Cement standards and selection

Pronto Readymix

Common Cements: SABS EN 197-1

Main types	Notation of products (types of common cement)		Composition, percentage by mass [a]										
			Clinker	Blast furnace slag	Silica fume	Pozzolana		Fly ash		Burnt Shale	Limestone		Minor addition-al con stituents
						natural	natural calcined	Sili-ceous	Calcar-eous				
			K	S	D[b]	P	Q	V	W	T	L	LL	
CEM I	Portland cement	CEM I	95 -100	-	-	-	-	-	-	-	-	-	0 - 5
CEM II	Portland-slag cement	CEM II A - S	80-94	6-20	-	-	-	-	-	-	-	-	0 - 5
		CEM II B - S	65-79	21 -35	-	-	-	-	-	-	-	-	0 - 5
	Portland-silica fume cement	CEM II A - D	90-94	-	6- 10	-	-	-	-	-	-	-	0 - 5
	Portland-pozzolana cement	CEM II A - P	80 - 94	-	-	6 - 20	-	-	-	-	-	-	0 - 5
		CEM II B - P	65 - 79	-	-	21 - 35	-	-	-	-	-	-	0 - 5
		CEM II A - Q	80 - 94	-	-	-	6 - 20	-	-	-	-	-	0 - 5
		CEM II B - Q	65 - 79	-	-	-	21 - 35	-	-	-	-	-	0 - 5
	Portland-fly ash cement	CEM II A - V	80 - 94	-	-	-	-	6 - 20	-	-	-	-	0 - 5
		CEM II B - V	65 - 79	-	-	-	-	21 - 35	-	-	-	-	0 - 5
		CEM II A - W	80 - 94	-	-	-	-	-	6 - 20	-	-	-	0 - 5
		CEM II B - W	65 - 79	-	-	-	-	-	21 - 35	-	-	-	0 - 5
	Portland-burnt shale cement	CEM II A - T	80 - 94	-	-	-	-	-	-	6 - 20	-	-	0 - 5
		CEM II B - T	65 - 79	-	-	-	-	-	-	21 - 35	-	-	0 - 5
	Portland-limestone cement	CEM II A - L	80 - 94	-	-	-	-	-	-	-	6 - 20	-	0 - 5
		CEM II B - L	65 - 79	-	-	-	-	-	-	-	21 - 35	-	0 - 5
		CEM II A - LL	80 - 94	-	-	-	-	-	-	-	-	6 - 20	0 - 5
		CEM II B - LL	65 - 79	-	-	-	-	-	-	-	-	21 - 35	0 - 5
	Portland-composite cement[c]	CEM II A - M	80 - 94	←------				6 - 20				------→	0 - 5
		CEM II B - M	65 - 79	←------				21 - 35				------→	0 - 5
CEM III	Blastfurnace cement	CEM III A	35 - 64	36 - 65	-	-	-	-	-	-	-	-	0 - 5
		CEM III B	20 - 34	66 - 80	-	-	-	-	-	-	-	-	0 - 5
		CEM III C	5 - 19	81 - 95	-	-	-	-	-	-	-	-	0 - 5
CEM IV	Pozzolanic cement[c]	CEM IV A	65 - 98	-	←------		11 - 35		------→	-	-	-	0 - 5
		CEM IV B	45 - 64	-	←------		36 - 55		------→	-	-	-	0 - 5
CEM V	Composite cement[c]	CEM V A	40 - 64	18 - 30	-	←------	18 - 30	------→	-	-	-	-	0 - 5
		CEM V B	20 - 39	31 - 50	-	←------	31 - 50	------→	-	-	-	-	0 - 5

Notes
(a) The values in the table refer to the sum of the main and minor additional constituents.
(b) The proportion of silica fume is limited to 10%.
(c) In Portland-composite cements CEM II A-M and CEM II B-M, in pozzolanic cements CEM IV A and CEM IV B, and in composite cements CEM V A and OEM V B, the main constituents other than clinker shall be declared by designation of the cement.

Compressive strength requirements of SABSEN 197-1.

Strength class	Compressive strength, MPa			
	Early strength		Standard strength	
	2 days	7 days	28 days	
32,5N	-	> 16,0	>32,5	<52,5
32.5R	>10,0	-		
42,5N	>10.0	-	>42,5	<62,5
42,5R	>20.0	-		
52,5N	>20,0	-	>52,5	
52,5R	>30,0	-		

Removal of formwork (minimum time in days (24hr))

Type of structural member of formwork	Strength class of cement used					
	42,5R or higher		32.5R, 42,5 and CEM IIA32,5		32,5	
	Weather					
	Hot or normal	Cold	Hot or normal	Cold	Hot or normal	Cold
a) Beam sides, walls and unloaded columns.	0.5	1	0.75	1.5	2	4
b) Slabs with props left underneath.	2	4	4	7	6	10
c) Beam soffits with props left underneath and ribs with a ribbed floor construction.	3	5	7	12	10	17
d) Slab props including cantilevers	5	9	10	17	10	17
e) Beam props including cantilevers	7	12	14	21	14	21

Weather may be regarded as "normal" when atmospheric temperatures adjacent to the concrete do not fall below 15°C, and as "cold" when such Temperatures fall below 5°C. When minimum temperatures are between these values, stripping times may be intermediate between the periods specified.

Guidelines for selecting cements for concrete.

Application	Comments
Conventional structural concrete in a non-aggressive environment	The cement is normally selected for economy. Any of the SABS EN 197-1 common cements should be suitable. Site blends of CEM I cement with 50% GGBS or 30% FA have been extensively and successfully used in South Africa. A site blend of CEM I cement and about 8% CSF is technically feasible but there is relatively little local experience of its use.
Large placements where temperature rise, due to heat of reaction, is to be kept as low as possible.	Best results are likely to be achieved with cements with extender contents in excess of 50% GGBS or 30% FA.
Structural precast	Choice of cement will depend mainly on strength requirements at early ages. High early strengths, without steam curing, will be achieved most economically with cements of strength grade 42,5R and higher and with low extender content. Cements with higher extender content are better suited to steam curing. Where there is no requirement for rapid strength gain, the choice of cement should be based on economy.
Precast bricks, blocks and pavers.	Provided the elements have sufficient strength to allow handling at an early age, typically the day after casting, the choice of cement should be based on economy.
High-performance concrete (High-strength concrete)	Strength class should be 42,5N or higher. The inclusion of about 8% CSF is common practice in this application. Other cement extenders may also be used for technical or economic benefits. Superplasticizer is an essential ingredient in high-performance concrete: the compatibility of the specific cementitious material and the superplasticizer is important.
Floors, roads and pavements with sawn joints.	Concrete for these applications must develop strength rapidly enough to permit joint sawing before the concrete cracks due to restrained drying shrinkage. The mature concrete must have good abrasion resistance. These properties are likely to be achieved most economically with cements with extender content not greater than 30%, and of strength grade 42.5N or higher.
Reinforced concrete in marine environment.	Research done with South African materials has shown that best results are achieved with extender contents of either 50% GGBS, 10% CSF, 40% GGBS + 10% CSF, or 30% FA.
Concrete made with alkali-reactive aggregate.	The cement should contain not less than 40% GGBS, or 20% FA, or 15% CSF. However, the use of CSF at this high replacement level usually results in sticky concrete requiring the use of a superplasticizer.
Concrete exposed to sulphate attack.	Fortunately this type of attack is rare in South Africa. A CEM I cement's resistance to sulphate attack depends largely on its C_3A content. CEM I cements with C_3A contents below about 9 to 10% give markedly higher sulphate resistance than those with C_3A contents above 9 fb 10%. South African CEM I cements have C_3A contents below 10% and therefore give relatively high sulphate resistance. International experience suggests that using high levels of GGBS in concrete will improve sulphate resistance- There is no South African data on which to base guidance to local users. The sulphate-resisting properties of concrete, made with specific materials, should therefore be investigated before a GGBS blend is specified. The inclusion of a minimum of 30% FA should improve the sulphate resistance of concrete. There is no South African data on which to base guidance on the use of CSF for sulphate resistance.

June 2009