THE IMPACT OF THE METHOD OF ANCHORING THE FAÇADE TEXTURE LAYER ON THE DURABILITY OF IS FIXING

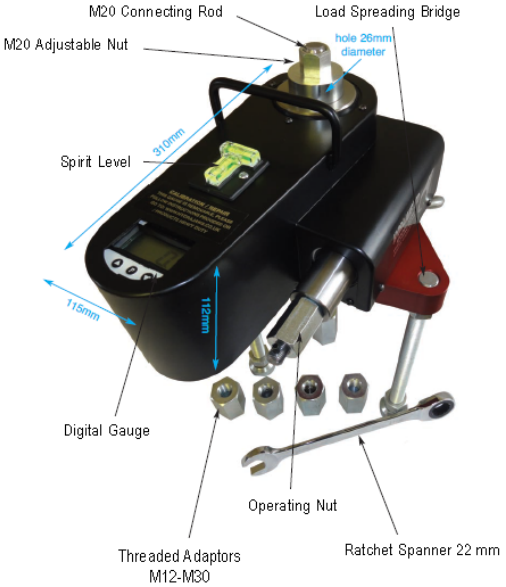
Dariusz Tomaszewicz

1. Introduction

Problems of large-plate construction are covered in many publications, articles and conference materials[1,2,3,3,4,5,6]. Starting from the location and impact of this fact (e. g. shocks in mines), ending with random events (vehicle collision, gas explosion or terrorist attack). The subject matter was reduced to 6 samples, which were reproduced as sections of three-layer slabs with existing reinforcement and new bonded anchors. The load-bearing capacity of anchoring both perpendiculars to the concrete surface and angle.

Additional anchors are naturally glued together to extend the lifespan of the individual layers. This is an elongation associated with the operation of additional anchors made of stainless steel and epoxy resin with specific strength parameters. After these reinforcements have been made, thermomodernisation works are being carried out, which will give new colors to façades in large-panel buildings and eliminate the destructive influence of weather conditions on the façade texture layer [7].

2. Description of the device used and the course of the research



The research was carried out using the Hydrajaws 2008 Pull-out Tester (fig. 1). The tester is designed to linearly check the load capacity of the anchor. This applies both to bonded anchors (resin) and mechanical anchors.

Figure 1. Hydrajaws 2008 Pull-out Tester for checking anchor load capacity on pull-out

The device consists of a bridge with two mounting positions for the tester. They give two different edge test distances in relation to the set test. When starting the test, 3 M20 feet should be attached to the sternum and the nut should be adjusted according to the required test. The tester is mounted in the required position and has been secured with fastening screws underneath the bridge, thus achieving a connection to the threaded holes in the tester. The tester was positioned in such a way that the threaded rod M20 passed through it and was connected to the threaded adapter M12. The M20 adjusting nut was then mounted on the threaded spindle and the tester was adjusted on the tripod rotor with rotating feet in such a way that the test runs smoothly between the crankshaft nut and the upper edge of the tester. In this case, the electronic indicator could be activated and the load applied to the hexagon nut by turning clockwise until the required test load was achieved. Once it is reached, the increase of force increases decreases [8].

2.1. Research samples

The research was carried out on six samples whose cross-sections are shown in Figure 2.

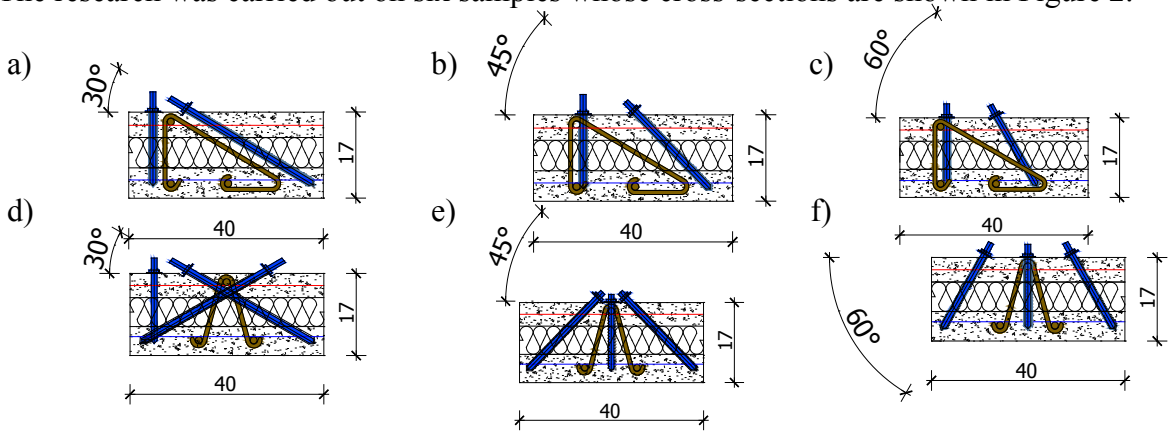


Figure 2. Diagrams of sample cross-sections with a stabilizing hanger with a diameter of 6 mm and anchors with a diameter of Ø 12 mm

The specimens, the cross-sections of which are shown in Figure 2, are made of C 12/15 concrete. The reinforcement was used for hangers in the form of ordinary rods Ø 6 mm and for the construction of reinforcement grid steel wire Ø 3 mm with mesh size 3 x 3 cm. Inside there is a 5 cm thick foamed polystyrene insulation layer. The new anchorages were made of M12 rods and bonded with epoxy resin.

3. Summary of research results

The research was conducted courtesy of KOELNER S.A and included in Table 1.

Table 1. Results of research load capacity of anchors for pull-out in three-layer samples

Sample number	Anchor pull-out force [kN]			Notes
	point anchor	diagonal anchor		
two anchor system COPY-ECO				
1	5,7	8,0		sample broke
2	6,2	10,7		sample broke
3	6,8	4,0		sample broke
three anchor system				
		diagonal anchor 1	diagonal anchor 2	
4	5,5	4,0	8,0	sample broke
5	9,0	7,0	4,0	sample broke
6	11,2	8,0	9,5	sample broke

The diagonal anchors, modelled on the COPY-ECO[9] system, were examined to prove their validity. The research did not achieve the desired effect due to the brittle cracking of concrete, caused by pulling out a single anchor and at the same time weakening the concrete surface around another anchor.

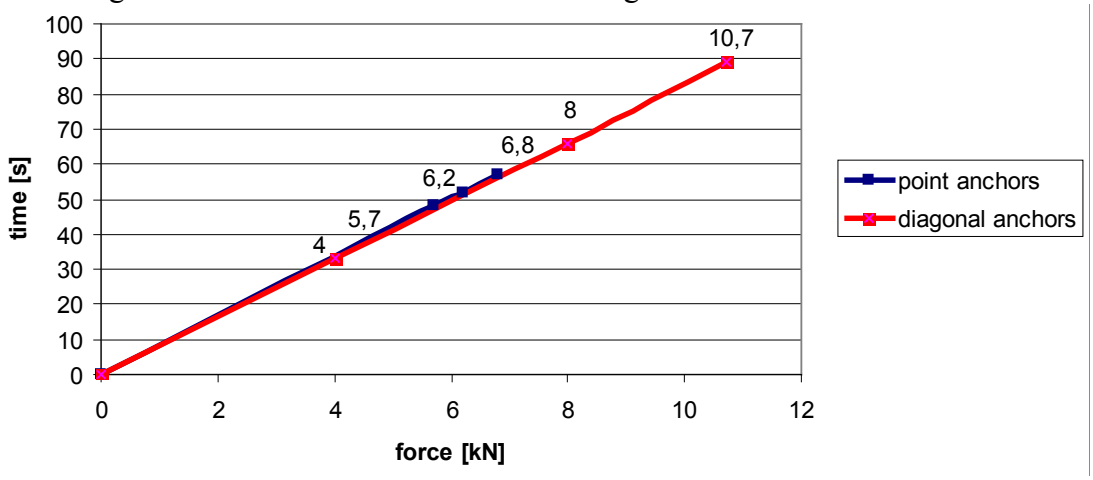


Figure 3. Determine the increment of the anchoring pull-out force of the anchor over time for two-anchors samples

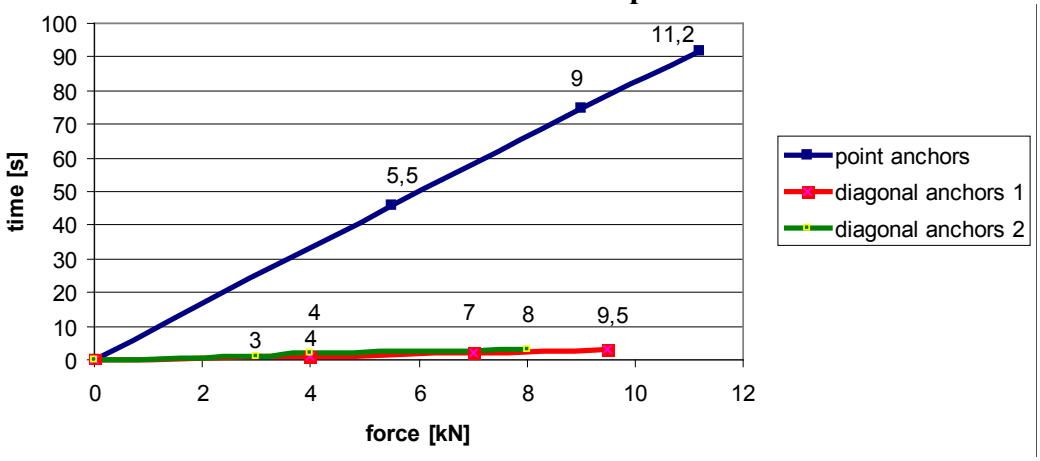


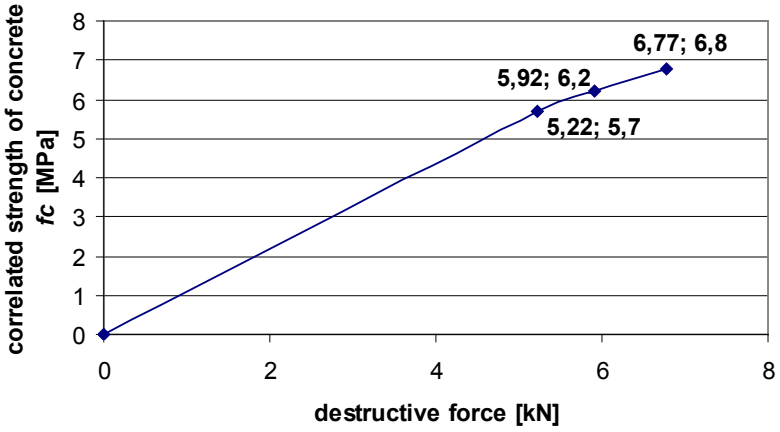
Figure 4. Determine the increment of the anchoring pull-out force of the anchor over time for three-anchors samples

According to the obtained value of the pull-out force of the anchor P, determined is correlated with it the compressive strength of concrete [9]:

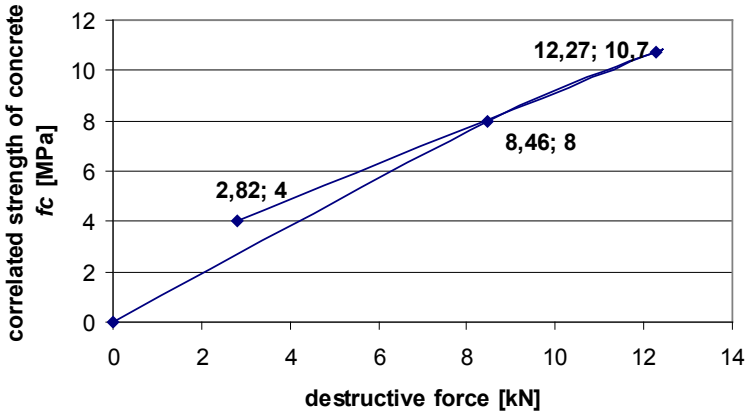
$$f_{c,cube} = 1{,}41 \cdot P - 2{,}82 \text{ [MPa]} \quad (1)$$

where: $f_{c,cube}$ – compressive strength of concrete, [MPa]; P – pull-out force, [kN]

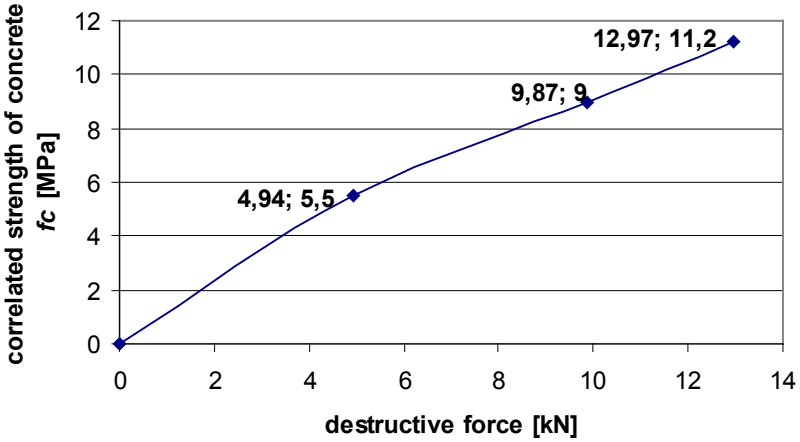
The correlation between the compressive strength of concrete and the values obtained from the tests is presented in Figures 5÷8.



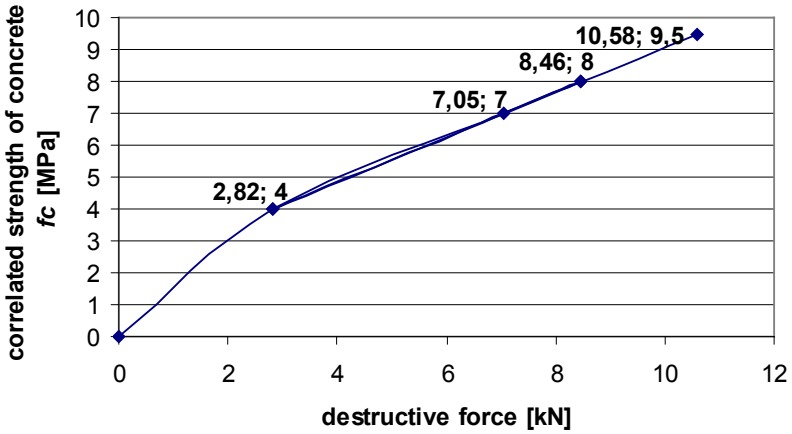
Rys. 5. Values of correlated concrete strength for compression with respect to the pull-out force of point anchors in the COPY-ECO system



Rys. 6. Values of correlated concrete strength for compression with respect to the pull-out force of diagonal anchors in the COPY-ECO system



Rys. 7. Values of correlated concrete strength for compression with respect to the pull-out force of point anchors in a three-anchor system



Rys. 8. Values of correlated concrete strength for compression with respect to the pull-out force of diagonal anchors in a three-anchor system

The necessity of reacting to the current condition of large slab buildings has been presented in the papers. [11, 12].

4. Conclusions

The method of anchoring and the number of anchorages used are determined for each plate in a calculation method. The use of new bonded anchors undoubtedly extends the fastening life of the façade texture layer due to, for example, steel grade (stainless steel) and resin strength parameters. It should also be remembered that too many anchors may have the opposite effect, as too many holes in a single plate may significantly weaken its cross-section. An interesting reinforcement factor is the use of diagonal anchors according to COPY-ECO system. It should be remembered that depending on the thickness of the concrete partition, the length of the anchor should be chosen in the first place. In the case of diagonal anchorages, it is possible to maneuver the angle of its installation (knowing the wall thickness of a given building). Tests of load-bearing capacity give an answer to the circumstances and forces that must be applied in order to permanently destroy the anchorage.

REFERENCES

1. Zabezpieczenia faktur zewnętrznych w budynkach z „wielkiej płyty”/ R. Ignatowicz et J. Gierczak – Materiały Budowlane 2/2006 – p. 34-36
2. *Long – Term Behaviour of Reinforced Concrete Panel Walls*, Saving Buildings in Central and Eastern Europe/ Cz. Miedzialowski et M. Malesza – IABSE Colloquium Berlin 4-5 June, 1998.
3. Zagadnienia remontowe warstwy fakturowej ścian trójwarstwowych / A Zybura et T. Jasniok – XXI Ogólnopolska Konferencja Warsztat Pracy Projektanta Konstrukcji, Szczyrk, 8÷11 marca 2006 r., p. 287-352
4. Cała prawda o budynkach wielkopłytowych / J. Dębowski – Przegląd Budowlany 9/2012 – p. 28-35
5. Identyfikacja uszkodzeń elementów wielkopłytowych w aspekcie oceny bezpieczeństwa eksploatacyjnego budynku / W. Ligęza et J. Dębowski – XIII Konferencja Naukowo-Techniczna „Awarie budowlane” Szczecin – Międzyzdroje, 2007 – p. 741-748
6. Stan zagrożenia i jego likwidacja w konstrukcji budynku wielkopłytowego / W. Ligęza et M. Płachecki – Inżynieria i Budownictwo 5/2001
7. Oddziaływanie obciążeń stałych i zmiennych w czasie na elewacyjną warstwę fakturową w systemie OWT-67/N /D. Tomaszewicz – Materiały Budowlane 1/2015, p.48-50
8. Hydrajaws 2008 Pull-Out Tester – 2008 Model Tester Operating Instructions
9. Katalog Techniczny KOELNER-RAWPLUG, Edycja 10
10. PN-EN 12504-3:2006 Badania betonu w konstrukcjach –Część 3: Oznaczenie siły wyrywającej
11. Usuwanie stanów zagrożenia zewnętrznych ścian warstwowych budynków mieszkalnych / J. Krentowski et R. Tribiłło – Przegląd Budowlany 2/2008 – p. 34-39
12. Metody usuwania wad technologicznych warstwowych ścian zewnętrznych podczas termomodernizacji budynków wielkopłytowych / A. Krysiak et K. Regulska – Zeszyty Naukowe Politechniki Częstochowskiej, Częstochowa 2012 – p.116-127