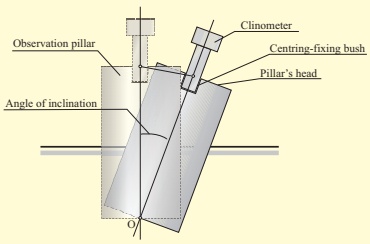
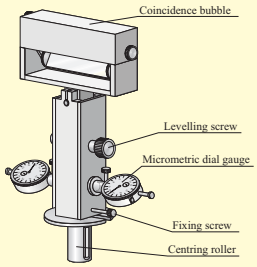
TESTING MEASUREMENTS OF THE PROTOTYPE OF LASER-PRISMATIC CLINOMETER FOR OBSERVATIONS PILLARS INCLINATION

K. Cmielewski, O. Jamroz, K. Kowalski

Institute of Geodesy and Geoinformatics, Agricultural University of Wroclaw
Grunwaldzka 53, 50-357 Wroclaw, Poland
Contact: jamroz@kgf.ar.wroc.pl / Fax: +4871 3205617

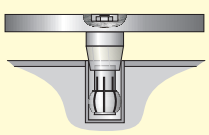


SCHEME OF MEASUREMENTS OF THE PILLAR INCLINATION

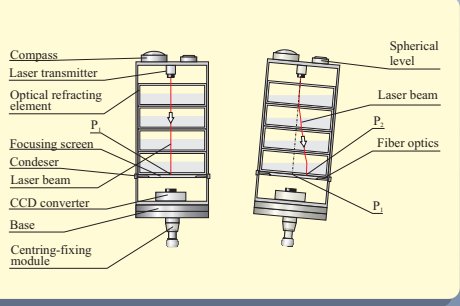


ANALOG CLINOMETER

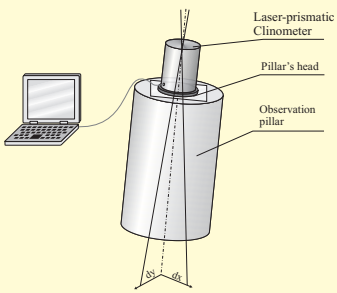
Laser beam is deflected in several liquid prisms of a variable breaking angle and registered using CCD converter with focusing screen. Focusing screen is equiped in four fiber optic conductors as reference points. Measurement range and observations accuracy of the clinometer are established. This new instrument makes possible to determine self movements and linear inclination of the observation pillars with high accuracy (approx 0,02 mm/m).

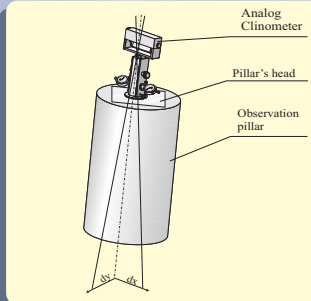


CENTRING-FIXING MODULE

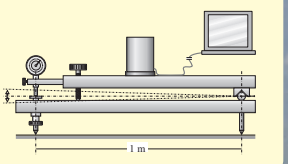


LASER-PRISMATIC CLINOMETER



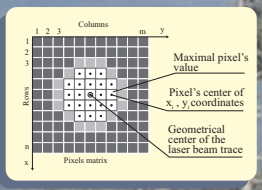


LASER-PRISMATIC AND ANALOG CLINOMETERS DURING THE PILLAR INCLINATION MEASUREMENTS

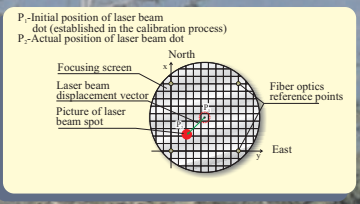


LASER-PRISMATIC CLINOMETER ON THE ADJUSTABLE EXAMINER

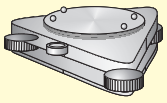
VIEW OF THE LASER BEAM DOT ON CCD CONVERTER



DETERMINATION OF THE LASER BEAM DOT CENTER IN 8-BIT GRAY SCALE



FOCUSING SCREEN WITH A PICTURE OF LASER BEAM TRACTS



FIXED EXAMINER

VIEW OF THE CLINOMETER'S MODULES (PROTOTYPE)

Table 1.

RESULTS OF OBSERVATIONS REPETABILITY FOR SIMULATED DIFFERENCES OF ELEVATION 1 mm/1 m

No.	Dot center coordinates y_i [mm]	Simulated value d_g [mm]	Dot center coordinates y'_i [mm]	Dot displacement in the picture scale $d_o = y'_i - y_i$ [mm]	Measured value of inclination $D = d_o \cdot k$ [mm]	$\Delta = D - d_g$ [mm]
1	9.899	1	9.944	0.045	1.023	0.023
2	9.902	1	9.945	0.043	0.977	-0.023
3	9.899	1	9.945	0.046	1.045	0.045
4	9.900	1	9.944	0.044	1.000	0.000
5	9.902	1	9.947	0.045	1.023	0.023
6	9.901	1	9.943	0.042	0.955	-0.045
7	9.898	1	9.944	0.046	1.045	0.045
8	9.899	1	9.943	0.044	1.000	0.000
9	9.899	1	9.942	0.043	0.977	-0.023
10	9.898	1	9.942	0.044	1.000	0.000
					RMS	**0.029** **4.2"**

Table 2.

RESULTS OF OBSERVATIONS FOR SIMULATED DIFFERENCES OF ELEVATION 0,1 mm/1 m

No.	Simulated value d_g [mm]	Dot center coordinates y_i [mm]	Dot displacement in the picture scale $d_o = y_{i+1} - y_i$ [mm]	Measured value of inclination $D = d_o \cdot k$ [mm]	$\Delta = D - d_g$ [mm]
1	0.0	10.357			
2	0.1	10.352	0.005	0.102	0.002
3	0.2	10.347	0.010	0.204	0.004
4	0.3	10.340	0.017	0.347	0.047
5	0.4	10.336	0.021	0.429	0.029
6	0.5	10.330	0.027	0.551	0.051
7	0.6	10.325	0.032	0.653	0.053
8	0.7	10.321	0.036	0.735	0.035
9	0.8	10.315	0.042	0.857	0.057
10	0.9	10.312	0.045	0.918	0.018
11	1.0	10.308	0.049	1.000	0.000
				RMS	**0.026** **5.3"**

Table 3.

RESULTS OF OBSERVATIONS FOR SIMULATED DIFFERENCES OF ELEVATION 1 mm/1 m

No.	Simulated value d_g [mm]	Dot center coordinates y_i [mm]	Dot displacement in the picture scale $d_o = y_{i+1} - y_i$ [mm]	Measured value of inclination $D = d_o \cdot k$ [mm]	$\Delta = D - d_g$ [mm]
1	0	10.355			
2	1	10.306	0.049	1.065	0.065
3	2	10.262	0.093	2.022	0.022
4	3	10.216	0.139	3.022	0.022
5	4	10.168	0.187	4.065	0.065
6	5	10.126	0.229	4.978	-0.022
7	6	10.077	0.278	6.043	0.043
8	7	10.033	0.322	7.000	0.000
9	8	9.986	0.369	8.022	0.022
10	9	9.941	0.414	9.000	0.000
11	10	9.896	0.459	9.978	-0.022
				RMS	**0.025** **5.2"**

Presented prototype of laser-prismatic clinometer is prepared to observe self movements of network points (concrete pillars) and to receive independent data of relative deformations of single crustal blocks. This clinometer is not competitive for other geodetic s instruments (GPS receivers, Total-Stations), but rather complementary for known methods of objects deformation determinations. Tested laser-prismatic clinometer (weight about 1 kg) is characterized by accuracy 5" and range approx +/-10° (calibration on the fixed and adjustable examiners). Increase of this instrument accuracy is possible by changing of optical elements quantity and improvement of laser transmitter power supply. Utility value, ergonomics and portativity of the instrument will be determined in real exploitation in the geodynamical networks.