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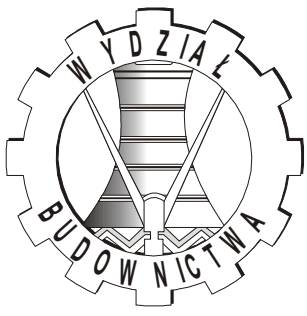


# **CONSISTENCY OF SCC AND ITS RELATIONSHIP WITH FORMWORK PRESSURE**

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Professor

**Michał Drewniok, MSCE**

Grzegorz Cygan, MSCE



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# **SYSTEMATICS OF THE PRESENTATION**

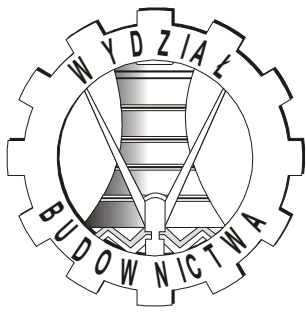
***1. Introduction***

***2. Experimental research***

***3. Experimental results***

***4. Conclusions***

***5. References***



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**The influence of time and  
technological factors on  
rheological properties of self  
compacting concrete in terms of  
the pressure on the formwork**

**2011 - 2014**

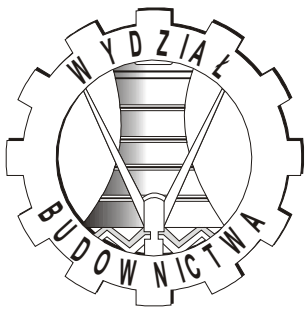
**The project is financed from the National  
Science Centre**

**No. 0842/B/T02/2011/40**

**In cooperation with Harsco  
Infrastructure Poland**

**HARSCO**  
INFRASTRUCTURE

*Regensburg, 06.03.2013*



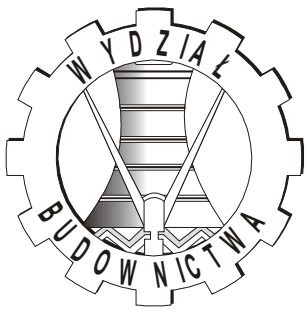
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## **PURPOSE OF THE RESEARCH**

*Knowledge about a nature of the rheological properties of SCC will enable to better understand the phenomena occurring in the processes related to casting a self-compacting concrete.*

*Understanding of the SCC **thixotropic behaviour** and the factors influencing that effect, will enable to practical use of this phenomenon to decrease concrete formwork pressure due to that mechanism. This will allow to optimum use of the formwork, by its proper design, particularly in terms of technology SCC.*

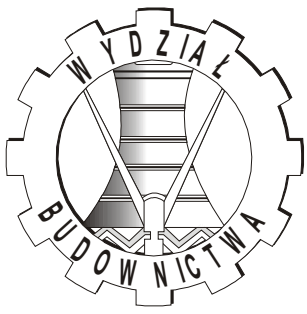


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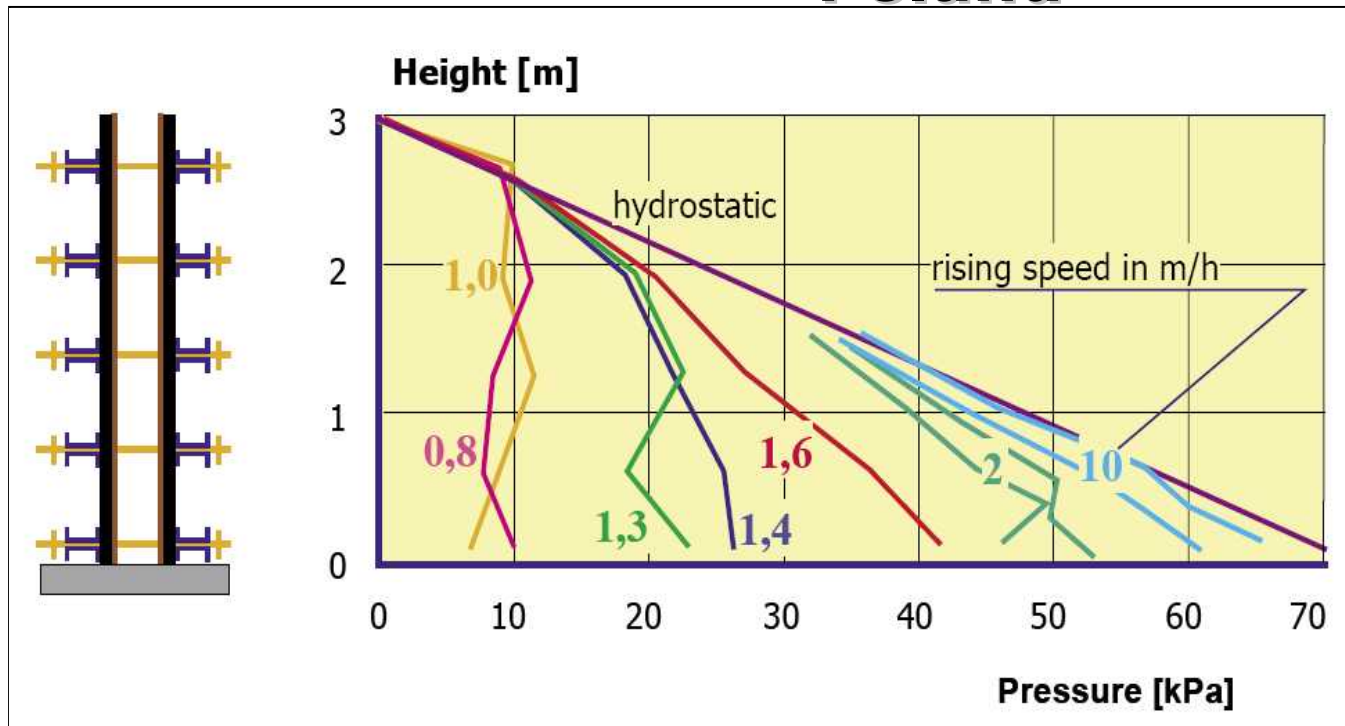


## **PURPOSE OF THE PRESENTATION**

***Purpose of the presentation is to show relationship between consistency of SCC (rheological properties of SCC) and its influence on formwork pressure (small part of research).***

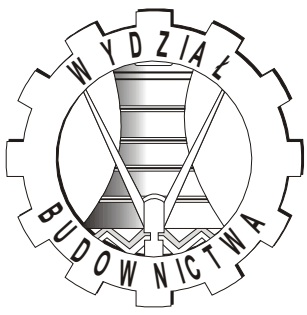


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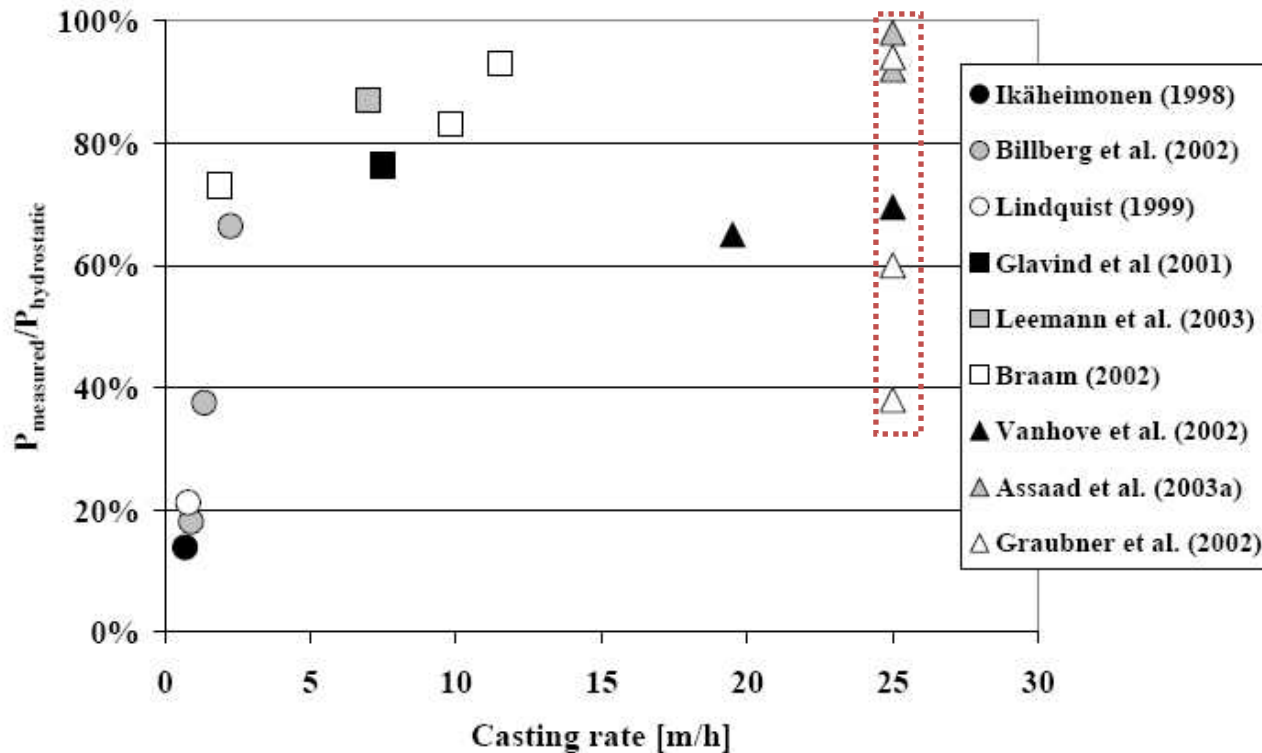


**Fig. 1 SCC Formwork pressure for various rising speeds of the concrete [1]**

**Photo: Akashi-Kaikyō Bridge**  
([www.pl.wikipedia.org](http://www.pl.wikipedia.org))

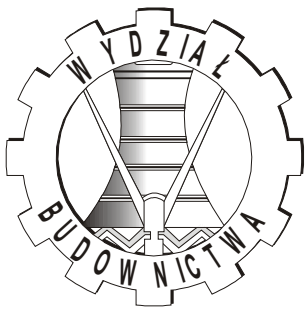


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**Fig. 2 Examples of reported form pressure when using SCC [2]**



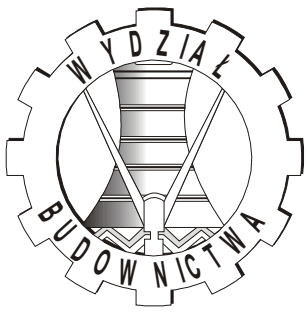


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**EXPERIMENTAL RESEARCH**





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*The rheological  
parameters of SCC were  
determined by using a  
rheometer Viskomat XL*

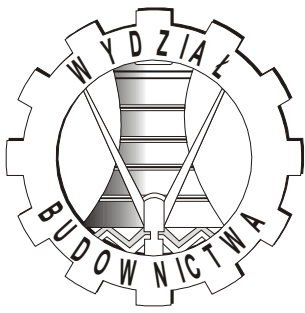
*The rheological  
properties of fresh  
concrete was described  
by the Bingham model [3]*



**Fig. 3 Circular probe for  
Viskomat XL** [www.schleibinger.com](http://www.schleibinger.com)



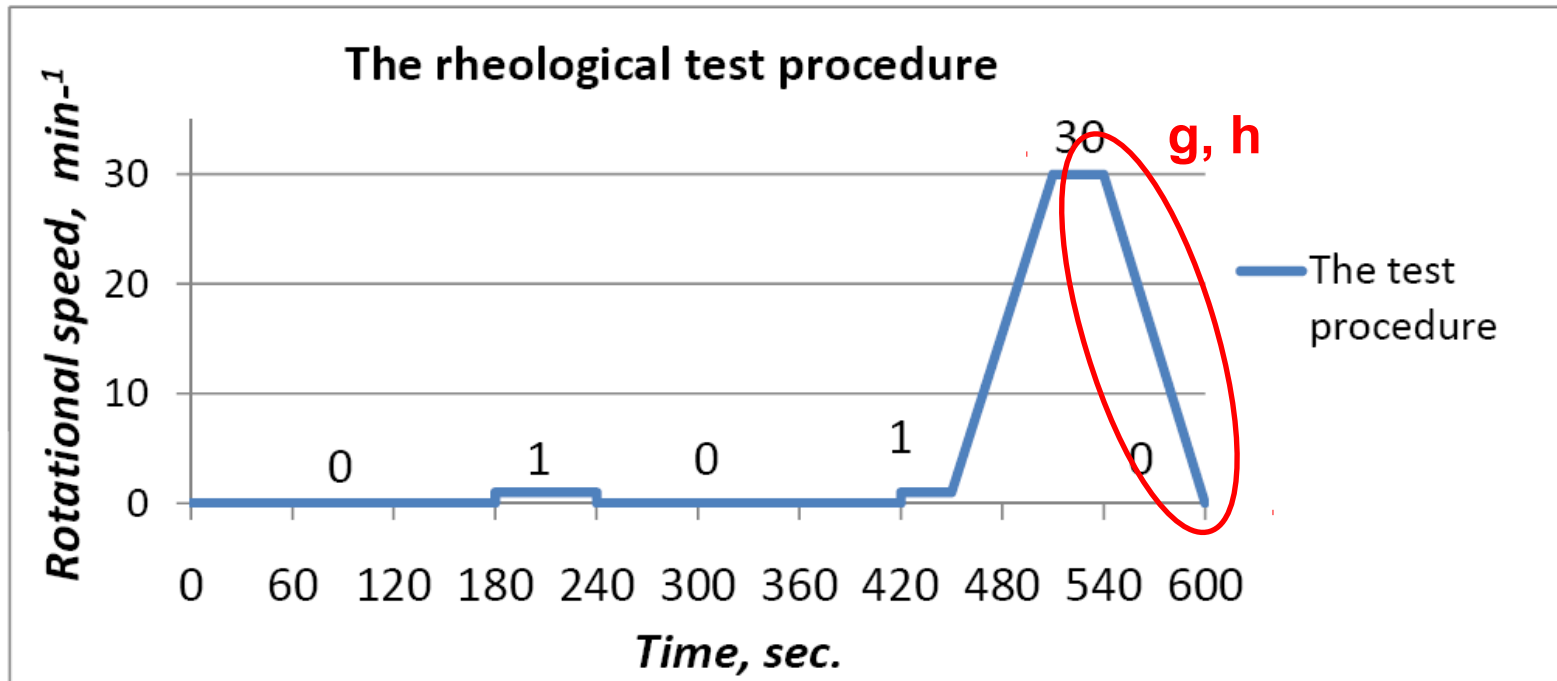
**Fig. 4 Viskomat**  
[www.schleibinger.com](http://www.schleibinger.com)



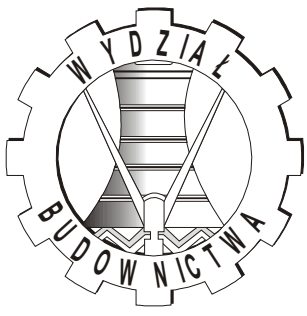
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## EXPERIMENTAL RESEARCH



**Fig. 5 Modified, according to the literature, Viskomat XL test procedure [4,5, Cheng]**



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### *Technical tests*

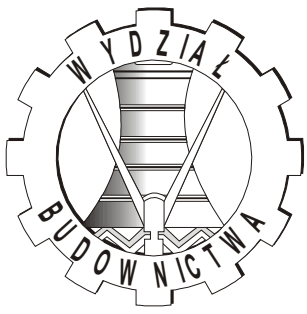
The slump flow test and  $t_{50\text{cm}}$  test (Abrams cone)

EN 12350 2 Testing fresh concrete: Part 2: Slump test  
EN 12350 8: Self-compacting concrete — Slump-flow test



**Fig.6 Slump-flow test**

(Photo: M.Drewniok, G.Cygan)



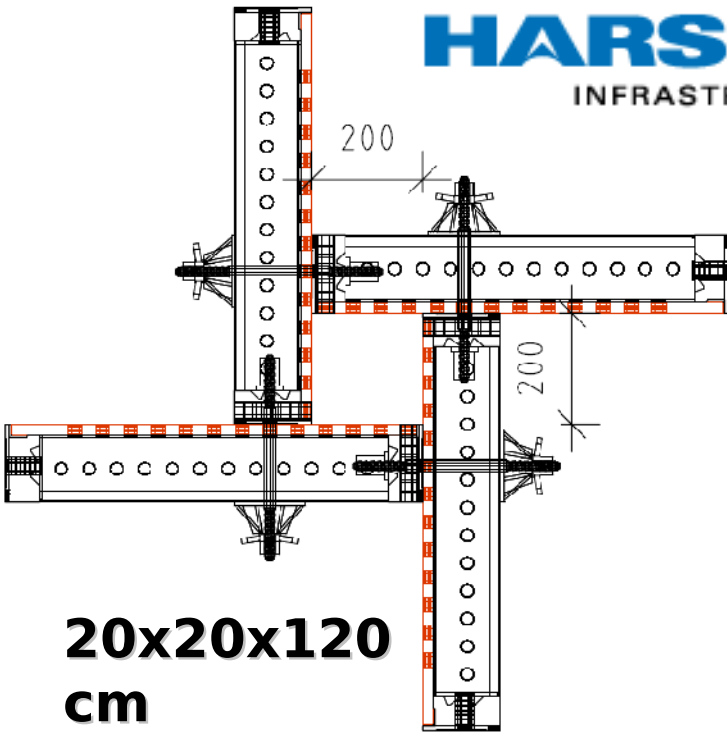
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## EXPERIMENTAL RESEARCH

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**20x20x120  
cm**

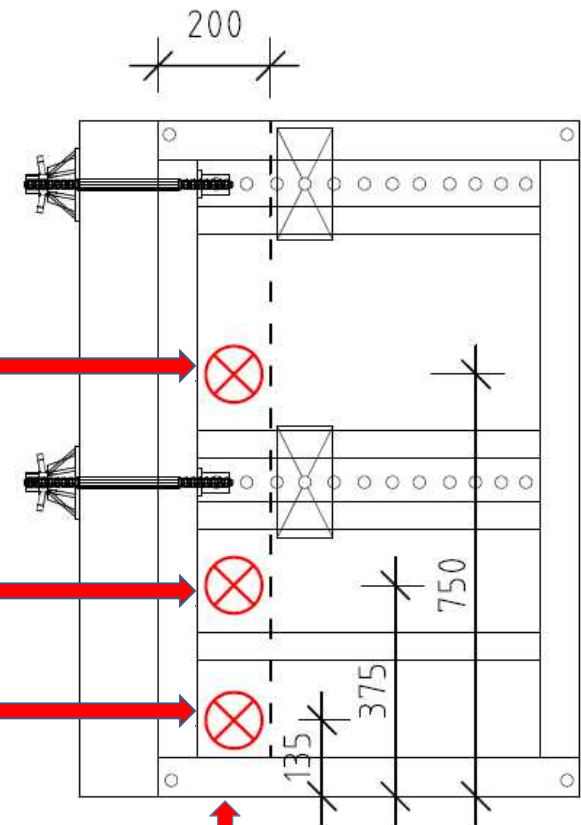
**Fig. 7 Laboratory model**

**SENSORS  
6,7**

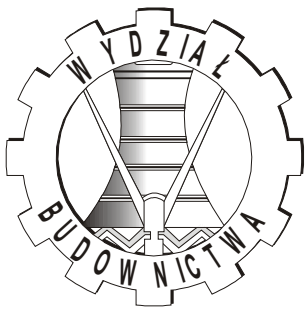
**SENSORS  
4,5**

**SENSORS  
2,3**

**SENSOR  
1**



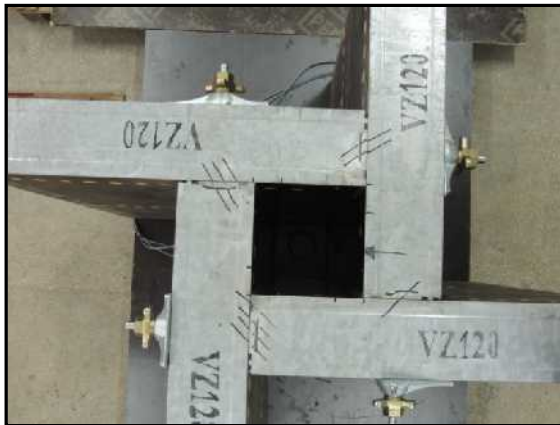




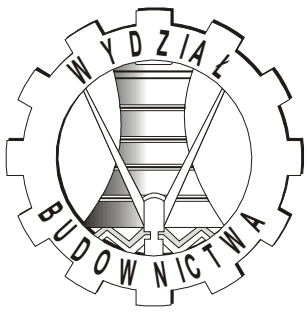
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## EXPERIMENTAL RESEARCH



**Photos: Laboratory model (M.Drewniok)**

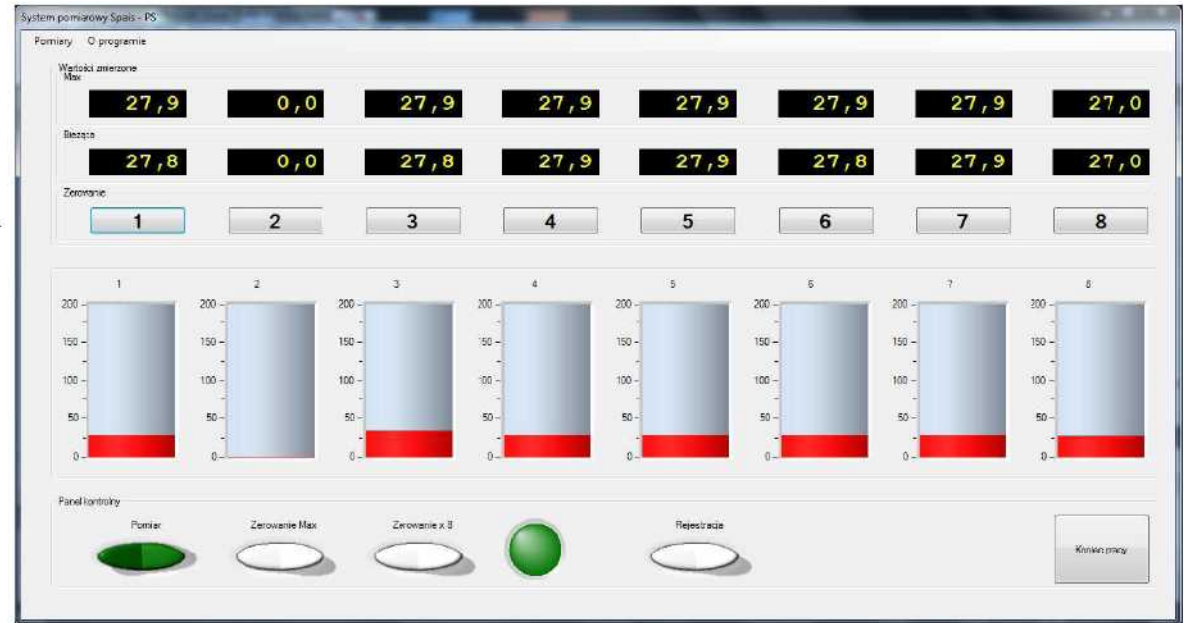
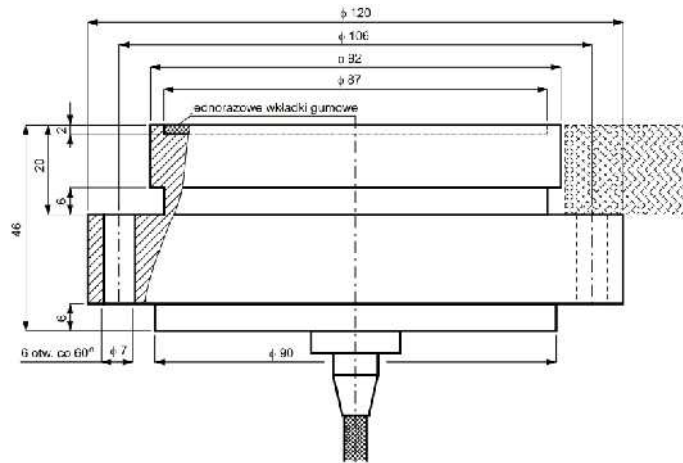


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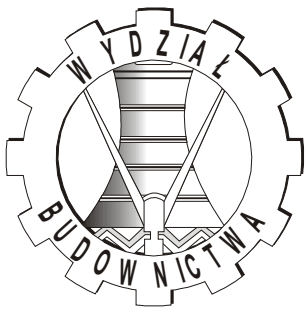


## EXPERIMENTAL RESEARCH

### Poliaid



**Fig. 8 Pressure sensors and its software**

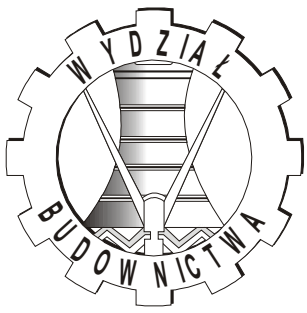


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# **EXPERIMENTAL RESULTS**

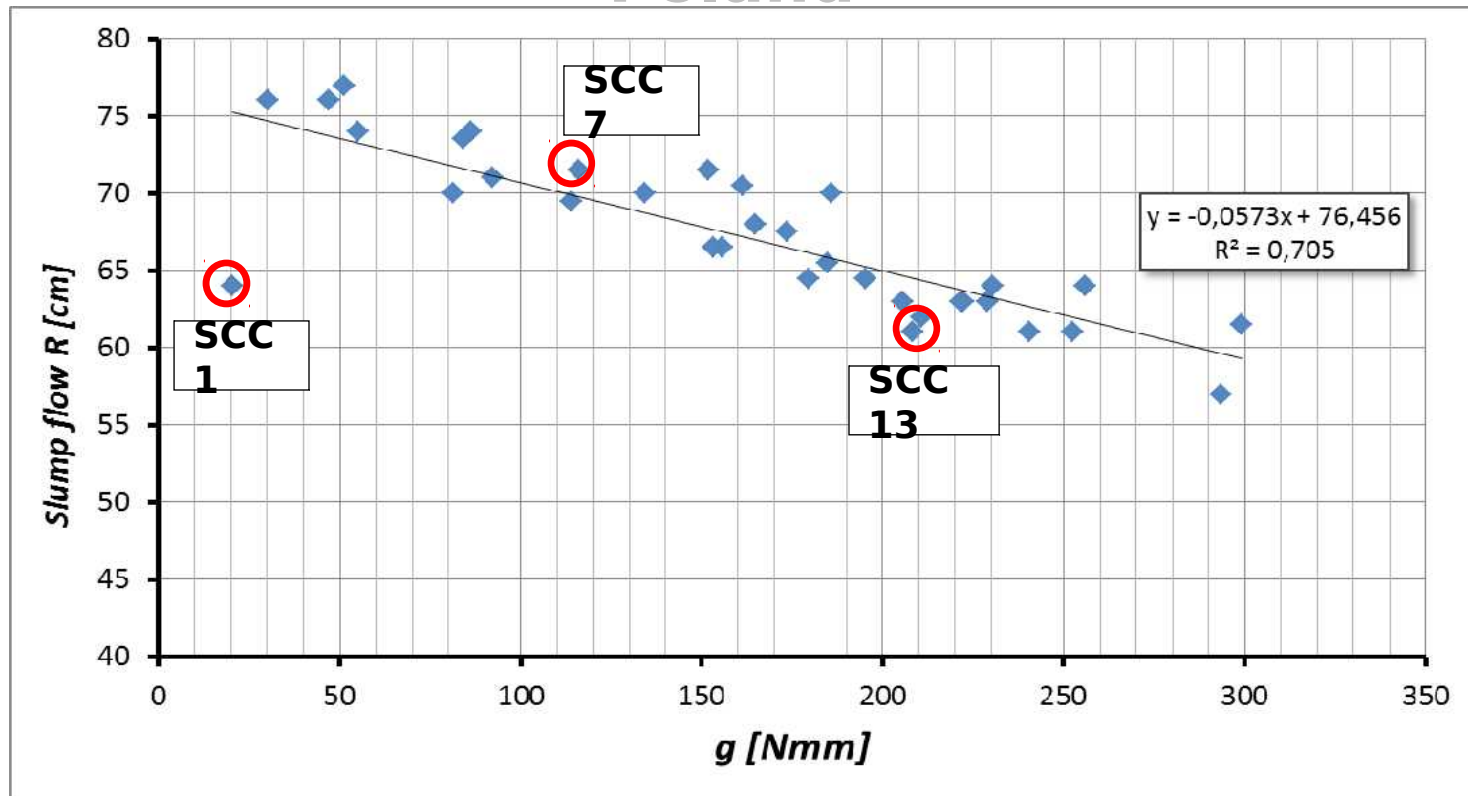




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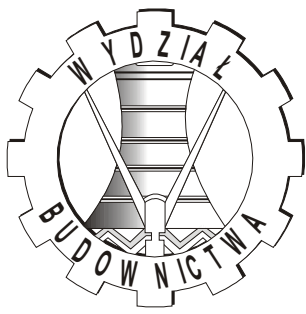


## EXPERIMENTAL RESULTS



**Fig. 9 Correlation between R [cm] and g [Nmm]**

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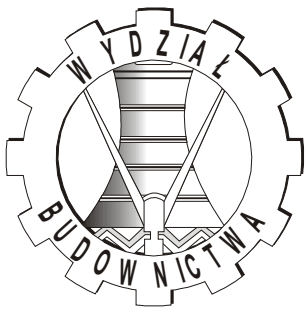


## EXPERIMENTAL RESULTS

Temperature 20 °C

Matherials		SCC 1	SCC 7	SCC 13
Cement type		CEM III 42,5 N	CEM I 42,5 R	CEM I 42,5 R
Cement	kg/m <sup>3</sup>	541,2	550,0	552,6
Water		162,4	165,2	165,8
w/b		0,3	0,3	0,3
Sand/Total aggregate	%	50%	50,0%	50,0%
Sand (0-2 mm)	kg	853,2	857,8	857,0
Coarse agg. (2-8 mm)		853,2	857,8	857,0
HWRA type - polycarboxylate ether		HWRA 1	HWRA 2	HWRA 3
HWRA content	%	3%	2%	3%
	kg	16,24	11,0	16,58
Slump flow	cm	64,0	71,5	61,0
T <sub>50</sub>	s	7,7	5,9	6,7
Yield value - g	Nmm	20,4	115,4	208,2
Plastic viscosity - h	Nmms	4993	1931	2258

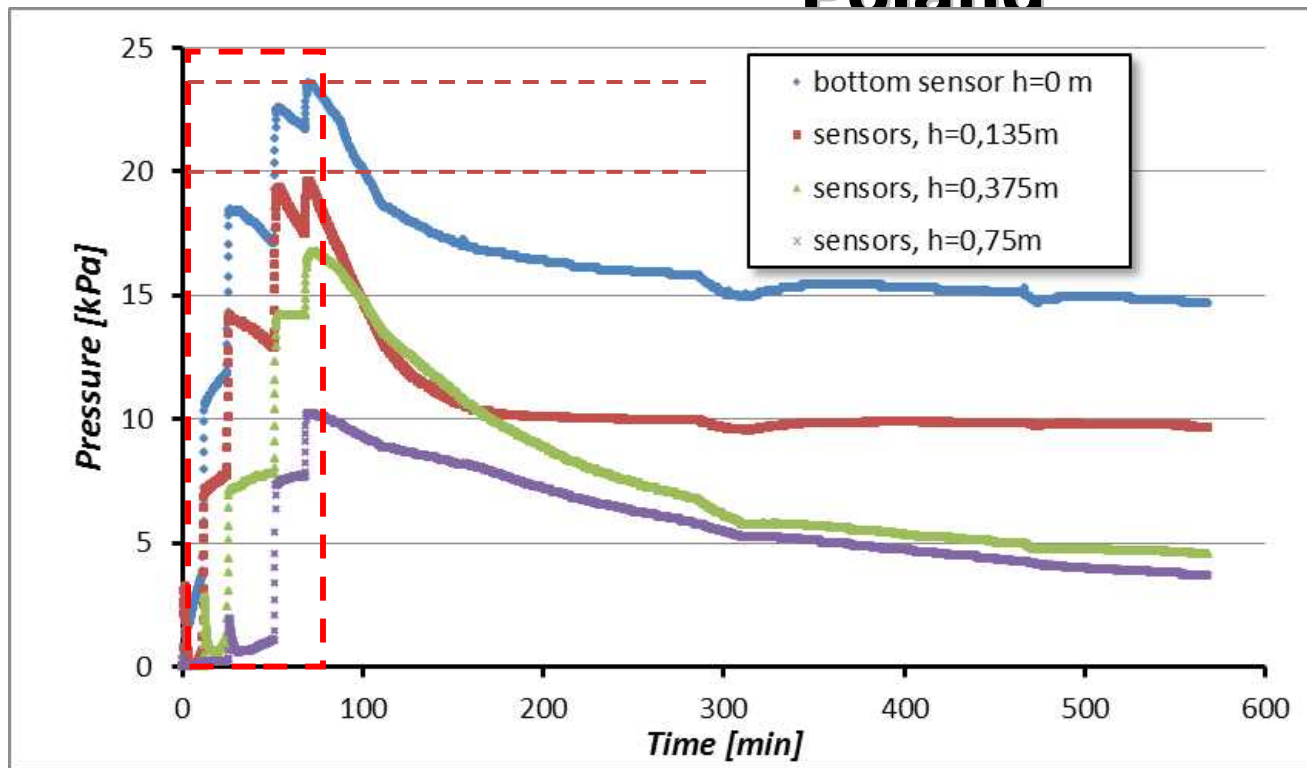
**Tab.1 Materials and composition of mortar**  
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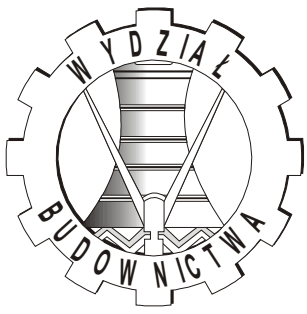


## EXPERIMENTAL RESULTS



--- concrete casting  
Rising speed 1 m/h

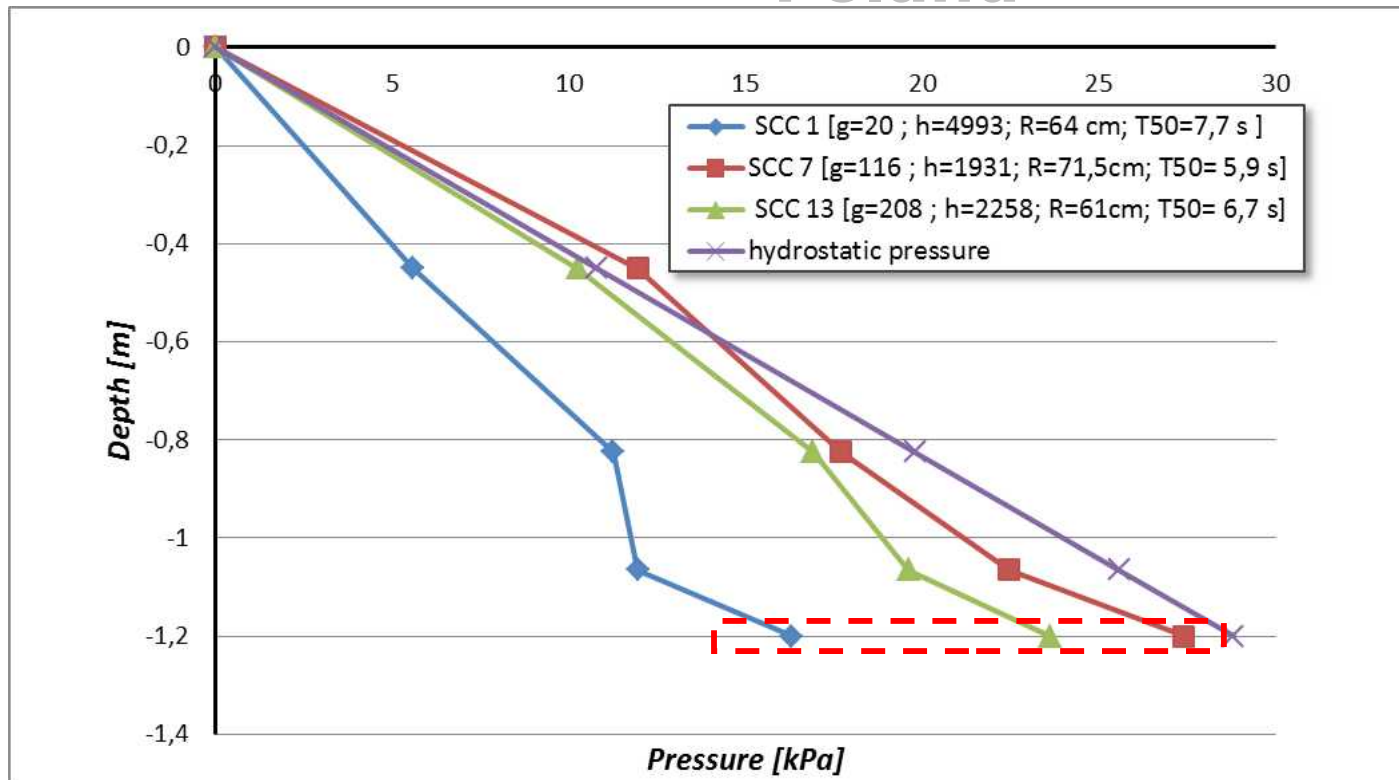
**Fig. 10 SCC 13 Formwork pressure for different sensors**



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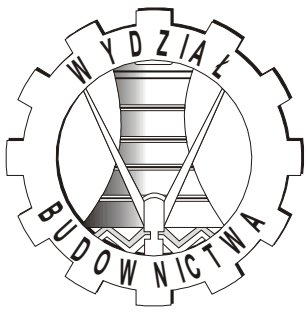


## EXPERIMENTAL RESULTS



**Fig. 11 Formwork pressure for different SCC (SCC1, SCC7, SCC13)**

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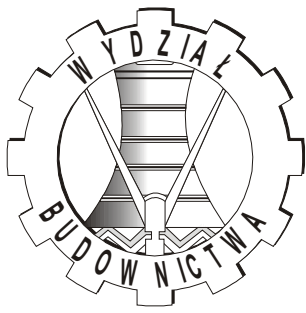
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- 1. Concrete mixtures which has very low yield stress and and very high plastic viscosity can reduce formwork pressure;**
- 2. Concrete mixtures which has largest and fastest slump flow can made a higher formwork pressure ;**
- 3. Increasing values of yield stress and plastic viscosity can reduce the formwork pressure.**

**NEXT ... collumns 270 cm, 540 cm high and**

*Rejensburg, 06.03.2013*



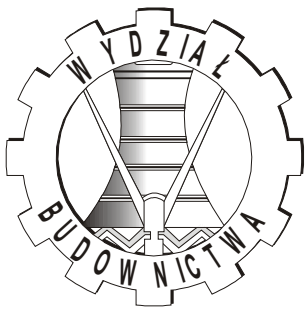
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- [1] Walraven J.: Taylor made concrete: a new approach in materials design. Delft University of Technology, Holland
- [2] Billberg P.: Form Pressure Generated by Self-Compacting Concrete - Influence of Thixotropy and Structural Behaviour at Rest. Doctoral Thesis, Royal Institute of Technology, Stockholm, Sweden, 2006
- [3] SZWABOWSKI J. red. Reologia w Technologii Betonu, Monografia. Wydawnictwo Politechniki Śląskiej, Gliwice 2009
- [4] KOEHLER Eric P.: Use Rheology to Specify, Design and Manage Self-Consolidating Concrete. 9th ACI International Conference on Superplasticizers & 10th International Conference on Recent, Seville, Spain, October 2009, p. 609-623.
- [5] PETIT J.Y., VANHOVE Y., WIRQUIN E. HELNAN-MOUSSA B.: Evaluation of the cement paste thixotrophy. Second International Symposium on Design, Performance and Use of Self-Consolidating Concrete, SCC'2009, China, Beijing, China, June 5-7 2009, pp. 526-533.

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