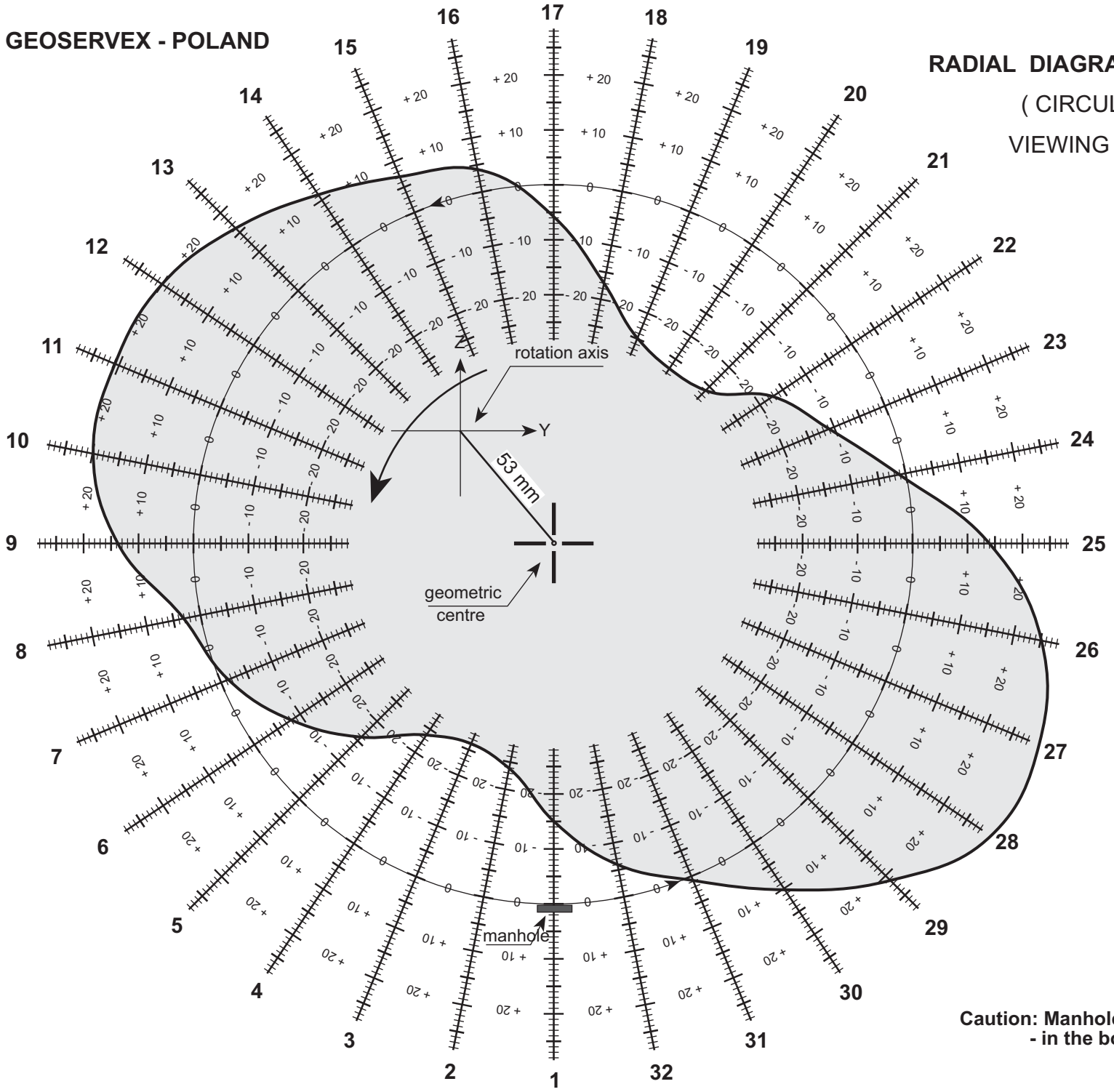
Caution: Manhole discribing kiln position - in the bottom (point No 1)

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

VIEWING FROM FEED END



EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 19

DEFORMATION SCALE 1 : 1

GEOMETRIC CENTRE COORDINATES

Y	34 mm
Z	- 41 mm
ECCENTR	53 mm

Date of survey: 07. 04. 2004

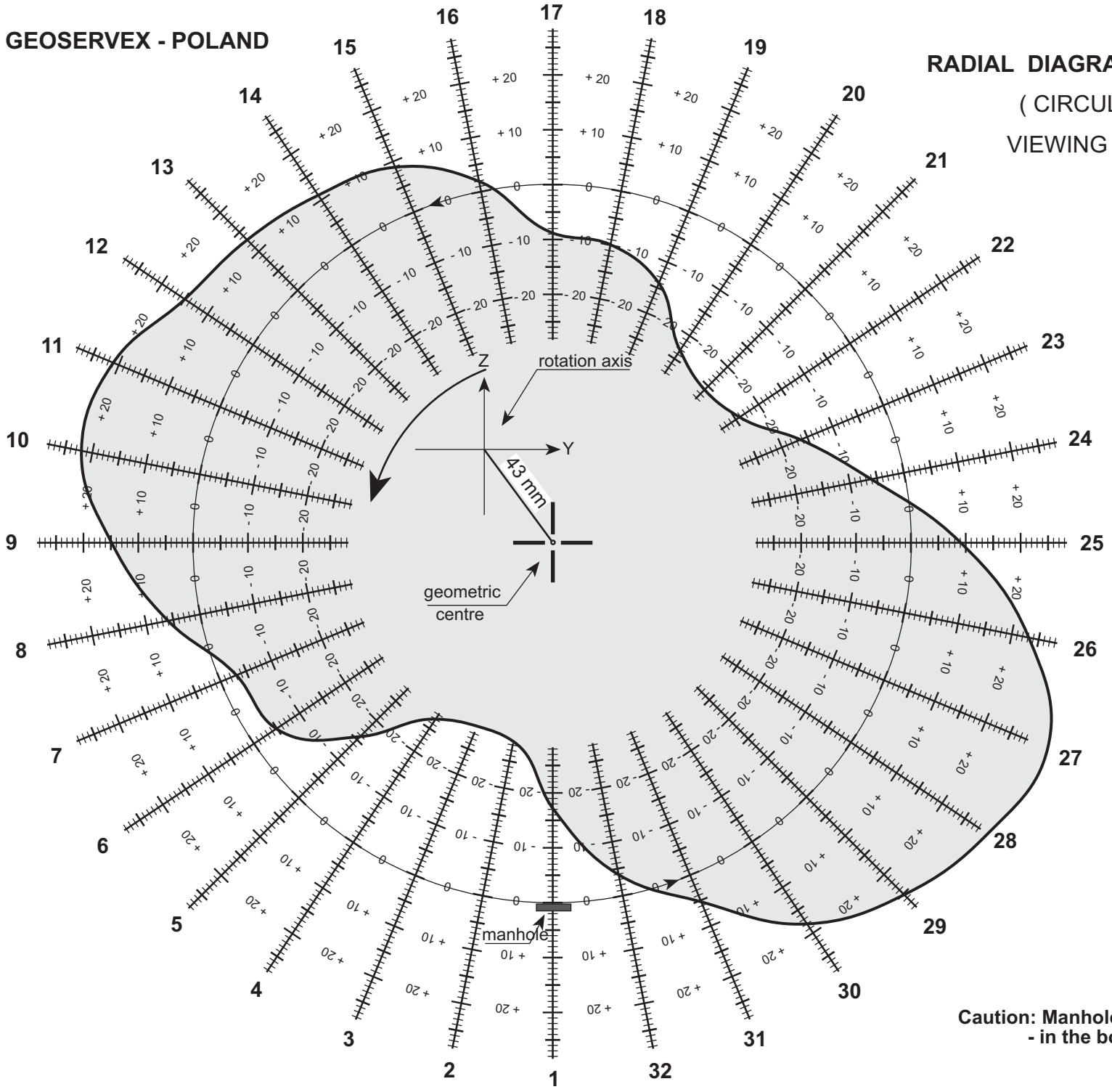
Caution: Manhole discribing kiln position - in the bottom (point No 1)

GEOSERVEX - POLAND

RADIAL DIAGRAM OF SHELL DEFORMATION

(CIRCULAR DEVIATIONS)

VIEWING FROM FEED END



EXEMPLARY CEMENT PLANT

KILN No 1

SECTION No 20

DEFORMATION SCALE 1 : 1

GEOMETRIC CENTRE COORDINATES

Y	26 mm
Z	- 34 mm
ECCENTR	43 mm

Date of survey: 07. 04. 2004

Caution: Manhole discribing kiln position - in the bottom (point No 1)

LIST OF COMPANIES AND PERSONS IN CHARGE
for contracting of HOT KILN ALIGNMENT Services in ***2001*** and ***2002***
who may provide verbal or written opinions about our quality of services

1. HKA Corporation, New York, **United States of America**
   (*responsible for whole contracts and services in **North America***)
   Mr Marc Pytel – President
   Phone: 001-718-349-7316; 001-917-562-8304

2. D-YOUNG TRADING Co,; Seoul, **Korea**
   Mr Michael Ahn – Technical Director
   Phone: 0082-2-553-001; 0082-2-553-0701

3. Gorazdze Cement Plant – HAIDERBERGER-**Poland**
   Mr Ulrych Lubojanski – Technical Director
   Phone: 0048-77-446-8418

4. The Cyprus Cement Company; Limassol; **Cyprus**
   Mr Costas G.Lazarou – Chief Mechanical Director
   Phone: 00357-25-634111

5. Cementarna Trbovlje; **Slovenia**
   Mr Rudolf Potrpin – Technical Director
   Phone: 00386-3-5652300; 00386-3-5652400

6. HOLCIM HUNGARIA – Miskolc, **Hungary**
   Ms. Marianna Szabo Bencone
   Phone: 0036-46-561647

7. National Council for Cement and Building Materials; **India**
   Dr K.Mohan; Additional Technical Director
   Phone: 0091-129-5242051 / 56

8. Denizli Çimento Sanayii T.A.Ş. Denizli, **Turkey**
   Mr Yousuf Ziya Bekiroğlu – Deputy General Manager (Techn.)
   Ms Benay Civil – Foreign Trade Chief
   Phone: 0090-258-7621260

Warsaw, May 23rd,2002

Polysius Polska

Polysius Polska Sp. z o. o., 85-027 Bydgoszcz, ul. Jagiellonska 103

To whom it may concern

Your ref.	Our ref. / Name	Date	Phone / E-Mail	Telefax
	Matthias Grosse	14 April 2003	+48(52) 56 43 863 kujsite@polysius.pl	+48(52) 56 43 867

4500 t/Day - KUJ DRY LINE - KUJAFA

Letter of Recommendation

We herewith confirm that the company "GEOSERVEX" Bydgoszcz has provided between 2001-2003 geodesy supports for the construction and assembly for our company Polysius Polska of the new 4500 t/Day - KUJ DRY LINE - LAFARGE Cement Polska in Piechcin.

This investment covered:
- Rotary kiln two-support POLYSIUS Ø5000/60m;
- Clinker cooler with filter;
- Raw Mill and Coal Mills with filters;
- Raw Meal Silo;
- Mixing Bed for raw material

Geodesy works were carried out efficiently, precisely and timely by means of modern precision TOPCON and LEICA measurement equipment. Sketches and maps were drawn up on computers in a AUTO-CAD system.
The geodesy team had good English language capabilities (verbally and in writing), and measurement documentation was drawn up on a current basis in English.
The company "GEOSERVEX" is specialized in precise measurements of rotary kilns and other industrial machines and buildings.
We confirm the operating professionalism of the company "GEOSERVEX" with respect to engineering geodesy in constructing and assembling facilities of the new LAFARGE cement plant.

Yours faithfully,

Polysius Polska Sp. z o. o.

Matthias Grosse

General Site Manager

Polysius Polska Sp. z o.o.
ul. Jagiellońska 103, 85-027 Bydgoszcz, Polska

M. Grosse

Polysius Polska Sp. z o. o.
ul. Jagiellonska 103, 85-027 Bydgoszcz, Poland
Telephone: +48 (52) 340 1174, 340 1260, 340 1238
Telefax: +48 (52) 360 2090
E-Mail: Kujsite@polysius.pl
BRE Bank S.A., Bydgoszcz, Account-No.
114 010 52-00-359 213-PLNCURR01-52
114 010 52-00-359 213-EURCURR01-41

Management: Dr. Friedrich-Wilhelm Dierkes,
Berthold Findling, Peter Kremerskothen
BRH 5082
Regon: 092909210
NIP: 554 - 24 - 09 - 863

National Council for Cement and Building Materials

34 KM Stone, Delhi - Mathura Road (NH-2), Ballabgarh-121 004 (Haryana) INDIA.
Tel. : (0129) 5242051 - 56, 5246174, Fax : (0129) 5242100, 5246175
Website : www.cementresearch.com; E-mail : nccbm@giasdl01.vsnl.net.in

TO WHOMSOEVER IT MAY CONCERN

This is to certify that "M/s. Geoservex, Poland have successfully executed the following two contracts for NCB :-

1. Supply of equipment and accessories including software for Hot Kiln Alignment (HKA) and training of NCB officials in Poland and India.
2. Training, alignment and correction of three kilns in India using HKA technology.

In the above two contracts, M/s. Geoservex have supplied good quality of Hardware, Software to NCB and trained three NCB officials on Hot Kiln Alignment (HKA). NCB officials received the training on theoretical and practical aspects of HKA in Poland. During training in India, M/s. Geoservex performed the alignment of three kilns including correction alongwith NCB officials to the entire satisfaction of cement plants. After acquiring training and mastering the technology, NCB officials have independently carried out the alignment of three kilns in India successfully. M/s Geoservex technology of HKA has been found accurate and reliable. During the execution of the above two contracts, cooperation of M/s. Geoservex was worth noting and appreciated by all".

Dr K. Mohan

K. Mohan

Date: 28 March 2002

Additional Director

NCB - Delhi
A-135, Defence Colony, New Delhi-110024
Tel. : (011) 4631151, 4641170 4645073
Fax : (011) 4631153

NCB - Hyderabad
NCB Bhawan, Old Bombay Road, Hyderabad-500 008
Tel. : (040) 3000344, 3000861, 3001933 & 3001942
Fax : (040) 3000343, E-mail : ncbhyd@hd2.vsnl.net.in

Urand Corp. *25-20 50th Avenue*
Long Island City
New York 11101

URAND®

WRITER'S DIRECT DIAL NO.
(800) 847-6478 ext. 61

Letter of Reference

To Whom It May Concern:

RE: GEOSERVEX Company

Urand Corp -HKA has had the pleasure of working with Geoservex Company of Bydgoszcz, Poland for the past 15 years. We have worked on projects ranging from supplying their expertise to our clients in cement, pulp and paper and other heavy industries, to providing assistance and help to our company on local, individual projects concerning precision measurements.

Geoservex Company is the leader in rotary kiln alignments and specialized machinery alignments and measurements. Geoservex has pioneered a unique and, so far as we know, the only consistently reliable system in the world of rotary kiln geometry measurements at full production conditions . Even though such a specialization is a narrow one, it has been greatly appreciated by our clients in the above mentioned industries. This alignment system allows our clients to significantly improve kilns' run factor which increases parts life expectancy and consequently leads to savings on maintenance expenditures.

Geoservex maintains a very professionally managed staff of engineering experts dedicated to producing high quality results. We have had and continue to have a thoroughly professional relationship. There is at their disposal the most innovative and technologically advanced measurement system with high quality instruments.

The list of clients we had worked with Geoservex is a lengthy list.
In the Cement industry it comprises of all five largest cement producers in the world such as Lafarge Corporation, Holcim (formerly Holderbank), Heidelberger/Lehigh Cement, Cemex and Italcementi/Essroc Cement. This list also includes numerous smaller cement manufacturers.
In Pulp and Paper industry, the clients' list is equally impressive; it includes International Paper, Boise Cascade, Smurfit Stone, just to name a few.

It is for all the above reasons that we can certainly recommend Geoservex Company as a valuable and great partner offering engineering services that are second to none.

Sincerely yours,

John Bailey, Managing Director

bm/JB

REFERENCE LIST

Year/m	Kind of works	Plant name	Company name	Country
2005/04	Rotary Dryers Alignment	Clinton	ADM Clinton	USA*
2005/04	Hot Kiln Alignment	San Juan	Essroc	Puerto Rico*
2005/04	Hot Kiln Alignment	Kryvyi Rih Cement	Heidelbergcement	Ukraine
2005/04	Cement Mill Alignment	Kryvyi Rih Cement	Heidelbergcement	Ukraine
2005/04	Hot Kiln #4 Alignment	Rudniki	CEMEX	Poland
2005/03	Hot Kiln Alignment	Nasice	NEXE Grupa	Croatia
2005/03	Hot Kiln #1 Alignment	Runiki	CEMEX	Poland
2005/03	Hot Kiln #1 Alignment	Dniprocement	Heidelbergcement	Ukraine
2005/03	Hot Kiln #2 Alignment	Dniprocement	Heidelbergcement	Ukraine
2005/03	Hot Kiln #5 Alignment	VAC	Heidelbergcement	Hungary
2005/03	Kiln #2 Renovation Supervision	Gorazdze	Heidelbergcement	Poland
2005/03	Hot Kiln Alignment	Odra	Cement Odra	Poland
2005/03	Hot Kiln #1 Alignment	Gorazdze	Heidelbergcement	Poland
2005/02	Coal Mill Alignment	Gorazdze	Heidelbergcement	Poland
2005/01	Hot Kiln #1 Alignment	Adana Cimento	OYAK	Turkey
2005/01	Hot Kiln #3 Alignment	Adana Cimento	OYAK	Turkey
2005/01	Hot Kiln #4 Alignment	Adana Cimento	OYAK	Turkey
2005/01	Hot Kiln #1 Alignment	Mardin Cimeto	OYAK	Turkey
2004/12	Cement Mill #3 Alignment	Gorazdze	Heidelbergcement	Poland
2004/12	Hot Kiln Alignment	Kryvyi Rih Cement	Heidelbergcement	Ukraine
2004/11	Hot Kiln #1 Alignment	Dniprocement	Heidelbergcement	Ukraine
2004/11	Hot Kiln #2 Alignment	Dniprocement	Heidelbergcement	Ukraine
2004/11	Hot Kiln #1 Alignment	Hanil	Hanil Cement	Korea
2004/11	Hot Kiln #2 Alignment	Hanil	Hanil Cement	Korea
2004/10	Hot Kiln Alignment	Odra	Cement Odra	Poland
2004/10	Rotary Cooler Alignment	Anwil-Wloclawek	ORLEN	Poland
2004/10	Centering of Drive Gear	IP Kwidzyn	International Paper	Poland
2004/09	Hot Kiln Alignment	Afyon Cimento	SET-Italcementi	Turkey
2004/08	Hot Kiln #1 Alignment	Kutayha Magnesit	Kumas	Turkey
2004/08	Hot Kiln #2 Alignment	Kutayha Magnesit	Kumas	Turkey
2004/07	Hot Kiln #3 Alignment	JECHEON-SI	Asia Cement	Korea
2004/07	Hot Kiln #4 Alignment	JECHEON-SI	Asia Cement	Korea
2004/06	Alignment of Power Turbine	Borowo	BE&K Europe	Poland
2004/06	Alignment of Power Turbine	Bydgoszcz	Power Plant	Poland
2004/05	Hot Kiln Alignment	Jaroszów	Jaroszów Cement	Poland
2004/05	Hot Kiln #2 Alignment	Hejocsaba	Holcim	Hungary
2004/05	Measurements of Furnance#4	Glogow Coper Plant	KGHM	Poland
2004/04	Hot Kiln Alignment	Mason City	Holcim	USA*
2004/04	Kiln Renovation Supervision	IOWA	Holcim	USA*

2004/04	Hot Kiln Alignment	Jaroszów	Jaroszów Cement	Poland
2004/04	Kiln Renovation Supervision	Jaroszów	Jaroszów Cement	Poland
2004/04	Rotary Cooler Alignment	Anwil-Wloclawek	ORLEN	Poland
2004/04	Hot Kiln #1 Alignment	Rudniki	CEMEX	Poland
2004/04	Hot Kiln #3 Alignment	Rudniki	CEMEX	Poland
2004/04	Hot Kiln #4 Alignment	Rudniki	CEMEX	Poland
2004/03	Hot Kiln #1 Alignment	Goliat – Malaga	Cem.RezolaItalcementi	Spain
2004/03	Hot Kiln #2 Alignment	Goliat – Malaga	Cem.RezolaItalcementi	Spain
2004/03	Cement Mill #2 Alignment	Goliat – Malaga	Cem.RezolaItalcementi	Spain
2004/03	Hot Kiln Alignment	Picton	Essroc	USA*
2004/03	Cement Mill #4 Alignment	Goliat – Malaga	Cem.RezolaItalcementi	Spain
2004/03	Kiln #2 Renovation Supervision	Gorazdze	Heidelbergcement	Poland
2004/03	Hot Kiln #4 Alignment	Odra	Cement Odra	Poland
2004/03	Hot Kiln Alignment	Arrigorriaga	Cem.RezolaItalcementi	Spain
2004/02	Kiln #1 Renovation Supervision	Gorazdze	Heidelbergcement	Poland
2004/02	Hot Kiln #1 Alignment	Gorazdze	Heidelbergcement	Poland
2004/02	Kiln Renovation Supervision	Kryvyi Rih Cement	Heidelbergcement	Ukraine
2004/02	Hot Kiln Alignment	Kryvyi Rih Cement	Heidelbergcement	Ukraine
2004/02	Kiln #1 Renovation Supervision	Dniprocement	Heidelbergcement	Ukraine
2004/02	Kiln #2 Renovation Supervision	Dniprocement	Heidelbergcement	Ukraine
2004/01	Hot Kiln #1 Alignment	Dniprocement	Heidelbergcement	Ukraine
2004/01	Hot Kiln #2 Alignment	Dniprocement	Heidelbergcement	Ukraine
2004/01	Hot Kiln Alignment	Arrigorriaga	Cem.RezolaItalcementi	Spain
2004/01	Hot Kiln Alignment	Hanil	HANIL CEMENT	Korea
Before 2004	Hot Kiln #1 and 2 Alignment	Denizli	Denizli Cimento	Turkey
Before 2004	Hot Kiln Alignment	Beli Izvor	Holcim	Bulgaria
Before 2004	Kiln Erection Supervision	Kujawy	Lafarge	Poland
Before 2004	Hot Kiln Alignment	IOWA	Heidelbergcement	USA*
Before 2004	Hot Kiln Alignment	Mason City	Holcim	USA*
Before 2004	Hot Kiln Alignment	NUH Cimento	NUH	Turkey
Before 2004	Hot Kiln Alignment	Sung Shin	Sung Shin Cement	Korea
Before 2004	Hot Kiln Alignment	Dong Hae	Ssang Yung	Korea
Before 2004	Hot Kiln Alignment	Sam Chok	Tong Yang Major	Korea
Before 2004	Hot Kiln Alignment	Monselice	Italcementi	Italy
Before 2004	Hot Kiln Alignment	Broceni	Readymix	Latvia
Before 2004	Hot Kiln Alignment	Trbovlie	Lafarge	Slovenia
Before 2004	Hot Kiln Alignment	Nowiny	Dyckerhoff	Poland
Before 2004	Hot Kiln Alignment	Sankarnagar	The India Cement	India
Before 2004	Hot Kiln Alignment	Jaypee Bela	Jaypee Bela Cem.	India
Before 2004	Hot Kiln Alignment	Jaypee Rewa	Jaypee Rewa Cem.	India
Before 2004	Hot Kiln Alignment	Chilamkur	The India Cement	India
Before 2004	Hot Kiln Alignment	Limassol	The Cyprus Cem.	Cyprus
Before 2004	Hot Kiln Alignment	Vassiliko	Vassiliko Cement	Cyprus
Before 2004	Hot Kiln Alignment	Nazareth	Essroc	USA*

Before 2004	Hot Kiln Alignment	Speed	Essroc	USA*
Before 2004	Hot Kiln Alignment	Bessemer	Essroc	USA*
Before 2004	Kiln Renovation Supervision	Bessemer	Essroc	USA*
Before 2004	Hot Kiln Alignment	Frederick	Essroc	USA*
Before 2004	Hot Kiln Alignment	Mason City	Holnam	USA*
Before 2004	Hot Kiln Alignment	Mason City	Lehigh	USA*
Before 2004	Hot Kiln Alignment	Logansport	Essroc	USA*
Before 2004	Hot Kiln Alignment	St. Lawrence	Holcim	Canada*
Before 2004	Hot Kiln Alignment	Ponce	CEMEX	Puerto Rico*
Before 2004	Hot Kiln Alignment	Picton	Essroc	Canada*

* - jointly with HKA Corp. New York City; USA