PROFESSIONAL,
HIGHLY ACCURATE MEASUREMENTS OF GEOMETRY AND DEFORMATIONS OF MACHINERY, STRUCTURES AND CONSTRUCTION

SPECIALITY:
- HOT KILN ALIGNMENTS AND ADJUSTMENTS
- COMPREHENSIVE KILN INSPECTIONS

GEOSERVEX

HISTORY

The roots of Geoservex date back to 1978, when the company founder, MSc Eng. Bolesław Krystowczyk, was given the challenge to measure rotary kiln alignment. Firstly, he applied a classic attitude and took the kiln measurements during machine stoppage. He quickly noticed that as soon as the kiln was started up its cold state adjustment did not give satisfactory effects. The support system geometry appeared to behave differently when compared to its hot condition. The findings induced him to make further researches and studies for the reasons of the described effect. This led to the conclusion that measurements concerning such a type of machine should be performed during the kiln operation. Then, he undertook a challenge to work out a proper rotary kiln alignment measurement and support rollers' location method while the machine was operating. Research and design works lasted two years. In effect, as the first in the World he worked out the method that was later called "Hot Kiln Alignment". Nowadays, nobody undermines the principle of such an attitude but then it was a true technology breakthrough.

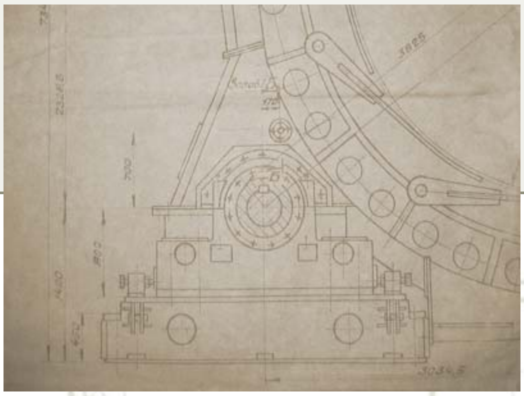
In the 1980s, the method was implemented and applied to dozens of kilns. Bolesław Krystowczyk published principles listing the advantages of his solution in periodical *"Zement Kalk Gips"* (1983). The method was widely discussed and adduced in *"Rock Produckts"* (1987 & 1989) and *"Wermessungs wesen und Raumordnung"* (1986) magazines. An innovative character of the solution won for him an international patent and the author himself wrote a doctoral thesis in 1980 to be granted the title of the Doctor of Technical Sciences. At that time, the problems with misalignment of multi-support kilns were so common. Despite of fact that Poland was a socialist country, alignment services based on PhD Eng. Bolesław Krystowczyk's method were ordered by cement plants from such countries as the USA and Canada.

True business breakthrough took place in 1990, right after a system revolution in Poland. Then, private company Geoservex was established and its founder gained an access to global market. At the same time, the method of kiln alignment at operating conditions was quickly gaining supporters and followers including leading kiln producers. Based on the same principle of measurement in operating state new solutions were worked out.

In the next years, obvious new needs and new technical possibilities of development of kiln parameters diagnostics were appearing. In 2000, the founder's son, Zbigniew Krystowczyk, joined the team of engineers. Combining staff experience with his own knowledge about world technical news started to introduce solutions such as linear laser scanning of kiln shell (2000), statistical methods of circular deviations elimination from calculation of kiln shell radial run-out (2001), analysis of cyclical change of support loads through the measurement of rollers' shaft deflection (2005) and analysis of kiln shell temperature profile influence on kiln crank (2005).

In 2007 Zbigniew Krystowczyk took up the position of Managing Director and the company's main strategist. He noticed the potential of numerical modelling and the possibility of its application in the diagnostics of rotary kilns and appointed a new research team to work out the method of three-dimensional visualisation of kiln shell deformation (2008). After that the team worked out full numerical kiln modelling system which enable to calculate and visualise all kiln mechanical key parameters (2010). The system bases on the Finite Element Method.

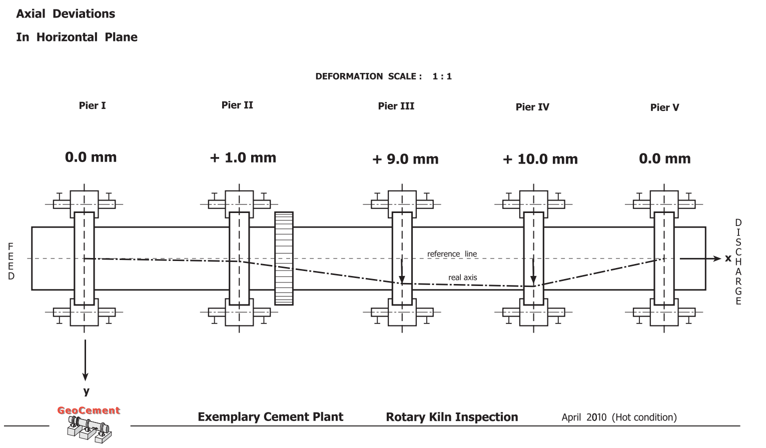
Geoservex will continue its service development hoping that the offered scope of service meet customers needs as properly fitted roots of girth gear and pinion.

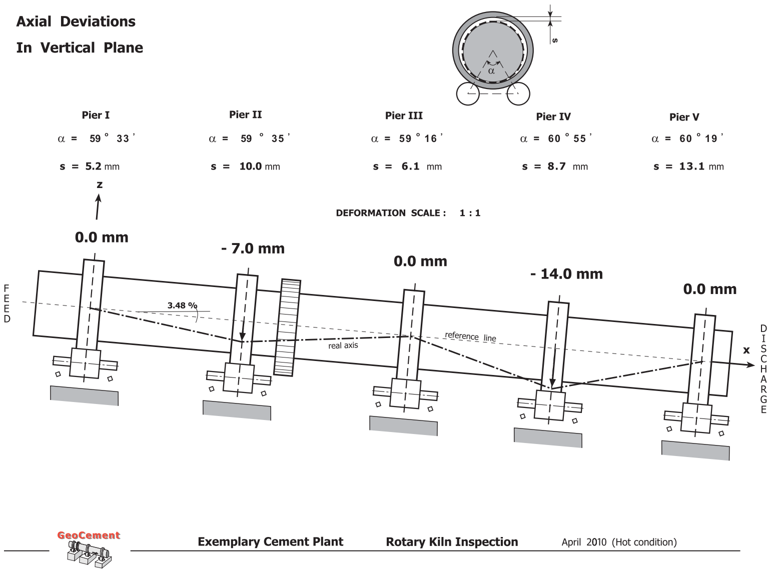


KILN ALIGNMENT

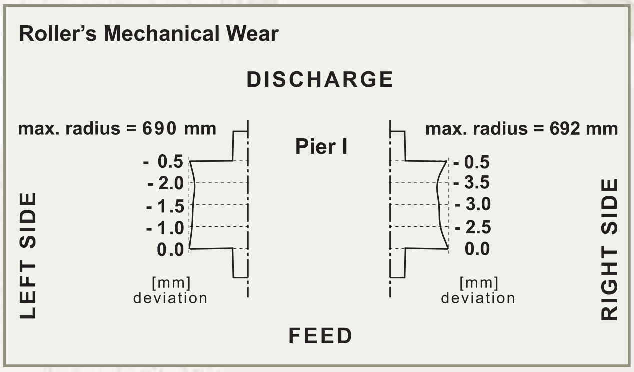
The determination of kiln axis position is a fundamental part of every kiln inspection. Our methodology base on the solution that has been tested for 30 years. The kiln axis of rotation is defined by determining tires' centres with simultaneously conducted measurements of tires' diameters and under-tire clearance (by measuring migration between tire and kiln shell). The method applied by us is based on classic optical measurement of the tires' vertical tangential generating lines in the same coordinate system. The method is thus free from the influence of temperature fields (there is no distance measurement with the use of electromagnetic range-finder) and measuring errors of tires' circumference (elimination of slip error). Furthermore, measurements are taken during normal kiln operation, independently in four positions of tires (every 90 degrees) from both sides (two reference lines). As a principle, each measurement is taken two times. Such an attitude allows to determine kiln axis deformation with a precision of +/- 1 mm and high reliability. Furthermore, measurements and calculations give results of real tires' diameters, undertire clearances, cyclical horizontal displacement of piers and the analysis of results accuracy with the consideration of tires' shape (deviation from circularity).

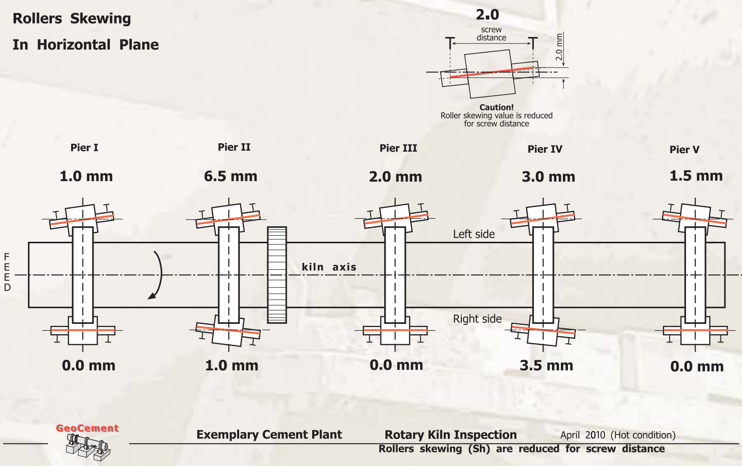
During kiln axis measurements we still base on the methodology worked out by PhD Eng. Bolesław Krystowczyk, the founder of Geoservex. Numerous comparison tests proved its precision and – maybe first of all – its advantage of results high reliability. The method has time-consuming character and expose our experts to conditions resulting from kiln operation. At the same time, this is an advantage as the experts are working close to key kiln components and may notice important symptoms and dangers. In principle mechanical kiln inspection is not a separate process. We are monitoring kiln day by day during daily works ...

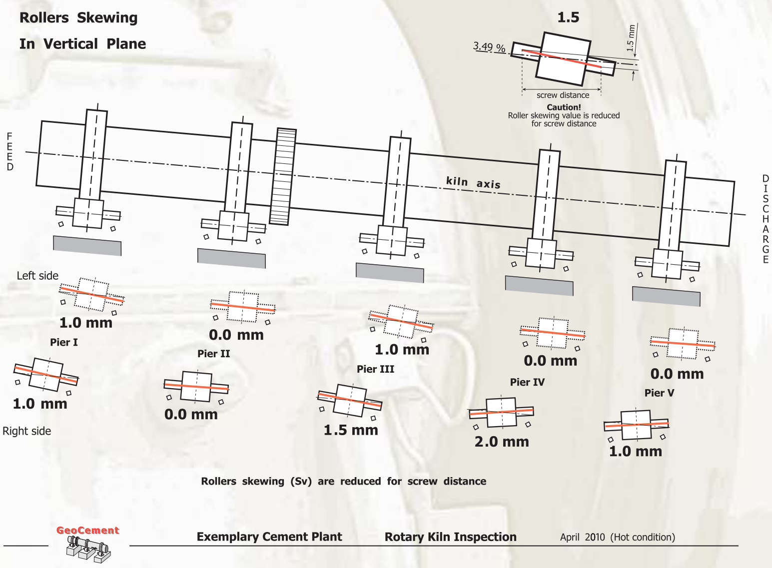




During standard kiln alignment the position of support rollers axis should be determined in relation with the measured kiln axis. Consequently horizontal skewing and vertical inclination of rollers axis is determined. All measurements are taken in the same reference system as kiln axis and the results are related to real (not designed) axis position. Both horizontal as well as vertical skewing have specific impact on axial force generated by the rollers to the tires. Moreover, the forces depend on the rollers' running surface profile. That is why during complex kiln measurement we are studying all parameters and analysing their influence on axial forces generated by the rollers. Simultaneously, we are inspecting rollers' axial mechanical position (contact and gap on thrust collars) and the contact between rollers and tires surfaces. This action is meant to appoint an optimum program of rollers' adjustment.



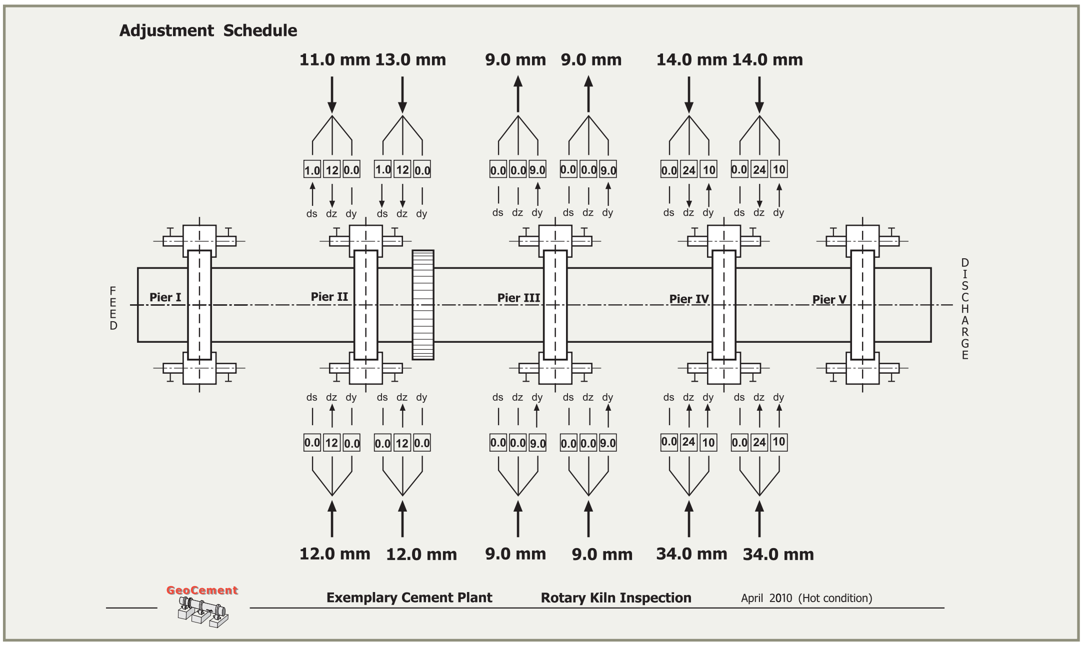


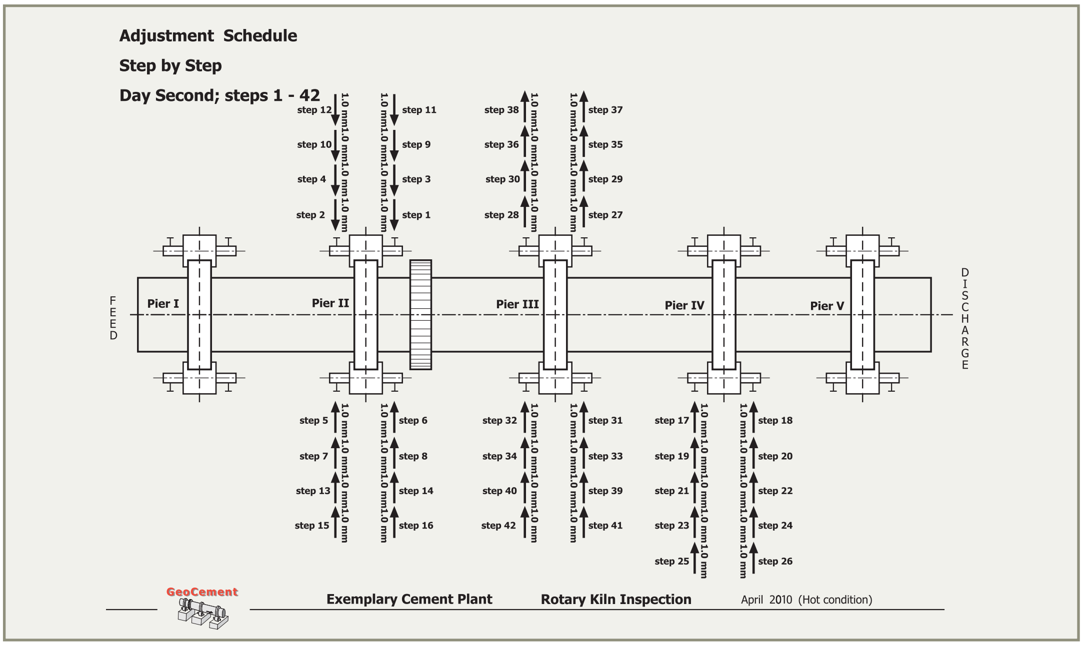


GEOSERVEX

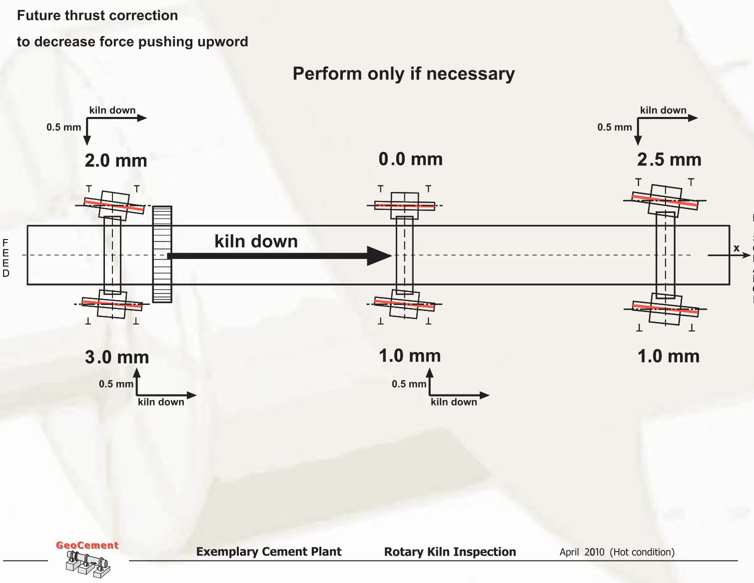
ADJUSTMENT PROGRAM & SCHEDULE

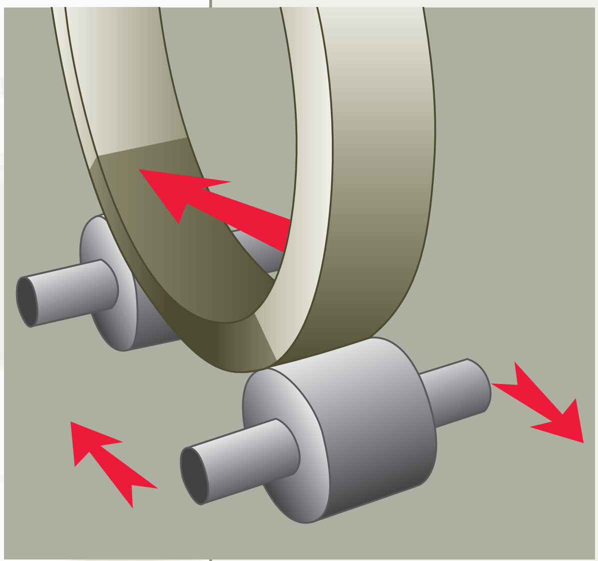
Kiln inspection without its adjustment would not be a sufficient action. The revealed misalignment and deviations of rollers' skewing should be eliminated during an inspection and under experts' supervision. Geoservex service is dedicated to the Plant managers responsible for kiln maintenance who are expecting something more than measurement report. Geoservex offers services of support rollers adjustment supervision under normal kiln operation in accordance with drawn up adjustment program and "step by step" schedule, during service visit in the plant. The program is updated and modified following the situation and machine reaction. In most cases, the adjustments might be completed within 3 days including control check survey. At the same time the team prepare drawings and complete final report for the customer. That is why we include adjustment supervision in a base service price.
The adjustment program is based on an assumption that the kiln to be measured is correctly designed and its design rotation axis is a straight line. If there are any doubts we are in a position to analyse kiln design paying special attention to design faults (see pages to follow).

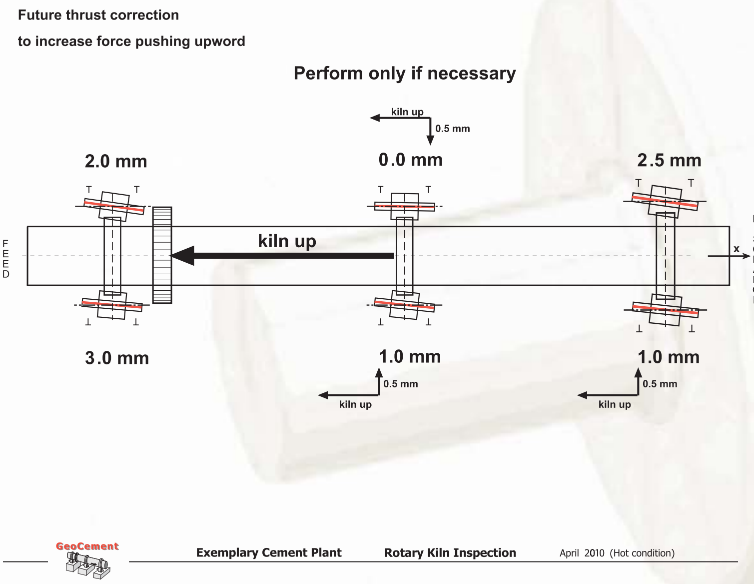


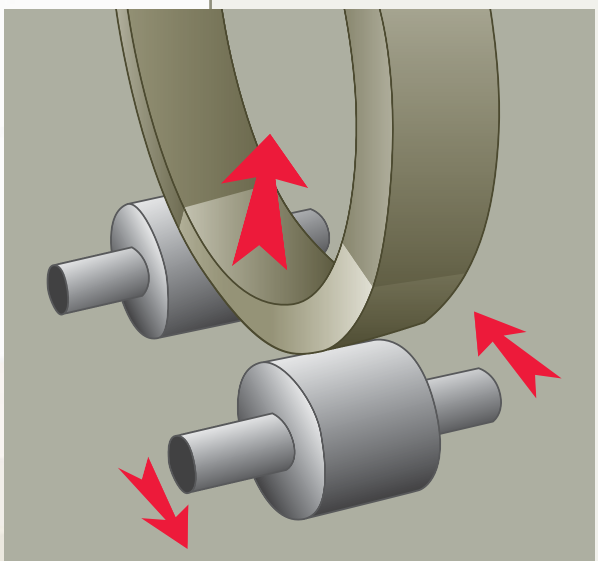


Kiln as a system generates an axial forces depending on the natural gravitational movement down that is balanced by axial forces coming from rollers' skewing, inclination and surface shape. Thus, mechanical kiln balance depends on many factors. During kiln inspection we are analysing all the influences at the same time and adjusting the whole system paying special attention to all factors optimization. Theoretically, 30 % of the axial force should be balanced by the skewing of support rollers and their axial forces. If hydraulic system exist on the kiln, it should carry 70 % of the axial force and its pressure should be in the range of 40 – 60 Bar. In practice, we always attempt to set pressure close to designed value. Nevertheless, the adjustment process requires an individual examination of each case and that is why the task must be carried out by a specialised and experienced expert.





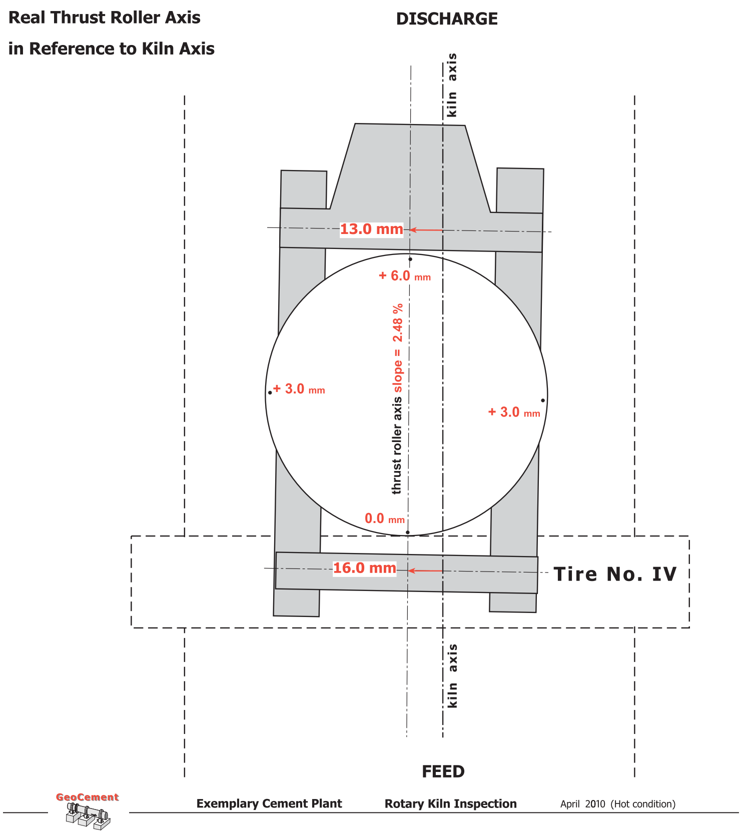




GEOSERVEX

HYDRAULIC SYSTEM

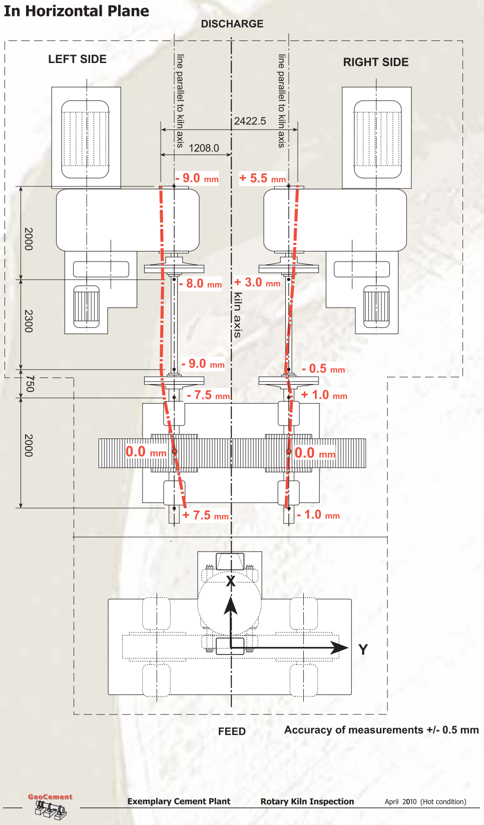
A thrust roller is designed to maintain the kiln in its axial position. If the kiln is correctly mechanically balanced the hydraulic system pressure should not be in excess of 40 – 60 Bar. However, it is not the only parameter important for proper kiln operation. The axis of thrust roller should be properly set up in relation to kiln axis and rotation direction. Otherwise, the roller is lifted up from its bearing or pressed down to the housing with great force. If there is any suspicion as to the thrust roller position it should be verified by measurements. The position of thrust roller has to be related to real (measured) kiln axis, not necessarily being in accordance with design axis. Additionally, we are taking measurements of roller inclination, its foundation frame and housing skewing in relation to kiln axis. These measurements are offered optionally.



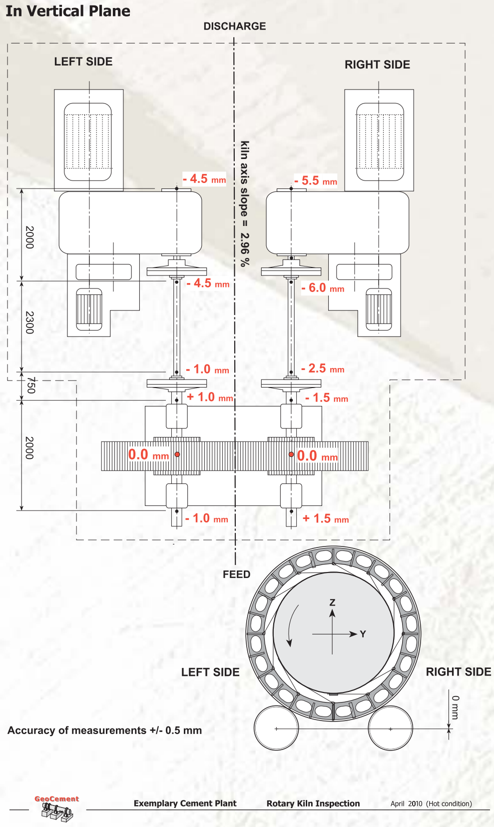
The inspection of drive is being made in order to reveal components wear and to assess root clearance and backlash. The inspection is carried out on working kiln and, therefore it is limited to evaluation statement. More exact inspection and direct measurement of clearances might be carried out only at the machine stoppage. The inspection of drive mesh enables us to take decision if during kiln axis adjustment a change of mesh should be considered.

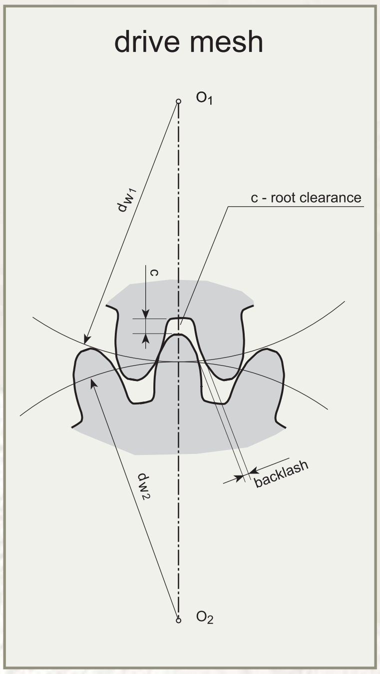
The alignment of a whole drive transmission system is usually made during assembling or components replacement. This measurement is offered optionally in case there is any suspicion of misalignment. In most cases for safety reasons the kiln should be stopped for measurements. The measurements are related to the real position of the kiln axis.

Axial Deviations of Drive Systems
In Horizontal Plane



Axial Deviations of Drive Systems
In Vertical Plane



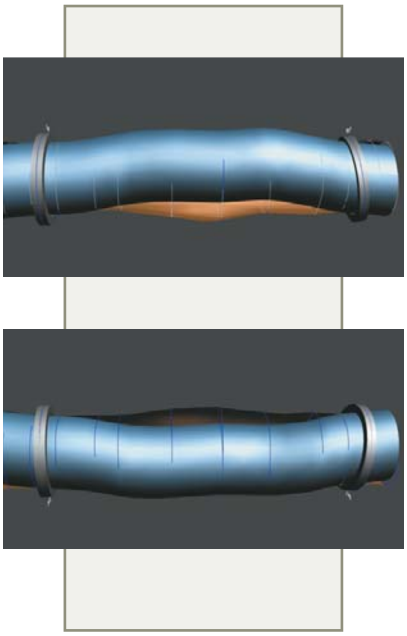


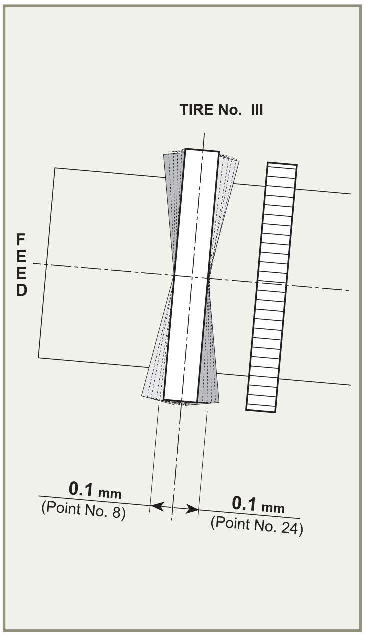
GEOSERVEX

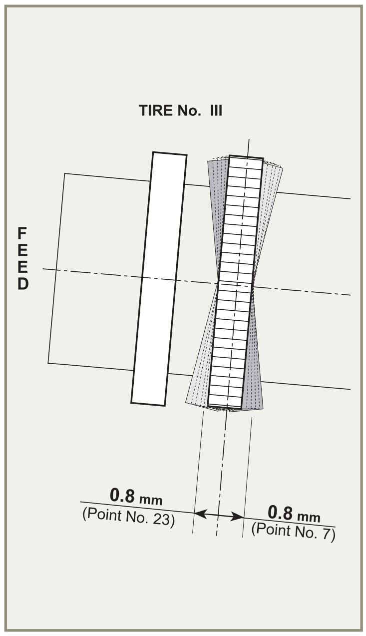
TIRE & GIRTH GEAR WOBBLING

Tires wobbling might be caused by deformation of kiln shell, wear out of shims or inner tire side. The most common case is an effect of the combination of those parameters. Excess axial wobbling has negative consequences on supporting rollers. In extreme cases the wobbling might cause the appearance of a gap between tire and rollers. The gap changes its location following tire movement causing an uneven load on bearings. Furthermore, the contact of the tire with the roller has a limited surface what causes a drastic increase of Hertz pressure. Tire wobbling might be eliminated by proper repair actions but background problem should be diagnosed first of all. During kiln inspection, we are making an exact measurement of kiln shell deformation and examine correlation between a tire wobbling and shell run-out. In order to precisely visualize the appearance (or its lack) of correlation of those factors we are making three-dimensional modelling of really measured values. By rotating the model with scaled deformations we may reveal changes and point their causes. The tool helps to undertake decisions concerning the replacement of shims, replacement or adjustment of kiln shell or machine of inner tire side.

Girth gear wobbling is diagnosed and visualized in the same way. In the case, after the cause fixing, wobbling reduction might be achieved by the gear centring in relation to rotation axis.

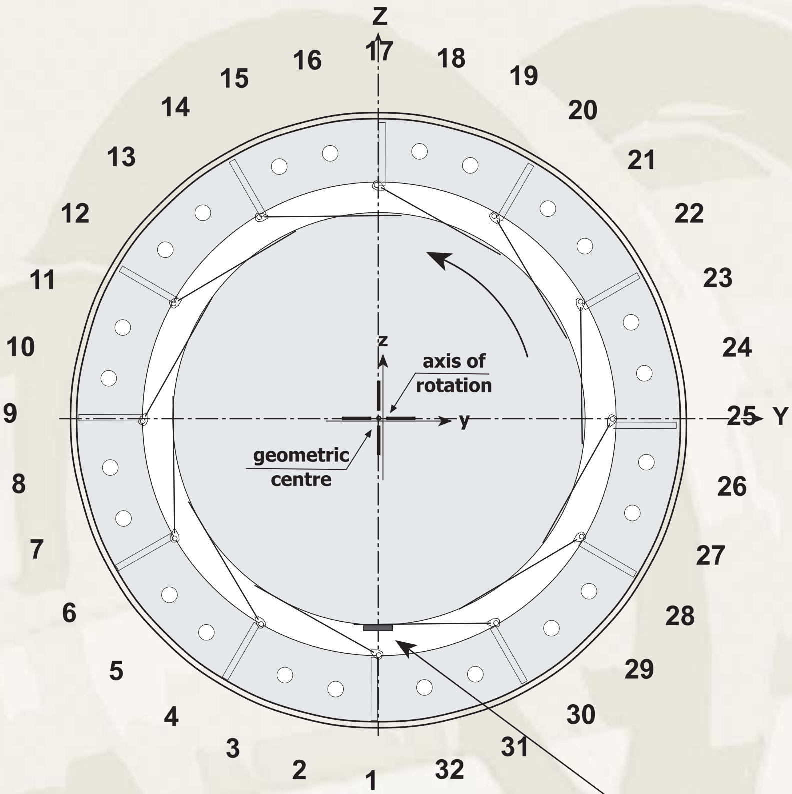




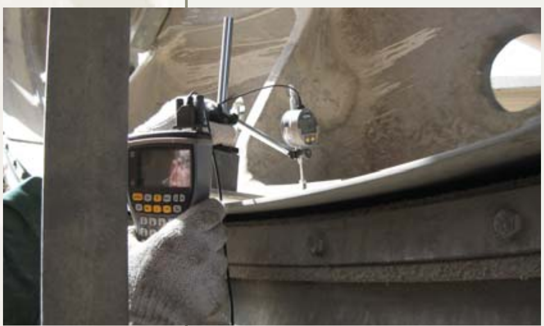


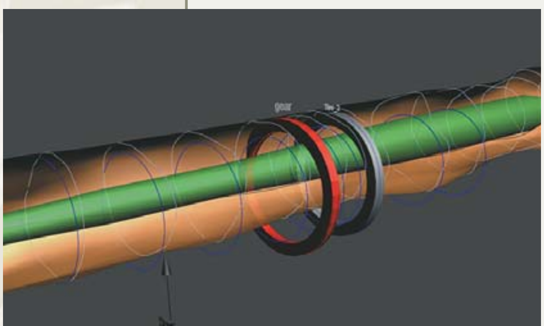
Girth gear radial run-out is one of key parameters of drive operation 'cause it influences root clearance of mesh. During standard kiln inspection, radial run-out in assessed through the monitoring of changes of root clearance. To take precise measurement we use digital sensors and continuous data recording. An easy access to the gear is essential. The gear radial run-out assessment allows the cause diagnosis of cyclically occurring higher vibration level. On the other hand, measurement results give precise and direct data for the adjustment of gear centring. This parameter is visualized in the three-dimensional model.

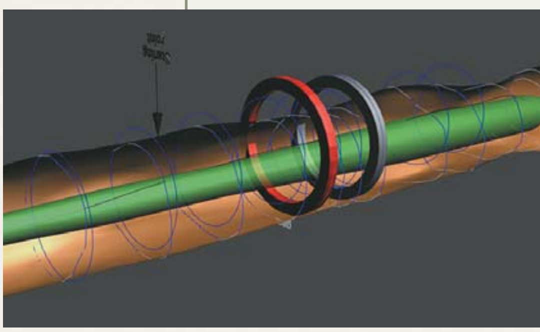
VIEWING FROM FEED END



Caution: Hatch describing kiln position - at the bottom





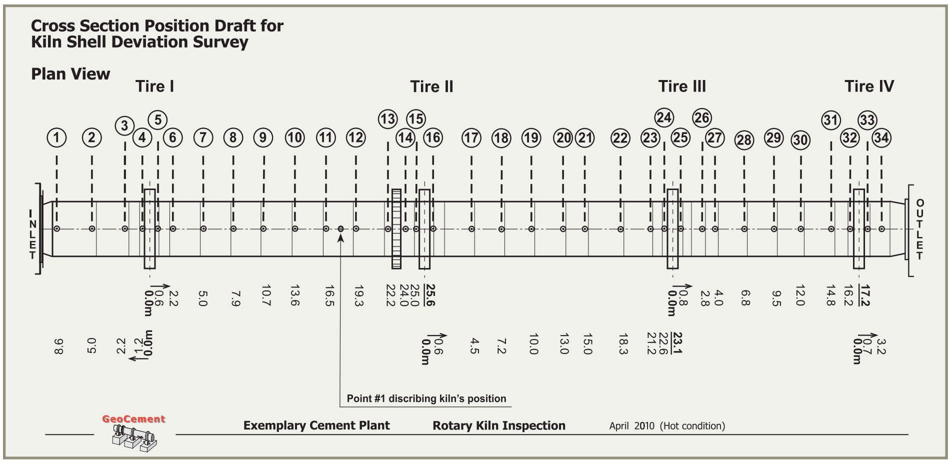


GEOMETRIC CENTRE COORDINATES

Coordinate Y	- 0.7 mm
Coordinate Z	+ 0.5 mm
ECCENTRIC	0.9 mm

KILN SHELL PROFILE

Measurements of shell deformation are started by making an agreement with customer on the layout of cross-sections to be measured. As a standard, we are making around 30 cross-sections per kiln, but on the client request any number might be done. It can be also agreed that some shell segments cross section distribution is different than others (every meter, every weld etc) . The measurement is continuously made with the use of a laser range-finder. Around 500 points on the shell circumference are recorded at every cross-section. In effect, a radial diagram of circularity deformation is obtained as well as the value and direction of eccentricity of the said cross-section in relation to the rotation axis. A key question is to distinguish the circularity deformation and to eliminate its impact on the value of eccentricity. To achieve is, we are using our own software based on statistical methods of determination of sinusoid parameters from a cloud of measured points.

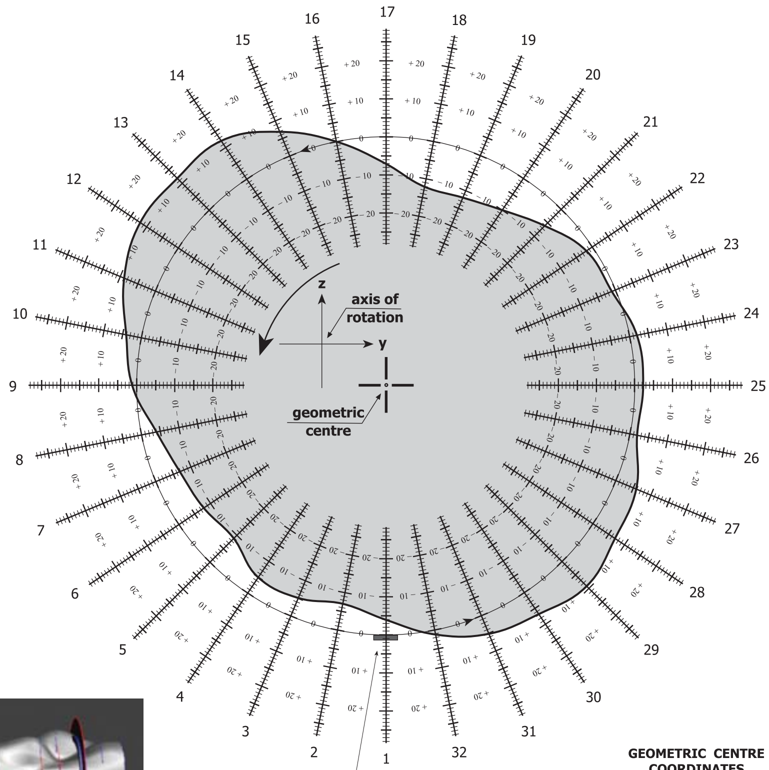


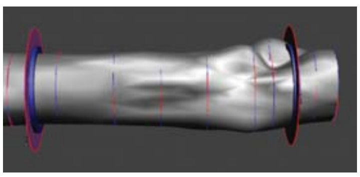
Radial Diagram of Shell Deformation

(Circular Deviations)

CROSS SECTION No 21

Deformation Scale - 1 : 1





Caution:

Point describing kiln position at the bottom

VIEWING FROM FEED SIDE

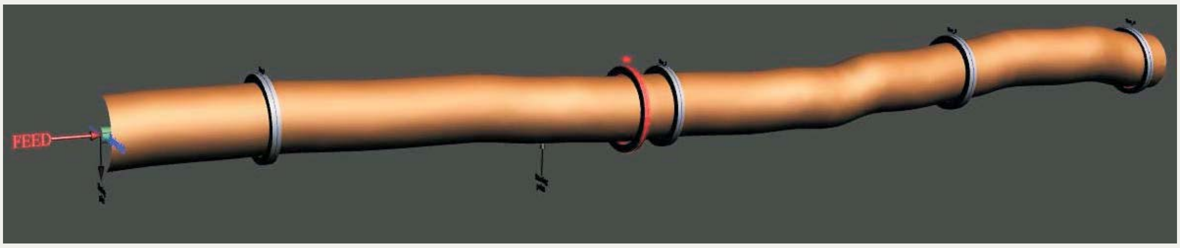
GEOMETRIC CENTRE COORDINATES

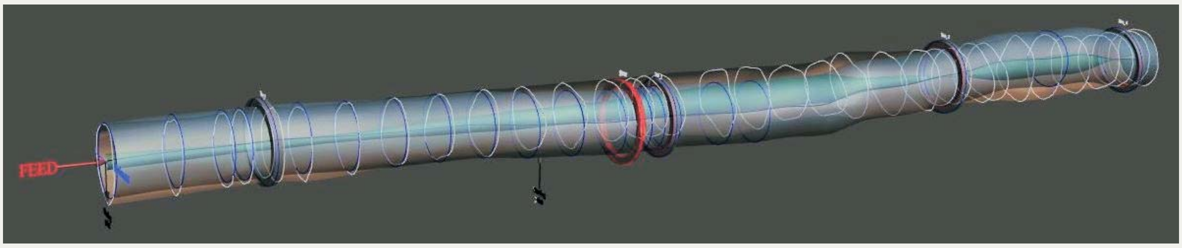
Coordinate Y	16 mm
Coordinate Z	- 10 mm
ECCENTRIC	19 mm

GeoCement Exemplary Cement Plant Rotary Kiln Inspection April 2010 (Hot condition)

Measurements of kiln shell geometry with the use of linear laser scanning made it possible to precisely visualize shell deformation. Former solutions did not make it possible for the monitoring of relations between shell circularity deformation, shell radial run-out, tires and gear wobbling and gear radial run-out. We have decided to work out a way to make a three-dimensional model of all parameters at once. In effect, the model appeared to be the most advanced in the World method of kiln shell deformation visualization related with the visualization of axial and radial movement of tires and gear. We allowed our customers to analyse the condition of shell geometry and its correlation with tires and gear wobbling on their own computer screen. Our model rotates the same way as the real kiln, it might be easily turned every side and even enables the customer looking inside the kiln shell. But the most important advantage of the solution is possibility of the kiln shell condition assessment, planning of necessary repairs and replacements, determining of correction cuts placement and its influence on tires and gear wobbling.

Shell Profile
Axonometric View
Starting point at bottom - 0º



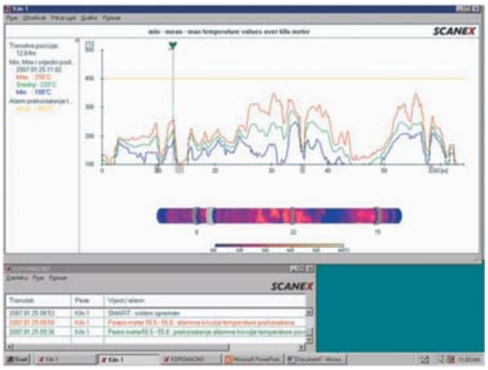


Cross Section No.	1	2	3	4	Tire No 1	5	6	7	8	9	10	11	12	13	Gear	14	15	Tire No 2	16	17
Coordinate Y	12	6	3	1	1	-1	-4	-6	-9	-12	-14	-12	-1	1	-1	2	-1	-2	-3	-4
Coordinate Z	5	8	7	7	6	8	6	1	-2	-3	-5	-14	-16	-22	-24	-22	-23	-17	-23	-28
Eccentric	13	10	8	7	6	8	7	7	9	13	15	18	16	22	24	22	23	18	23	29
Cross Section No.	18	19	20	21	22	23	24	Tire No 3	25	26	27	28	29	30	31	32	Tire No 4	33	34	Unit
Coordinate Y	2	13	13	16	10	6	2	0	-1	0	-1	4	7	10	-2	1	0	-1	-2	[mm]
Coordinate Z	-30	-25	-27	-10	-8	-3	1	0	2	9	16	21	18	21	10	1	0	-3	-7	[mm]
Eccentric	30	28	30	19	12	7	2	0	2	9	16	22	19	23	10	2	1	3	8	[mm]

GeoCement **Exemplary Cement Plant** **Rotary Kiln Inspection** April 2010 (Hot condition)

MECHANICAL & TEMPERATURE CRANK FORMATION

Except for geometry deformation rotary kiln shell might be subject to crank. Such a situation takes place when the kiln shell has been improperly assembled, has undergone local overheating or it has uneven temperature distribution on its circumference. In such situations we used to tell, the crank has mechanical or temperature background. The phenomenon causes certain consequences as it influences cyclical changes of loads on individual supports. During kiln inspection, we are pay special attention to eventual crank in the shell through the measurements of supporting rollers' shafts deflection changes. Simultaneously, we are measuring temperature distribution on the kiln shell circumference. This way we may determine crank origin and its range in relation to acceptable tolerance. We are able to define what action should be undertaken to limit or eliminate the phenomenon.

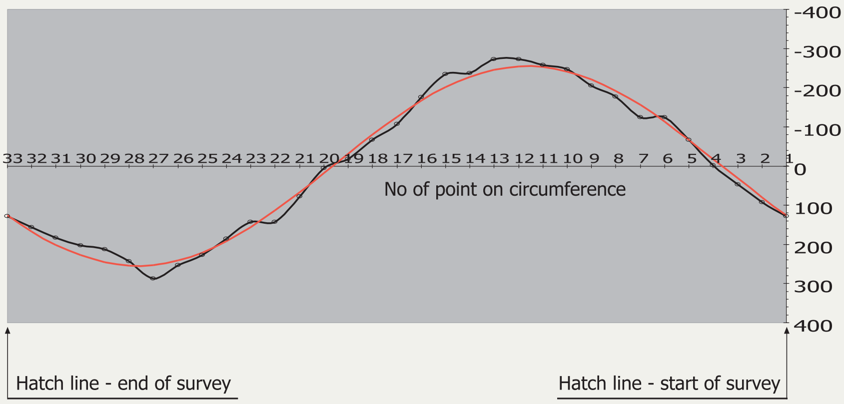


Roller's Shaft Deflection

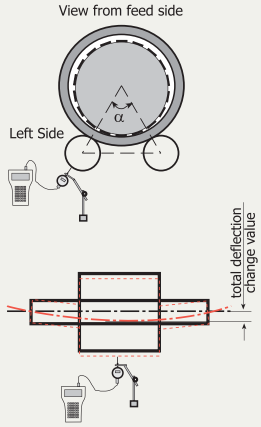
PIER No II

LEFT ROLLER

Unit: [0.001 mm]



Measurement Method



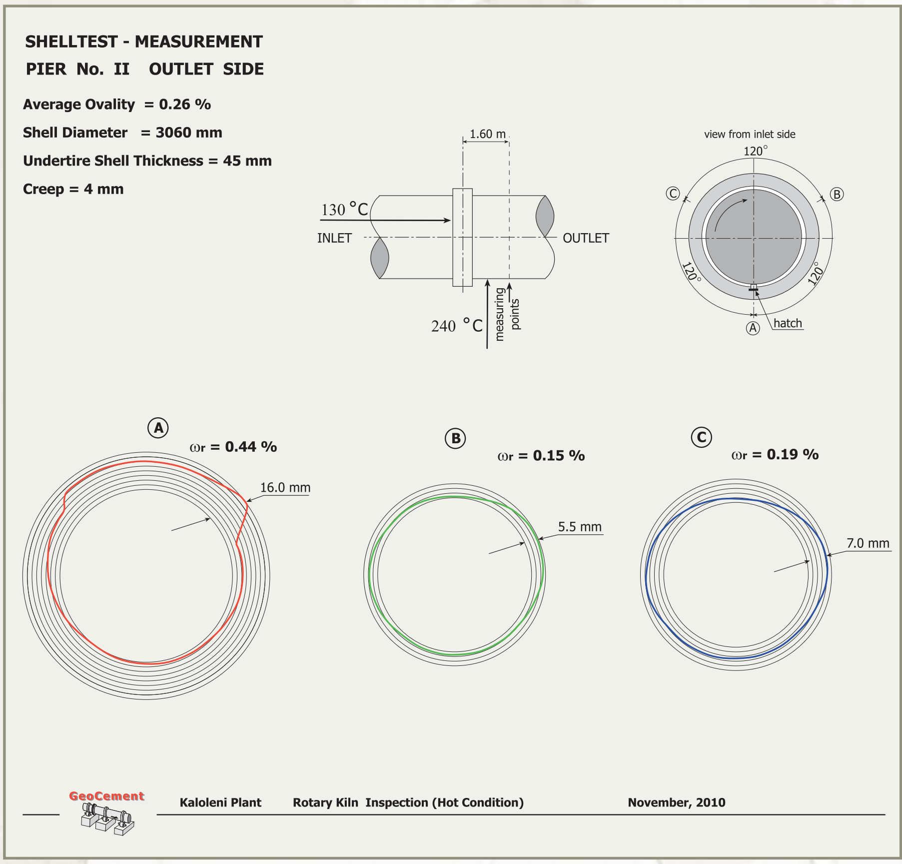
Eccentricity: **0.25 mm** (tolerance 0.15 mm)

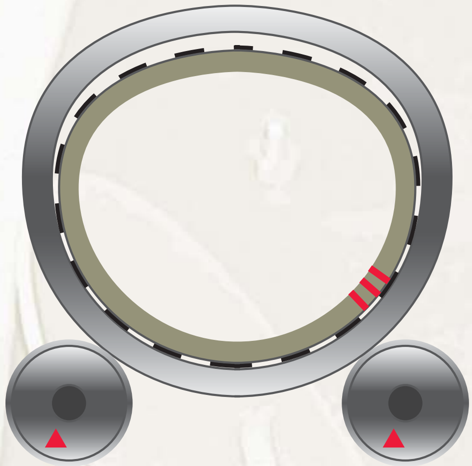
Total deflection value: **0.50 mm**

Maximum deflection angle: **300 degrees**

GeoCement **Exemplary Cement Plant** **Rotary Kiln Inspection** April 2010 (Hot condition)

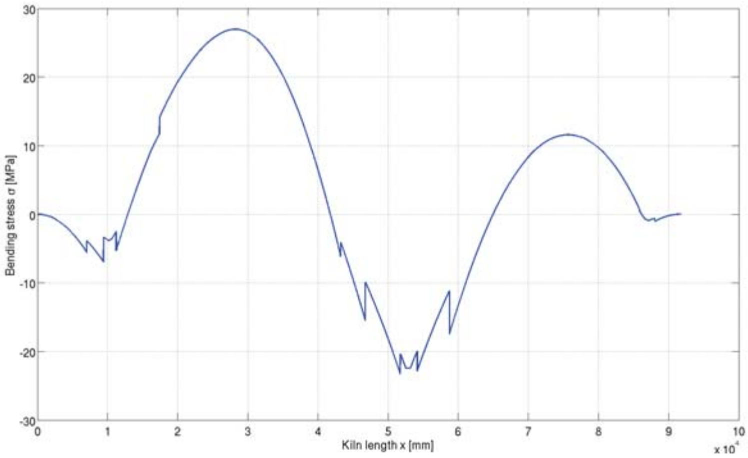
Rotating kiln shell is also subject to plastic deformations defined as ovality. Measurements of this parameter are done with the use of the SHELLTEST device. Shell ovality is correlated with alignment and supports load distribution, but in our methodology we are not making the use of ovality measurement results to set an optimum kiln axis location. The shelltest is made only to examine how plastic is the shell in its support zone and what impact it has on the condition of kiln refractory lining. Furthermore, the measurement may help to indicate shell crack within the measured cross-section. The ovality measurement is hard to precisely interpret as the maximum of the parameter appears under the tires while the measurement is taken far away from the maximum (due to the presence of thrust rollers and heat protection covers). That is why we are considering this measurement as optional. The ovality is strongly correlated with circumferential tire migration and during standard alignment it is sufficient to evaluate this parameter.



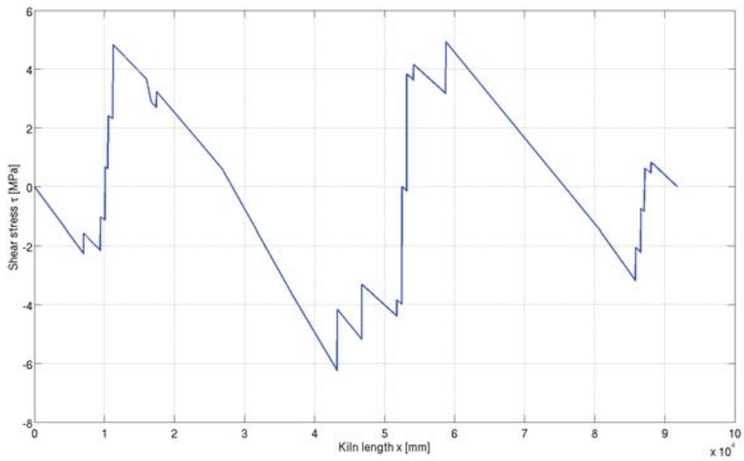


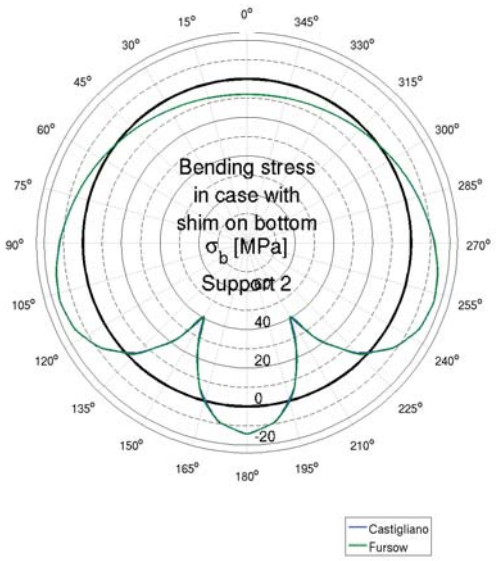
► LOADS, PRESSURES, STRESSES

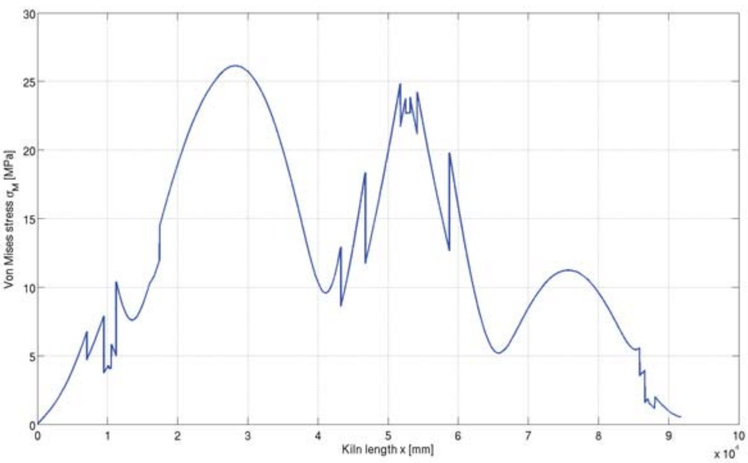
Our long experience and mechanical analysis of many types of kilns produced by all reputed kiln manufacturers let us state that a correctly designed rotary kiln should have a straight geometric axis being in accordance with rotation axis. However, in some cases the straight kiln axis may not be optimal for the kiln operation. Simple human errors, the application of wrong principles during modelling, finally, the increase of production parameters such as capacity increase, fuel change, raw-material composition change, all that may have an impact on the change of supports load.

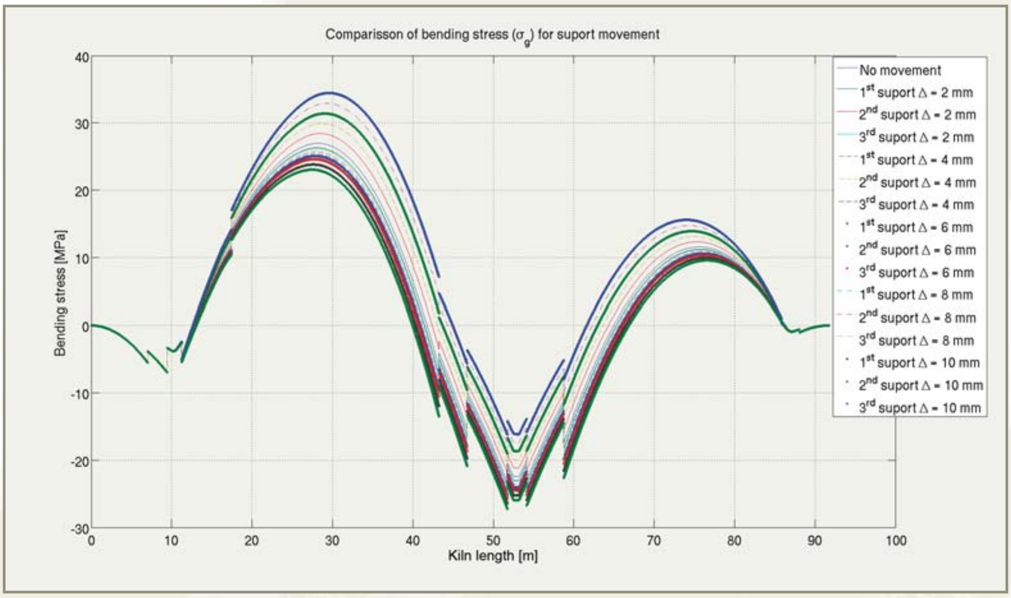


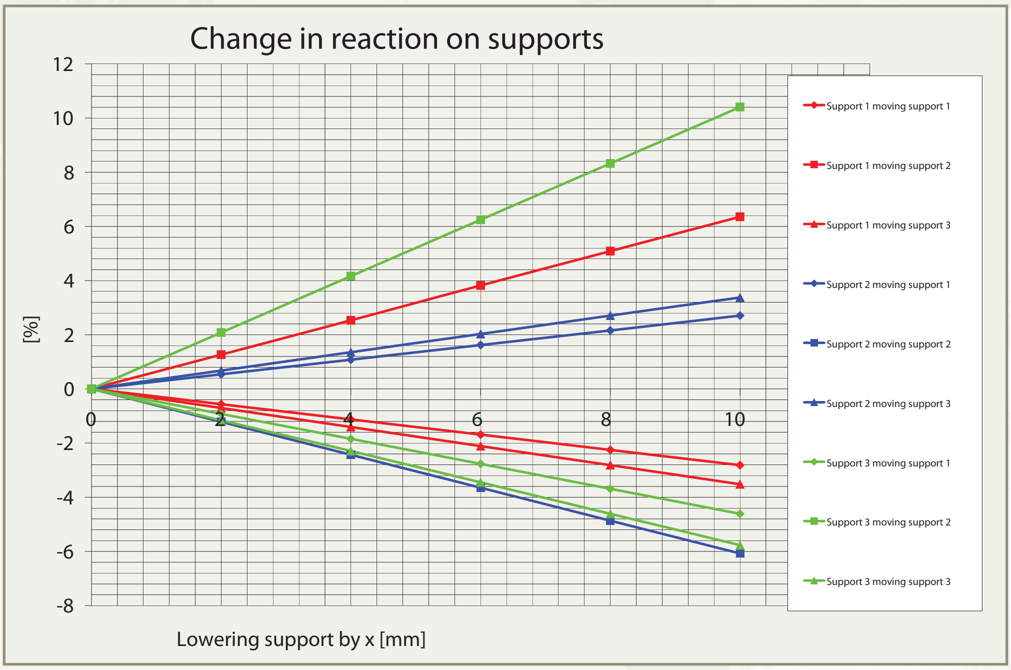
In effect, the kiln aligned for straight line might not meet key mechanical parameters, such as longitudinal bending stress of shell, pressure on bearings, Hertz pressures on contact between rollers and tires, shear stress etc. Recently, we have observed growing demand for such analysis due to a global tendency to strive after the maximum production effectiveness.

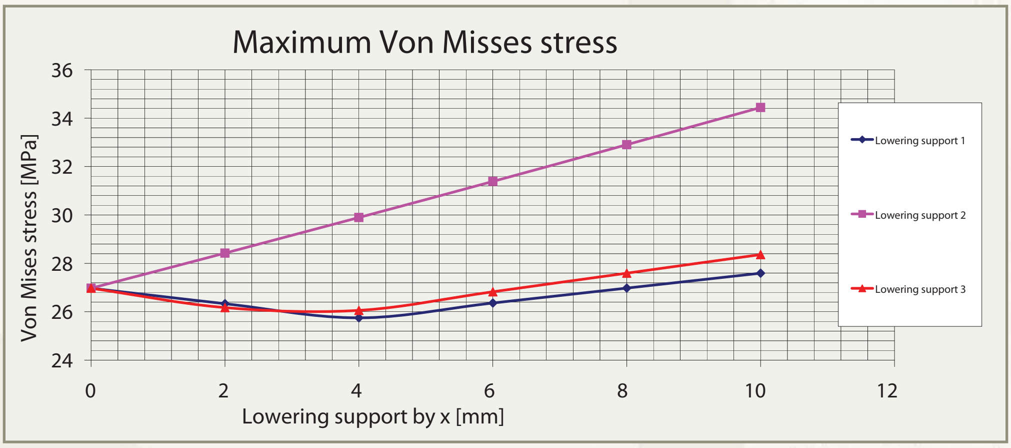






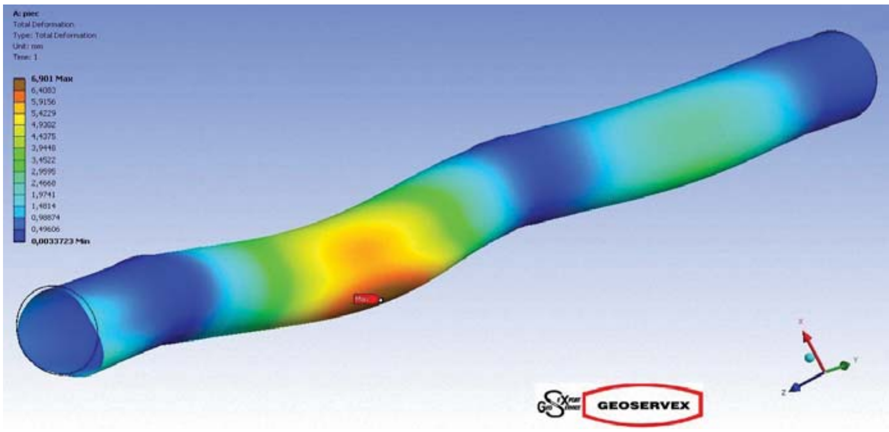


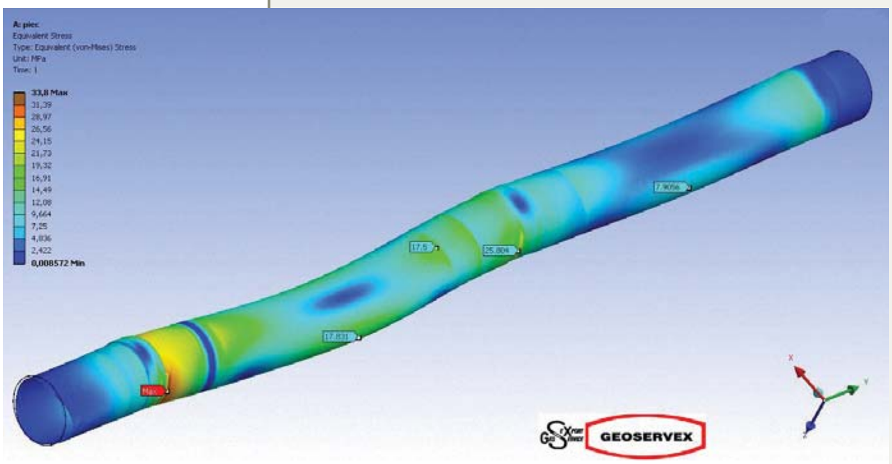


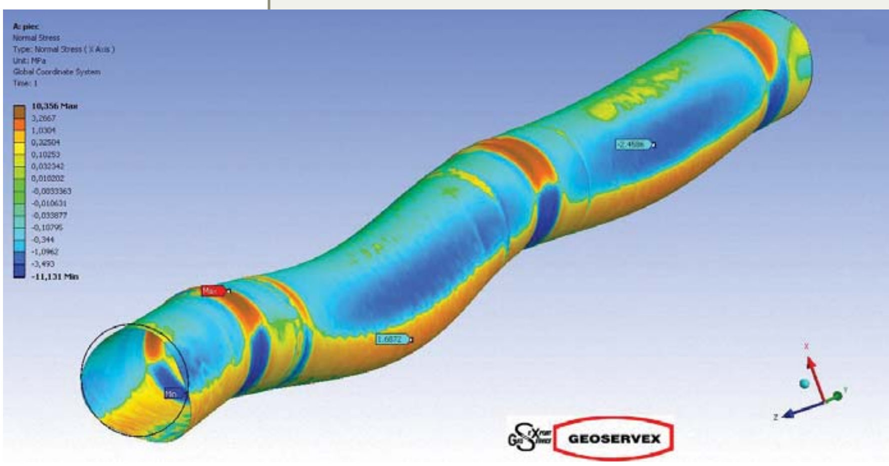


Giving an answer to customers' demand we have worked out calculation system generating results of all key mechanical parameters. When a kiln design (for any reason) does not meet the intended standards and as a result, it causes difficulties in operation, we are able to calculate values of key parameters and optimize the location of kiln axis within the framework of acceptable bearings pressure values, Hertz pressures, shell bending stress and pressures in the tires. In effect, we create "stiffness matrix" describing changes of reactions on supports by the lowering of individual supports by a definite value counted in [mm]. It should be kept in mind that the optimization of the kiln axis position is a process of overload correction and that process from its nature is a critical one. The change of kiln axis position may eliminate overload on one support, increasing loads on neighbouring supports and increasing bending stress of shell at the same time. That is why the procedure is recommended only in well justified cases.

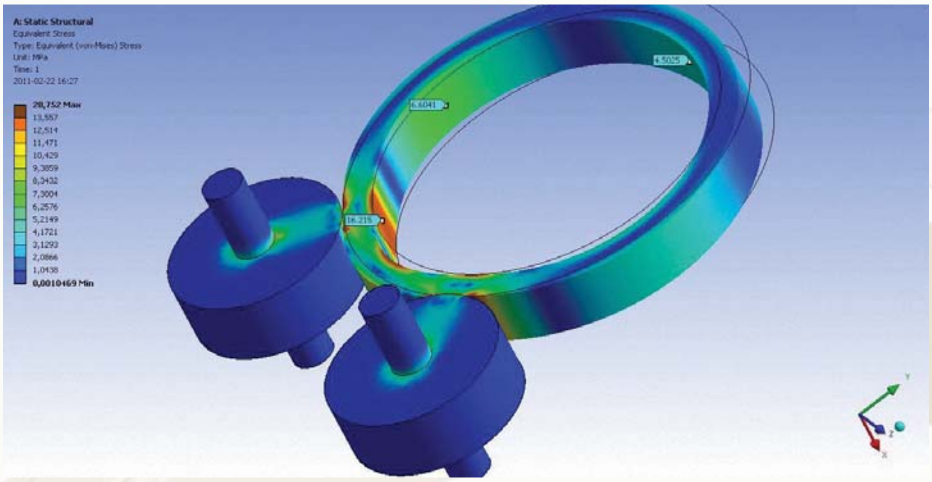
Analytical calculations of mechanical kiln parameters not always give answer to the question for reasons of specific symptoms (shell, shafts, and roller cracks, hot bearings). Classical attitude relays on calculating beam parameters having specific geometry and supported in tires locations. Such an attitude is a simplification that passes over the specific stress distributions that appear on contacting surfaces where stresses may concentrate. We know about cases when correctly designed and aligned kiln, meeting all tolerance criteria failed as circum-ferential weld of undertire shell cracked. To search for such problems we are offering a numerical modelling of the whole kiln and the use of finite element method to fully visualize stresses appearing within all kiln compo--nents and on contacts between surfaces working together. In the case mentioned above the reason for this was the concentration of stress of the shell on the contact with a tire (middle drawing with an arrow). And the root cause of problem has been the resignation from the use of shims in favour of the increased shell thickness.

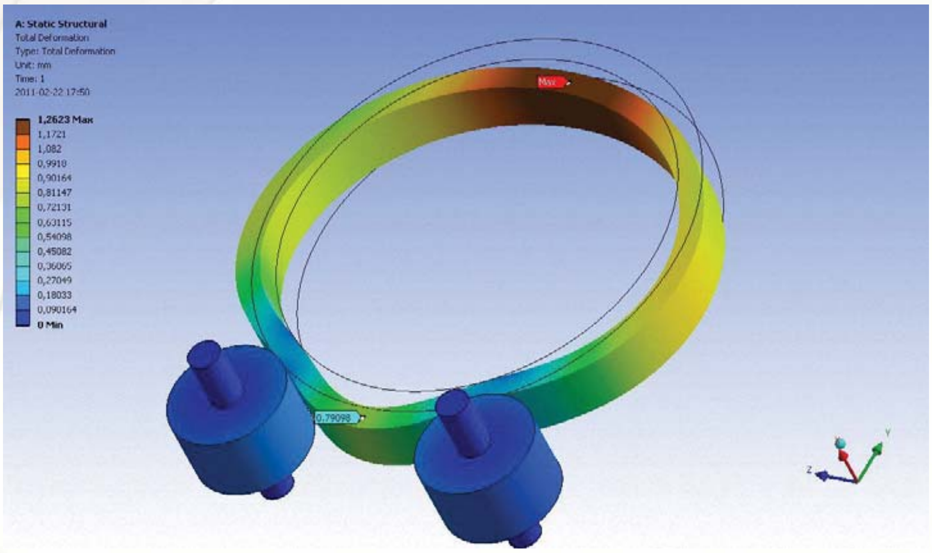


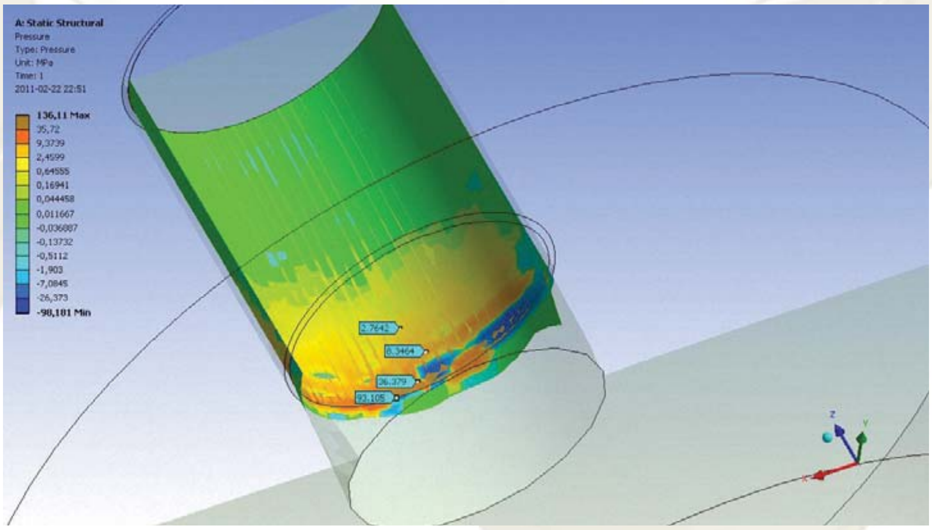




Numerical kiln modelling and the calculation of its parameters with the aplication of finite element method is opposite procedure to kiln designing. While executing such a task we do not use design data but construct the model based on real measured dimensions of the kiln and its operation parameters. We have no connection with the kilns' producers so our analysis is fully objective. The process is time-consuming and requires individual attitude to each case. Yet, sometimes it is the only way to find out the reasons of serious problems and repeating failures that are hard to explain. We have called this service "The comprehensive test of kiln mechanical parameters", formulating at the same time a new definition of term "Comprehensive Kiln Inspection".







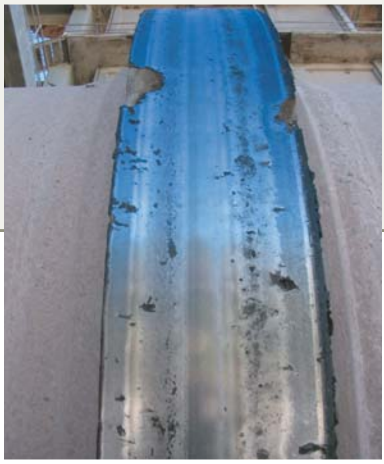
OVERALL INSPECTION

Rendering the service of alignment as a standard we perform visual inspection of kiln components. We examine the condition of rollers, tires, shims and retaining rings and stop-blocks, rollers shafts, sealing as well as the condition of kiln shell for any visible symptoms of overheating or cracks. We control in details the condition of the girth gear and pinion, gear fastening system, completeness of bolts and condition of welds. Additionally, we pay attention to condition of frames, foundations, adjustment systems and general maintenance of kiln surroundings. Based on the inspection, we make a photographic documentation showing concerning problems, irregularities and repair recommendations.



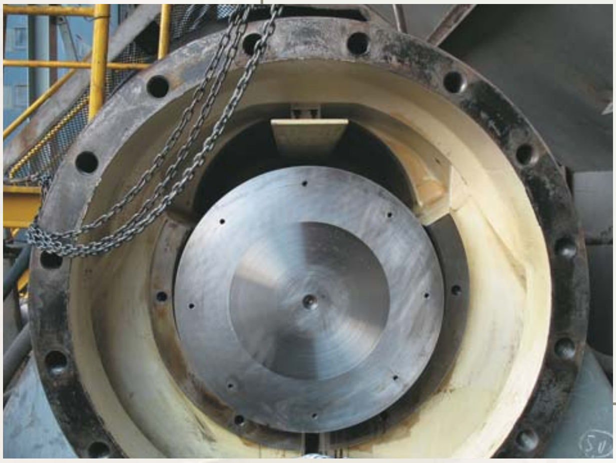





Our activity also covers geometrical supervision over the assembly of new production lines, modernisation and overhauls, replacement of shell sections, shell straightening, elimination of mechanical crank through correction cuts as well as supervision over replacement of rollers and tires. We have supervised new kiln installations, complicated shell overhauls, joining shell sections replacement with correction cuts in order to correct old segments. We have got enormous experience in "reclaiming" kilns that were not working for years and in making them operation ready.

We offer complex examination of the whole cement plant and buildings settlement and dislocation. The service has been used as a tool to monitor safety installation and in particular, when there are visible threat symptoms (building wall foundation cracks, deviation of high-rise buildings and structures etc.)



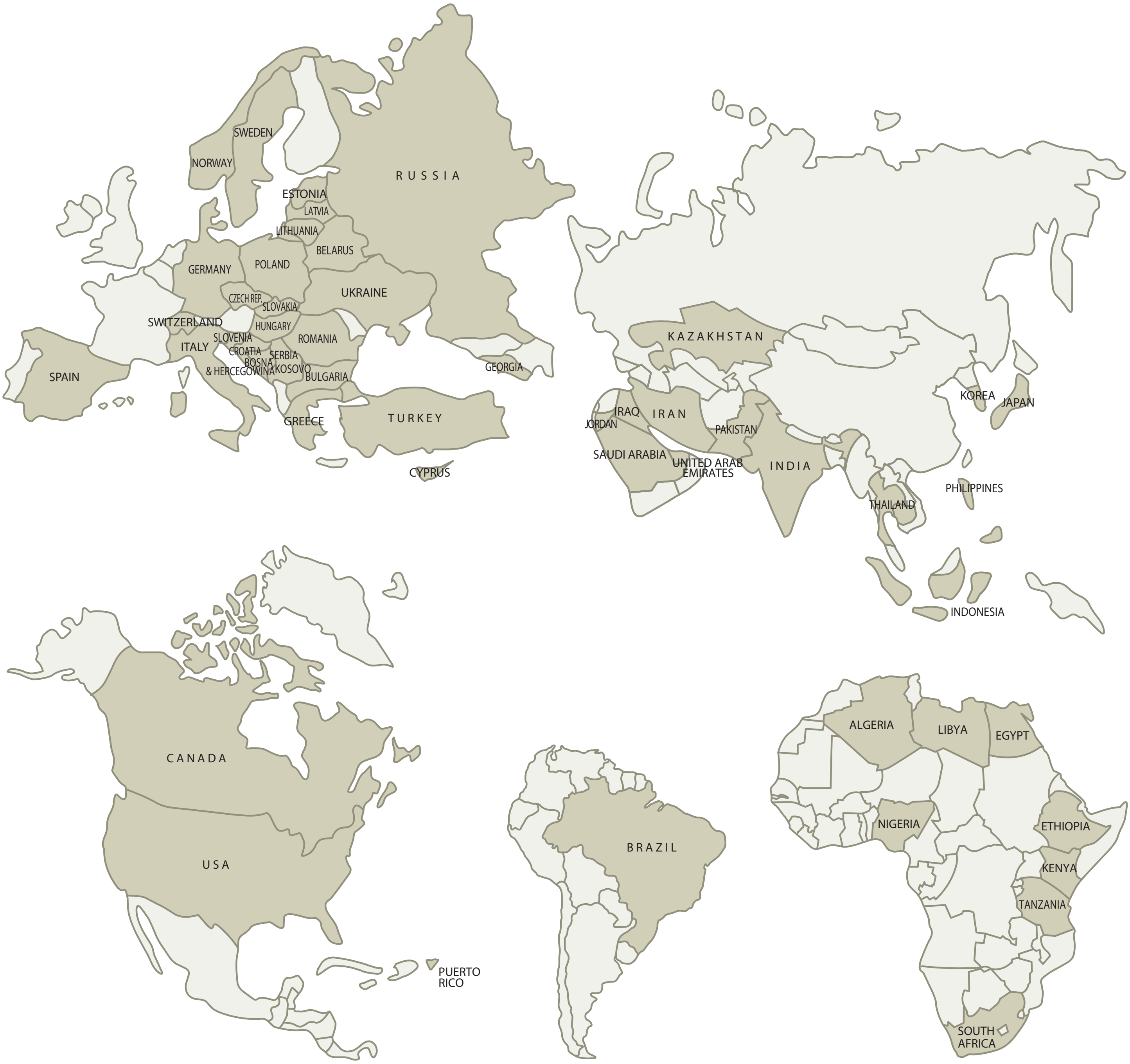
GEOSERVEX

OUR CUSTOMERS (selected list)

1	LAFARGE, Oggaz plant	Algeria
2	LAFARGE, M'sila Plant	Algeria
3	Kostiukoviczi Belarus Cement	Belarus
4	HEIDELBERGCEMENT, Tvornica, Kakanj D.D.	Bosnia&Herzegovina
5	Liz Cimento	Brasil
6	Mondi Stambolijski EAD	Bulgaria
7	HOLCIM, Beli Izvor Plant	Bulgaria
8	LAFARGE, Bath Plant	Canada
9	ESSROC/ITALCEMENTI, Picton Plant	Canada
10	HOLCIM, St. Lawrence Plant	Canada
11	Nasice Nexe Group	Croatia
12	HOLCIM, Koromacno Plant	Croatia
13	The Cyprus Cement, Limassol Plant	Cyprus
14	Vassiliko Cement	Cyprus
15	HOLCIM, Prachovice Plant	Czech Republic
16	HEIDELBERGCEMENT, Kunda Tsement	Estonia
17	Mugher Cement Enterprise	Ethiopia
18	HEIDELBERGCEMENT, Kaspi Saqcementi	Georgia
19	HEIDELBERGCEMENT, Kartuli Cement	Georgia
20	HEIDELBERGCEMENT, Rustavi	Georgia
21	Schwenk Zement, Karlstadt	Germany
22	Portlandzementwerk Wittekind Hugo Miebach Sohne KG	Germany
23	AUMUND, Aumund Foerdertechnik GmbH	Germany
24	Polygyros Grecian Magnesite	Greece
25	Larymna Larco	Greece
26	LAFARGE, Heracles General Cement Milaki	Greece
27	HEIDELBERGCEMENT, Duna-Drava Cement Vac	Hungary
28	HOLCIM, Hejoscaba Plant	Hungary
29	Jaypee Bela Cement	India
30	Jaypee Rewa Cement	India
31	Chilamkur, The India Cement	India
32	Sankarnagar, The India Cement	India
33	RCL Ramapuram, Priya Cement	India
34	PT Caturdaya Gema Industri	Indonesia
35	HEIDELBERGCEMENT, PT Indocement Tunggal	Indonesia
36	Sistan Cement	Iran
37	Fars Nov Cement	Iran
38	Khazar Cement	Iran
39	Kash Cement	Iran
40	Tehran Cement Co.	Iran
41	Saveh White Cement Company	Iran
42	Kordestan Cement	Iran
43	Sharg Cement Company Mash-Had	Iran
44	Sepahan Cement	Iran
45	Hormozgan Cement	Iran
46	Delijan Omran-e	Iran
47	Larestan Cement	Iran
48	Shahre-kord Cement	Iran
49	Sarooj Bushehr	Iran
50	Nyriz White Cement Co	Iran
51	Doroud Cement Co., Teheran	Iran
52	Urmia White Cement, Teheran	Iran
53	Bukan Cement	Iran
54	KaroonCement	Iran
55	LAFARGE, Bazian	Iraq
56	LAFARGE, Karbala Plant	Iraq
57	LAFARGE, Tasluja	Iraq
58	ITALCEMENTI, Monselice Italcementi	Italy
59	Huntsman Toxide, Scarlino	Italy
60	LAFARGE, Kanda Plant	Japan
61	LAFARGE ASO Cement Co. Ltd. , Tagawa Plant	Japan
62	LAFARGE, The Jordan Cement, Rashadiyah	Jordan
63	LAFARGE, The Jordan Cement Co.LTD Fuhais	Jordan
64	HEIDELBERGCEMENT, Bukhtarma	Kazakhstan
65	Caspi Cement LLC	Kazakhstan
66	Kaloleni Athi River Mining	Kenya
67	Jecheon-Si Asia Cement	Korea
68	Sam Cheok Tong Yang Cement	Korea
69	Sam Chok Tong Yang Major	Korea
70	Dong Hae Ssang Yung	Korea
71	Sung Shin Sung Shin Cement	Korea
72	Jangseong Eugene Corporation	Korea
73	LAFARGE, Halla Plant	Korea
74	Hanil Cement	Korea
75	Ferronikeli Complex L.L.C.	Kosovo
76	Broceni Readymix	Latvia
77	LCC, Benghazi Plant	Libya
78	Partner Teknik Turkey, Ahlia Cement Co. El Margeb	Libya
79	Akmenes Cementas	Lithuania
80	Pahang Cement Sdn. Bhd.	Malaysia
81	Lafarge Cement Wapco Nigeria Plc., Sagamu	Nigeria
82	Dangote Cement Plc., Ibese	Nigeria
83	Dangote Cement Plc., Obajana	Nigeria
84	LAFARGE Cement Wapco Nigeria Plc., Ewokoro II	Nigeria
85	West African Portland Cement, Ikeja	Nigeria
86	HEIDELBERGCEMENT, Brevik Plant	Norway
87	Bestway Cement Limited, Mustekham Plant	Pakistan
88	Bestway Cement Limited, Hattar Plant	Pakistan
89	Bestway Cement Limited, Zaveh-Torbat Plant	Pakistan
90	Bestway Cement Limited, Ardekan Palletizing Plant	Pakistan
91	Bestway Cement, Chakval Plant	Pakistan
92	Army Welfare Trust, Nizampur Cement Plant	Pakistan
93	Gharibwal Cement Limited	Pakistan
94	LAFARGE, Kujawy Plant	Poland
95	Glogow Copper Mining KGHM Polska Miedź	Poland
96	Brugmann S.A.	Poland
97	Odra Cement	Poland
98	Inowrocław Solino-Salt Mine	Poland
99	Evonik Carbon Black Polska	Poland
100	Kłodawa Salt Mining Plant	Poland
101	Nowiny Dyckerhoff	Poland
102	Warta Cement	Poland
103	Bukowa Lhoist	Poland
104	Energa-Hydro Power	Poland
105	Górażdże Cement	Poland
106	Hydro-Power Plant	Poland
107	Alstal Construction Group	Poland
108	HEIDELBERGCEMENT, Górażdże Cement	Poland
109	CEMEX, Rudniki Plant	Poland
110	Stomil S.A., Bydgoszcz	Poland
111	EDF TORUŃ S.A.	Poland
112	Orion Engineered Carbons Sp. z o.o., Jasło	Poland
113	Piec-Bud, Chorula	Poland
114	Remy Sp. s o.o., Głogów	Poland
115	ADM Szamotuły Sp. z o.o.	Poland
116	ESSROC/ITALCEMENTI, San Juan Plant	Puerto Rico
117	CEMEX, Ponce Plant	Puerto Rico
118	HEIDELBERGCEMENT, Fieni Plant	Romania
119	HEIDELBERGCEMENT, Deva Plant	Romania
120	HEIDELBERGCEMENT, Bicaz Plant	Romania
121	HOLCIM, Alesd Plant	Romania
122	HOLCIM, Schurovsky Cement Plant	Russia
123	Tulacement LLC	Russia
124	Shuravo Plant	Russia
125	Yamama Saudi Cement Co. Ltd.	Saudi Arabia
126	HOLCIM, Novi Popovac Plant	Serbia
127	Holcim (Slovensko) a.s., Turna n/Bodvou	Slovakia
128	Mondi SCP, a.s., Ruzomberok	Slovakia
129	LAFARGE, Trbovlie Plant	Slovenia
130	FYM/ITALCEMENTI, Arrigorriaga Cementos Rezola	Spain
131	FYM/ITALCEMENTI, Angora Cementos Rezola	Spain
132	FYM/ITALCEMENTI, Malaga Cementos Goliat	Spain
133	CEMEX, Lloseta Plant	Spain
134	CEMEX, Morata de Jalon	Spain
135	HOLCIM, Carboneras Plant	Spain
136	HOLCIM, Lorca Plant	Spain
137	HOLCIM, Gador Plant	Spain
138	Sociedad Financiera Y Minera S.A.	Spain
139	Idwala Lime	South Africa
140	Highveld Steel	South Africa
141	Arcelor Mittal	South Africa
142	Vesuvius	South Africa
143	HEIDELBERGCEMENT, Cementa Slite	Sweden
144	LAFARGE, Mbeya Cement Plant	Tanzania
145	SCCC Saraburi	Thailand
146	Bastas Baskent Cimento	Turkey
147	Denizli Cimento	Turkey
148	Mus Yurt Cimento	Turkey
149	Kumas Kutahya Manyesite	Turkey
150	NUH Cimento, Hereke	Turkey
151	Bolu Cimento Sanayii A.S.	Turkey
152	Bilecik Sancim Cimento	Turkey
153	Kahramanmaras Cimento-Beton	Turkey
154	LIMAK, Kurtalan	Turkey
155	LIMAK, Gaziantep	Turkey
156	LIMAK, Balikesir Cement Plant	Turkey
157	AS Cimento Sanayi Ve Ticaret A.S., Bucak	Turkey
158	OYAK, Mardin Cimento Sanai	Turkey
159	OYAK, Unye Cimento Sanai	Turkey
160	OYAK, Erdemir Plant	Turkey
161	OYAK, Adana Plant	Turkey
162	OYAK, Ladik Plant	Turkey
163	LAFARGE, Emirates Cement L.L.C.	UAE
164	ESSROC/ITALCEMENTI, Bessemer Plant	USA
165	ESSROC/ITALCEMENTI, Nazareth Plant	USA
166	ESSROC/ITALCEMENTI, Speed Plant	USA
167	ESSROC/ITALCEMENTI, Frederick Plant	USA
168	ESSROC/ITALCEMENTI, Logansport Plant	USA
169	HOLCIM, Mason Plant	USA
170	HOLCIM, IOWA Plant	USA
171	LAFARGE, Fredonia Plant	USA
172	HEIDELBERGCEMENT, Dniprocement	Ukraine
173	HEIDELBERGCEMENT, Amvrosiyivka Plant	Ukraine
174	HEIDELBERGCEMENT, Donetsk Plant	Ukraine
175	HEIDELBERGCEMENT, Kryvyi Rih Plant	Ukraine
176	Reinosa/Gerdau, Poltava Plant	Ukraine
177	YUGcement Public Join-Stock Company	Ukraine

We do love kilns and challenges. We are a small engineering company but the range of our activity is global. We have worked for all leading cement producers in the World, we have aligned and inspected kilns of all types and constructions, from two to eight supports, with grate or planetary coolers, made by all producers (FLS, Polysius, KHD, Humboldt, FCB, Fuller, Sket, PSP, Makrum, and many others). We are offering our services to all customers, no matter the country, continent or climate conditions and the only obstacle might be military conflict and embargo. So far we have visited over 200 plants in 49 countries and since the creation of our technology of Hot Kiln Alignment we have executed the inspection of over 1000 rotary kilns. We have defined and continue to define new trends in the field.

We would like to invite you to use our service.



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