

## CONTENT

<b>1</b>	<b>NEW GENERATION CEMENT CONCRETES</b> <b>(Sičáková)</b>	<b>11</b>
<b>1.1</b>	<b>General classification and characteristics</b>	<b>11</b>
<b>1.2</b>	<b>Cement concretes in European standardization</b>	<b>16</b>
1.2.1	<i>Development of standards</i>	17
1.2.2	<i>European standards in our conditions</i>	18
1.2.3	<i>Technical standards</i>	18
1.2.4	<i>Concrete in European standardization</i>	20
<b>1.3</b>	<b>New generation cement concrete and sustainable development</b>	<b>24</b>
1.3.1	<i>Sustainable development</i>	24
1.3.2	<i>History of creating and development of the principles of the principles of sustainable development</i>	24
1.3.3	<i>Sustainable Construction</i>	26
1.3.4	<i>Requirements on concrete as a construction product</i>	29
1.3.5	<i>Suggestions for ensuring concrete durability</i>	30
<b>2</b>	<b>BEHAVIOUR OF CEMENT AND ADMIXTURES IN CONCRETE OF NEW GENERATION</b> <b>(Hela, Bodnárová)</b>	<b>33</b>
<b>2.1</b>	<b>Description of hydration development in cement</b>	<b>33</b>
2.1.1	<i>Factors influencing the shape of hydration curve</i>	34
<b>2.2</b>	<b>Rheological behavior of cement mortars and fresh concrete</b>	<b>34</b>
<b>2.3</b>	<b>Basic rheological properties and their determination</b>	<b>37</b>
<b>2.4</b>	<b>Factors influencing rheological properties of mastic cement and fresh concrete</b>	<b>38</b>
2.4.1	<i>Influence of cement properties</i>	38
2.4.2	<i>Influence of properties of aggregate</i>	40
2.4.3	<i>Influence of admixtures</i>	40
2.4.3.1	<i>Plasticizers and superplasticizers</i>	41
2.4.3.2	<i>Lignin sulphonate, melamin sulphonated and naphthalene sulphonated based admixtures - plasticizers</i>	43
2.4.3.3	<i>Admixtures of new generation – on the basis of polycarboxylethers, polyacrylates - superplasticizers</i>	43
2.4.3.4	<i>Air entrainers</i>	44
<b>2.5</b>	<b>Factors influencing interaction between (super)plasticizers and Portland cement</b>	<b>45</b>
2.5.1	<i>Superplasticizers – principles of action</i>	45
2.5.2	<i>Adsorption properties of admixtures</i>	46
2.5.3	<i>Influence of composition of cement on dispersion effect of superplasticizers</i>	46

<b>3</b>	<b>SELF- COMPACTING CONCRETE</b> <b>(Hela, Bodnárová)</b>	<b>51</b>
<b>3.1</b>	<b>Development of SCC</b>	<b>51</b>
<b>3.2</b>	<b>Characteristics of SCC</b>	<b>51</b>
<b>3.3</b>	<b>Composition of SCC</b>	<b>52</b>
<b>3.3.1</b>	<b>Cement</b>	<b>52</b>
<b>3.3.2</b>	<b>Aggregate</b>	<b>52</b>
<b>3.3.3</b>	<b>Water</b>	<b>52</b>
<b>3.3.4</b>	<b>Additives</b>	<b>53</b>
<b>3.3.4.1</b>	<i>Micronized lime stone</i>	<b>53</b>
<b>3.3.4.2</b>	<i>Metakaolin</i>	<b>54</b>
<b>3.3.4.3</b>	<i>Fly ash</i>	<b>54</b>
<b>3.3.4.4</b>	<i>Siliceous dusting - microsilica</i>	<b>54</b>
<b>3.3.4.5</b>	<i>Granulated crushed blast furnace slag</i>	<b>55</b>
<b>3.3.5</b>	<b>Admixtures</b>	<b>55</b>
<b>3.3.5.1</b>	<i>Superplasticizers</i>	<b>55</b>
<b>3.4</b>	<b>Design of SCC</b>	<b>56</b>
<b>3.4.1</b>	<i>Principle of designing mixture</i>	<b>57</b>
<b>3.5</b>	<b>Properties of fresh SCC</b>	<b>58</b>
<b>3.5.1</b>	<i>Consistency of fresh SCC</i>	<b>58</b>
<b>3.5.2</b>	<i>Main requirements of workability of fresh SCC</i>	<b>59</b>
<b>3.6</b>	<b>Properties of hardened SCC</b>	<b>60</b>
<b>3.6.1</b>	<i>Compressive strength</i>	<b>60</b>
<b>3.6.2</b>	<i>Tensile strength</i>	<b>60</b>
<b>3.6.3</b>	<i>Static elasticity modulus</i>	<b>60</b>
<b>3.6.4</b>	<i>Contraction and creep</i>	<b>61</b>
<b>3.6.5</b>	<i>Durability</i>	<b>61</b>
<b>3.7</b>	<b>Special SCC</b>	<b>62</b>
<b>3.7.1</b>	<i>Light-weight Self Compacting Concrete (LWSCC)</i>	<b>62</b>
<b>3.7.2</b>	<i>Fiber reinforced Self Compacting Concrete (FRSCC)</i>	<b>62</b>
<b>3.7.3</b>	<i>Aerated SCC</i>	<b>63</b>
<b>4</b>	<b>HIGH PERFORMANCE CONCRETE</b> <b>(Śliwiński, Tracz)</b>	<b>65</b>
<b>4.1</b>	<b>High Performance Concretes: definition and general characteristics</b>	<b>65</b>
<b>4.2</b>	<b>HPC as a two-component composite with a grain aggregate</b>	<b>65</b>
<b>4.3</b>	<b>Factors important for production of high performance concretes</b>	<b>67</b>
<b>4.4</b>	<b>Essential requirements as to the HPC components</b>	<b>70</b>
<b>4.5</b>	<b>Design of HPC composition</b>	<b>71</b>
<b>4.6</b>	<b>Basic information on the technology for production of</b>	<b>77</b>

	<b>the elements from HPC</b>	
4.6.1	<i>Production, transport, setting and consolidation</i>	77
4.6.2	<i>Maintenance</i>	77
4.7	<b>Applications of HPC</b>	78
5	<b>BEHAVIOUR OF CEMENT CONCRETE IN HIGH TEMPERATURE (Hager)</b>	82
5.1	<b>Introduction</b>	82
5.2	<b>Temperature effect on concrete structure and microstructure</b>	82
5.2.1	<i>Cement paste</i>	82
5.2.2	<i>Aggregate</i>	85
5.2.3	<i>Cement paste and aggregate interaction in concrete during heating</i>	87
5.3	<b>Explosive spalling of concrete</b>	87
5.4	<b>Changes in mechanical properties of heated concrete</b>	88
5.4.1	<i>Compressive strength and modulus of elasticity</i>	88
5.4.2	<i>Tensile strength</i>	91
5.4.3	<i>Thermal strain, thermal strain under load and transient thermal strain</i>	92
6	<b>FIBRE-REINFORCED CONCRETE (Śliwiński, Zych)</b>	95
6.1	<b>Fibre-reinforced concrete as a composite material</b>	95
6.2	<b>Idea of fibrous reinforcement and its role</b>	95
6.3	<b>Types of fibres and their properties</b>	96
6.4	<b>Role of fibres and basic mechanisms of their effect</b>	98
6.5	<b>Selected results of research on the effects of application of fibres</b>	102
6.6	<b>Basic information on technology of fibre-reinforced concretes</b>	104
6.7	<b>General characteristics of fibre-reinforced concretes with steel and polypropylene fibres and main directions of their applications</b>	104
7	<b>REACTIVE POWDER CONCRETE (RPC) AS ULTRA HIGH STRENGTH CEMENT- BASED COMPOSITE (Śliwiński, Zdeb)</b>	108
7.1	<b>Introduction</b>	108



<b>7.2</b>	<b>Fundamentals of theory and production technology of RPC type materials</b>	<b>108</b>
7.2.1	<i>Minimizing of composite porosity</i>	109
7.2.2	<i>Modification of a binder matrix microstructure by application of appropriate thermal treatment</i>	109
7.2.3	<i>Improvement of material homogeneity by application of a fine-grained aggregate</i>	110
7.2.4	<i>Packing density for dry grain components</i>	111
7.2.5	<i>Reducing of brittleness by addition of the fibers of adequate properties and sizes</i>	113
<b>7.3</b>	<b>Components of concretes with reactive powders, their role and requirements</b>	<b>113</b>
7.3.1	<i>Cement</i>	114
7.3.2	<i>Silica fume</i>	114
7.3.3	<i>Silica sand</i>	115
7.3.4	<i>Quartz flour</i>	115
7.3.5	<i>Steel fibers</i>	115
<b>7.4</b>	<b>Impact of curing conditions on RPC properties</b>	<b>115</b>
<b>7.5</b>	<b>Selected results of the investigations on RPC realized at the Cracow University of Technology</b>	<b>118</b>
<b>7.6</b>	<b>Applications of RPC</b>	<b>120</b>
<b>8</b>	<b>WATERPROOF CONCRETE (Sičáková)</b>	<b>123</b>
8.1	<b>Permeability of concrete</b>	123
8.2	<b>Concrete Porosity</b>	123
8.3	<b>Waterproofness of concrete</b>	125
8.4	<b>Design of waterproof concrete</b>	128
8.4.1	<i>Specification of waterproof concrete</i>	128
8.4.2	<i>Composition of waterproof concrete</i>	129
8.5	<b>Principles of construction a waterproof structure</b>	131
8.6	<b>Conclusion</b>	133
<b>9</b>	<b>ROAD CONCRETE (Sičáková)</b>	<b>135</b>
9.1	<b>Introduction</b>	135
9.2	<b>Nomenclature</b>	136
9.3	<b>Loading and environmental factors</b>	136
9.4	<b>Fundamental structural principles</b>	137
9.5	<b>Components of concrete mixture</b>	137
9.5.1	<i>Aggregate</i>	137

9.5.2	Cement	139
9.5.3	Water	139
9.5.4	Admixtures	139
9.6	Technological principles of road concrete	140
9.6.1	Concrete mix composition	140
9.6.2	Mixing of concrete mix	141
9.6.3	Transportation of fresh concrete	141
9.6.4	Processing of fresh concrete	142
9.6.5	Curing and surface protection	142
9.7	Quality control and testing	143
9.7.1	Initial tests	143
9.7.2	Quality control tests	144
9.7.3	Completion or take over tests	145
9.7.4	Reference segment	145
9.8	Conclusion	145
10	INTEGRATED MANAGEMENT SYSTEMS FOR PRODUCTION OF FRESH CONCRETE (Sičáková)	148
10.1	Introduction	148
10.2	QMS	149
10.3	QMS in concrete production	150
10.4	EMS	154
10.5	EMS in concrete production	155
10.6	HSMS	156
10.7	HSMS in concrete production	156
11	SELECTED TESTS OF CONCRETE PROPERTIES (Hela, Bodnárová)	158
11.1	Tests of fresh self-compacting concrete	158
11.1.1	Slump-flow	158
11.1.2	Flow-rate, determined during the slump-flow test - time $t_{500}$ (Slump - flow test)	160
11.1.3	V-funnel test	161
11.1.4	L-box test	162
11.1.5	Orimet test	166
11.1.6	J-ring Test	167
11.1.7	Orimet and J - Ring test	170
11.1.8	Summary of the chapter on Test of properties of fresh self-compacting concrete	171
11.2	Tests of fresh concrete - Determination of air content in fresh concrete	172