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Vojvode Stepe 251, Beograd.

## **REPORT**

### **ON TESTING OF PREFABRICATED SIMPROLIT FLOOR PLATES' BEHAVIOR UNDER LOAD**

(This Report is a part of the scientific-research project: "Research, implementation and application of contemporary materials and products in Civil engineering")

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# REPORT

## ON TESTING OF PREFABRICATED SIMPROLIT FLOOR PLATES' BEHAVIOR UNDER LOAD

### 1. GENERAL FACTS

- 1.1 Customer: SIMPRO, Engineering, consulting and trade company, Vojvode Stepe 251, 11000 Belgrade.
- 1.2 Contractor: Faculty of Civil Engineering - University of Belgrade - Institute for materials and structures (IMK), Bulevar kralja Aleksandra 73, 11000 Beograd.
- 1.3 Subject: testing of prefabricated SIMPROLIT floor plates' behavior under load.
- 1.4 Product type: prefabricated single-layered (SOP) and three-layered (SUP) floor plates made of Simprolit - patented lightweight composite based on cement, water, expanded polystyrene grains (EPS) and special admixtures.
- 1.5 Author of the system: DTech. Milan Dević, General manager of «Simpro» V.Stepe 251/49 Belgrade and «Simpro Ru» Dm.Uljanova 16/2/316 Moscow.

This Report is made in accordance to the contract No. 92120/3 from November 14, 2002 signed between the firm SIMPRO and the Faculty of Civil engineering - University of Belgrade, as participants in the realization of the project "Research, implementation and application of contemporary materials and products in Civil engineering " financed by the Serbian Ministry of science, technology and development.

### 2. LABORATORY TESTS

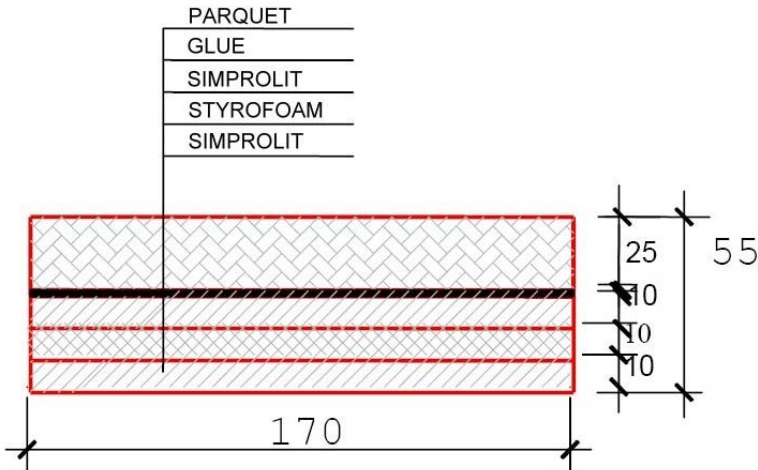
During laboratory testing two types of prefabricated Simprolit floor plates were considered:

- single-layered plates (SOP) made of Simprolit monolith;
- three-layered plates (SUP) consisting of one styrofoam layer placed between two Simprolit layers.

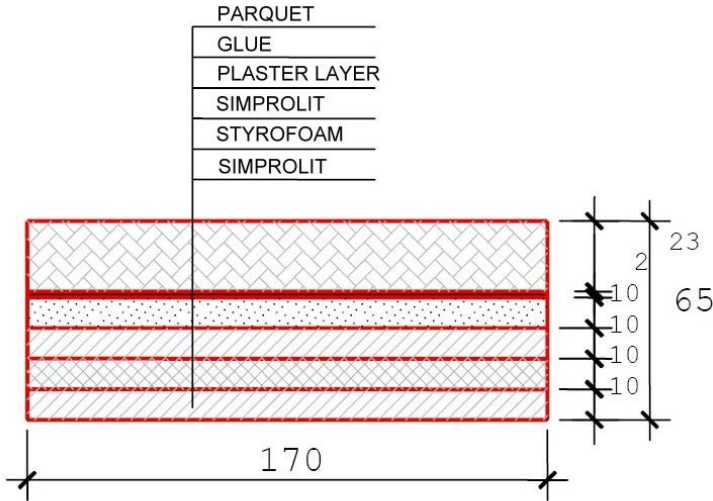
In both cases the thickness of the tested plates was 3 cm, which means that the three-layered (SUP3) plate consisted of two Simprolit layers (1 cm each) with a styrofoam layer of the same thickness between them. Considering three-layered Simprolit plates, two characteristic cases were analyzed - when the upper side of the plate was plastered with approximately 1 cm plaster layer, i.e. the case without plastering.

In order to define the behavior of the prefabricated plates subjected to the compressive load, the specimens with dimensions 17x17 cm were cut out of these plates. After that, 2.3 cm parquet cover was glued on the upper surface of the specimens using approximately 2 mm thick glue layer. All three characteristic types of the specimens (SOP3, SUP3 with plaster layer and SUP3 without plastering) are shown at the Figure 1.

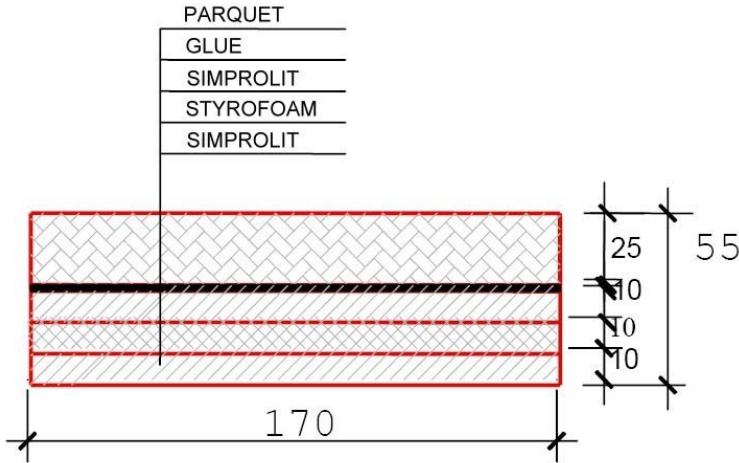
Figure 1. The specimens of Simprolit single-layered (SOP) and three-layered prefabricated floor plates



SAMPLE 1 (SOP3)



SAMPLE 2 (SUP3)



SAMPLE 3 (SUP3)

### 3. THE TESTING PROCEDURE AND THE OBTAINED RESULTS

The testing of all the above-mentioned types of Simprolit prefabricated floor plate specimens was conducted according to the disposition showed at the Figure 2. As one can see, it was a compressive test at which the vertical deformations were measured (using deflectometers U1, U2, U3 and U4 placed at corner points of the specimen) for different force values. Except for the force P (measured in daN) and vertical deformation U (measured in mm), the corresponding stress values  $\sigma$  (in MPa) were also calculated.

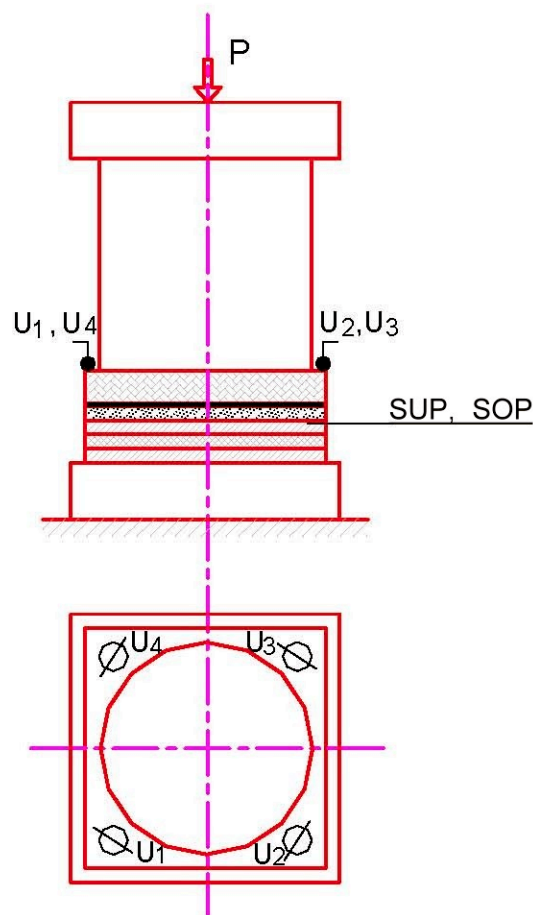


Figure 2. The disposition of the test

The mean values of the obtained laboratory testing results are shown in the following tables 1, 2 and 3, as well as in the form of the corresponding diagrams presented at Figures 3,4 and 5. Besides, at Figure 6 all three  $\sigma$ -U relations are shown at the same diagram.

The photographs taken during the described testing are also given in the Appendix.

Table 1. The testing results of the single-layered (SOP3) plate

Specimen	Force P	Stress $\sigma$	Deflectometer reading				Differences (mm)				Vert. defor. r. (mm)
			Measuring point								
	daN	MPa	U1	U2	U3	U4	$\Delta_1$	$\Delta_2$	$\Delta_3$	$\Delta_4$	U
- 1 (SOP3) -	0	0	2002	1918	2230	1946	-	-	-	-	-
	100	0.035	2002	1917	2227	1945	0.00	0.01	0.03	0.01	0.01
	200	0.069	2001	1914	2224	1943	0.01	0.04	0.06	0.03	0.04
	300	0.104	1995	1909	2219	1940	0.07	0.09	0.11	0.06	0.08
	400	0.138	1990	1905	2215	1937	0.12	0.13	0.15	0.09	0.12
	500	0.173	1985	1901	2210	1933	0.17	0.17	0.20	0.13	0.17
	600	0.208	1980	1897	2206	1930	0.22	0.21	0.24	0.16	0.21
	700	0.242	1977	1894	2202	1928	0.25	0.24	0.28	0.18	0.24
	800	0.277	1973	1891	2199	1925	0.29	0.27	0.31	0.21	0.27
	900	0.311	1970	1889	2195	1923	0.32	0.29	0.35	0.23	0.30
	1000	0.346	1967	1886	2193	1921	0.35	0.32	0.37	0.25	0.32
	1100	0.381	1963	1884	2189	1918	0.39	0.34	0.41	0.28	0.36
	1200	0.415	1960	1881	2187	1916	0.42	0.37	0.43	0.30	0.38
	1300	0.450	1957	1879	2184	1914	0.45	0.39	0.46	0.32	0.41
	1400	0.484	1953	1875	2182	1912	0.49	0.43	0.48	0.34	0.44
	1500	0.519	1950	1872	2178	1909	0.52	0.46	0.52	0.37	0.47
	1600	0.554	1948	1870	2176	1907	0.54	0.48	0.54	0.39	0.49
	1700	0.588	1945	1867	2174	1905	0.57	0.51	0.56	0.41	0.51
	1800	0.623	1942	1863	2171	1902	0.60	0.55	0.59	0.44	0.55
	1900	0.657	1939	1859	2167	1899	0.63	0.59	0.63	0.47	0.58
2000	0.692	1856	2164	1895	0.66	0.62	0.66	0.51	0.61	0.60	
2100	0.727	1852	2161	1892	0.70	0.66	0.69	0.54	0.65	0.63	
2200	0.761	1847	2157	1888	0.73	0.71	0.73	0.58	0.69	0.68	
2300	0.796	1843	2154	1885	0.77	0.75	0.76	0.61	0.72	0.71	
2400	0.830	1839	2150	1881	0.80	0.79	0.80	0.65	0.76	0.75	
2500	0.865	1834	2146	1877	0.83	0.84	0.84	0.69	0.80	0.79	
3000	1.038	1792	2110	1844	1.29	1.26	1.20	1.02	1.19	1.17	

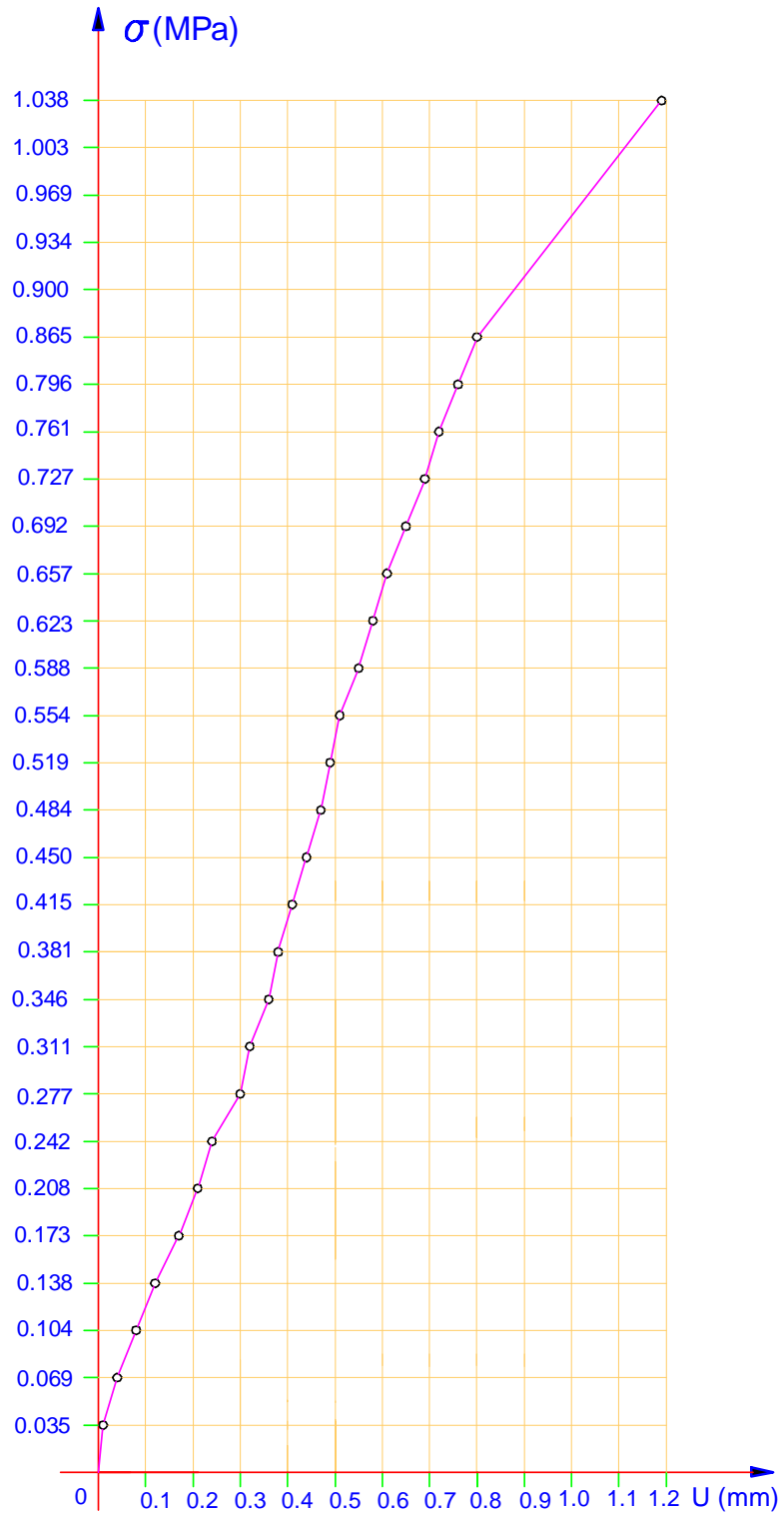


Figure 3. Diagram Stress-Vertical deformation for specimen number 1 - single-layered (SOP) plate

Tabele 2. The testing results of the three-layered (SUP) plate with plaster layer on the upper surface

Specimen	Force P	Stress $\sigma$	Deflectometer reading				Differences (mm)					Vert. defor. (mm)
			Measuring point									
			U1	U2	U3		daN	MPa	U1	U2	U3	
- 2 (SUP3)	0	0	2057	1929	1965	2306	-	-	-	-	-	
	100	0.035	1995	1872	1893	2228	0.62	0.57	0.72	0.78	0.67	
	200	0.069	1872	1734	1741	2085	1.85	1.95	2.24	2.21	2.06	
	300	0.104	1684	1541	1532	1892	3.73	3.88	4.33	4.14	4.02	
	400	0.138	1575	1425	1406	1779	4.82	5.04	5.59	5.27	5.18	
	500	0.173	1478	1318	1293	1676	5.79	6.11	6.72	6.30	6.23	
	600	0.208	1406	1237	1209	1600	6.51	6.92	7.56	7.06	7.01	
	700	0.242	1342	1167	1137	1533	7.15	7.62	8.28	7.73	7.70	
	800	0.277	1295	1116	1085	1486	7.62	8.13	8.80	8.20	8.19	
	900	0.311	1256	1073	1041	1446	8.01	8.56	9.24	8.60	8.60	
	1000	0.346	1219	1030	999	1408	8.38	8.99	9.66	8.98	9.00	
	1100	0.381	1174	985	955	1365	8.83	9.44	10.10	9.41	9.45	
	1200	0.415	1146	949	917	1331	9.11	9.80	10.48	9.75	9.79	
	1300	0.450	1117	918	885	1301	9.40	10.11	10.80	10.05	10.09	
	1400	0.484	1095	893	859	1276	9.62	10.36	11.06	10.30	10.34	
	1500	0.519	1072	869	834	1262	9.85	10.60	11.31	10.44	10.55	

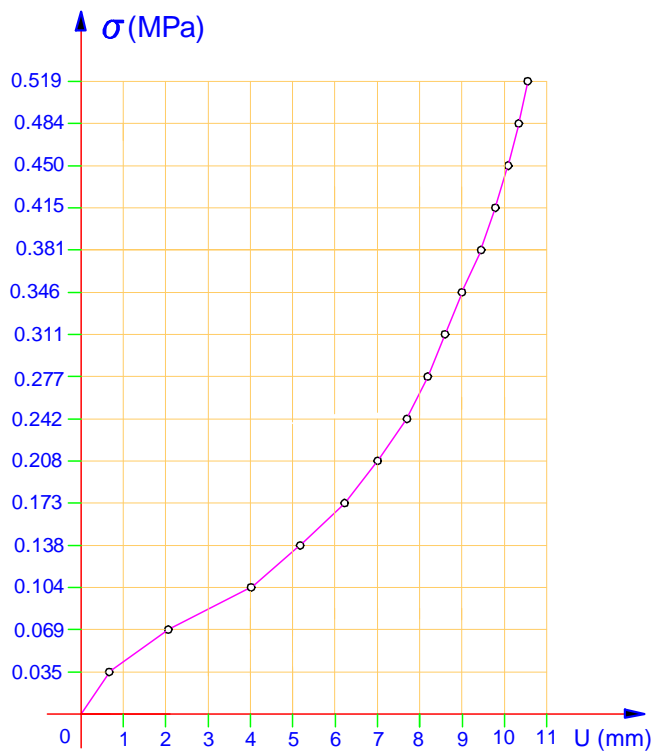


Figure 4. Diagram Stress-Vertical deformation for specimen number 2 - three-layered (SOP) plate with plaster layer at the surface

Table 3. The testing results of the three-layered (SUP) plate without plastering

Specimen	Force <b>P</b>	Stress <b><math>\sigma</math></b>	Deflectometer reading				Differences (mm)				Vert. defo r. (mm)
			Measuring point				daN	MPa	U1	U2	
	daN	MPa	U1	U2	U3		daN	MPa	U1	U2	U3
- 3 (SUP3) -	0	0	1966	1922	1929	2066	-	-	-	-	-
	100	0.035	1861	1841	1803	1912	1.05	0.81	1.26	1.54	1.17
	200	0.069	1646	1630	1563	1680	3.20	2.92	3.66	3.86	3.41
	300	0.104	1526	1503	1423	1522	4.40	4.19	5.06	5.44	4.77
	400	0.138	1429	1387	1297	1397	5.37	5.35	6.32	6.69	5.93
	500	0.173	1356	1320	1225	1329	6.10	6.02	7.04	7.37	6.63
	600	0.208	1307	1263	1164	1271	6.59	6.59	7.65	7.95	7.20
	700	0.242	1264	1216	1114	1224	7.02	7.06	8.15	8.42	7.66
	800	0.277	1232	1178	1074	1185	7.34	7.44	8.55	8.81	8.04
	900	0.311	1201	1141	1036	1151	7.65	7.81	8.93	9.15	8.39
	1000	0.346	1174	1111	1004	1121	7.92	8.11	9.25	9.45	8.68
	1100	0.381	1145	1080	972	1089	8.21	8.42	9.57	9.77	8.99
	1200	0.415	1119	1050	940	1060	8.47	8.72	9.89	10.06	9.29
	1300	0.450	1101	1031	920	1042	8.65	8.91	10.09	10.24	9.47
	1400	0.484	1080	1010	896	1022	8.86	9.12	10.33	10.44	9.69
1500	0.519	1052	980	865	992	9.14	9.42	10.64	10.74	9.99	

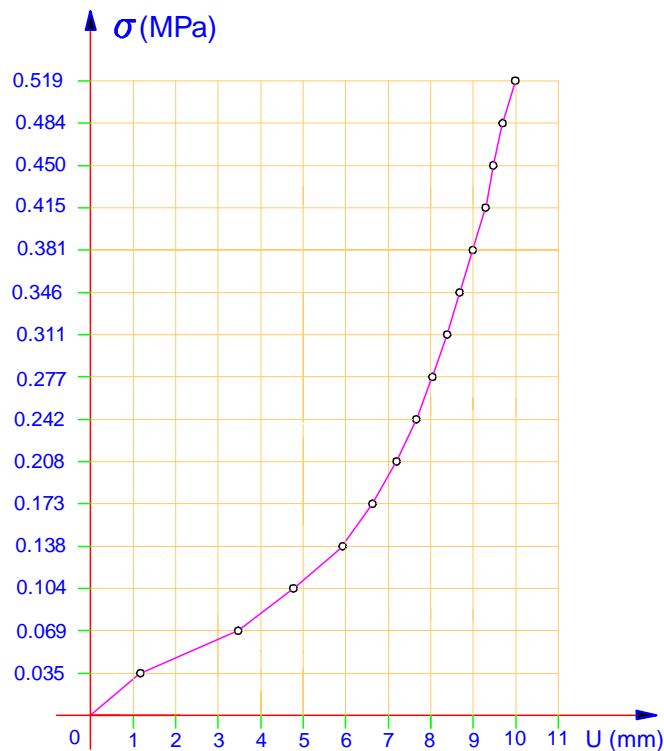


Figure 5. Diagram Stress-Vertical deformation for specimen number 3 - three-layered (SOP) plate without plastering



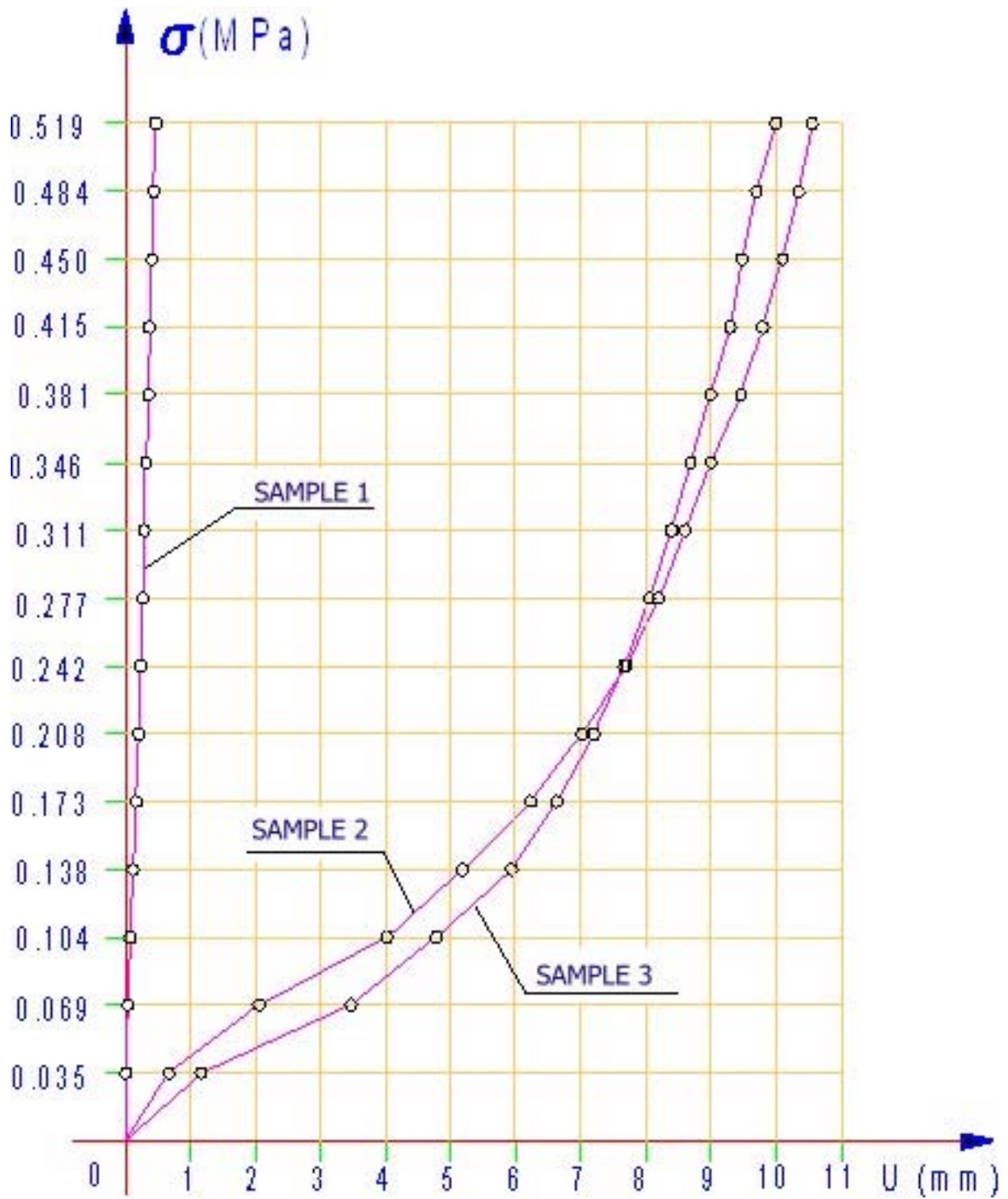


Figure 6. Comparative diagram Stress-Vertical deformation for all 3 types of Simprolit prefabricated floor plate specimens

#### 4. CONCLUSIONS

Based on the above-presented laboratory results, the general conclusion can be drawn that the tested prefabricated SIMPROLIT floor plates fulfill all requirements concerning the necessary bearing capacity. Also, the deformations registered during compressive load testing are inside the allowed limits defined for this type of structural elements. It must be underlined that the single-layered Simprolit plates (SOP3) have shown much lower vertical deformation values compared to the three-layered (SUP3) plates of the same thickness. The explanation of this phenomenon is based on the fact that the middle layer of SUP plates consists of styrofoam, whose deformations are far bigger than Simprolit's deformations at the same load level. Besides, the fact must be emphasized that the  $\sigma$ -U diagrams of specimen types 2 and 3 are approximately the same, which means that the 1 cm thick plaster layer applied over the upper surface of the specimen number 2 had practically no influence on the vertical deformation value.

Based on the presented experimental results, the conclusion can also be drawn that the tested three-layered (SUP) plates had vertical deformations of approximately one tenth of a millimeter for the usual load values (under  $500 \text{ kg/m}^2$ ), while these deformations measured on single-layered (SOP) plates had even smaller values.

Having all the above-stated facts in mind, it may be concluded that both single-layered and three-layered SIMPROLIT plates fulfill the necessary requirements for application as prefabricated floor plates. However, in every single case of application one must follow the recommendations given by the producer.

Finally, the fact must be underlined that this Report represents a part of the scientific-research project: "Research, implementation and application of contemporary materials and products in Civil engineering" for the year 2003 - related to the implementation and application of Simprolit as a contemporary building material.

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