Trial Mix Details

Physical requirements verification for Super-plasticizers

❖ **ASTM C 494 & IS 9103**

- **Water reduction efficiency**
- **Strength**
- **Setting Time**
- **Air Content**
- **Bleeding**

Could be suggested - Slump retention for all slump range

Criteria for material selection used in trial mixes – to limit the variations

- **Cement shall be fresh and free from lumps**
- **River sand as fine aggregate falling in Zone II**
- **75micron passing in wet sieve shall not exceed 1% by weight**
- **Coarse Aggregate grading from 20mm to 4.75 shall comply with the limits given as per IS 383**
- **Limits for Flakiness and Elongation Index are suggested as follow;**
  - **Flakiness less than 15%**
  - **Elongation less than 15%**
  - **Combined Flakiness and Elongation less than 25%**
- **Grading of All in Aggregates shall comply with the limits given as per IS 383**
- **Water for Construction purpose conforming to the requirements of IS 456**
- **Raw Materials shall be obtained from the same pool of samples for both reference mixes and mixes with admixture in order to control the variables.**
- **Moisture and absorption corrections shall be verified and effected**

Criteria for trial mixes

- **Two different Cement content, 310 kg/cum for MRWR Admixture and 350 kg/cum for HRMR, can be used as given in the reference trial mixes. The reason is that the mix used to evaluate HRMW admixtures like PCE based one would require a cement content more than 310 kg/cum for better dispersement of admixture and rheology of the mix.**
- **Air content of 2% can be assumed as 20mm nominal maximum size aggregate is used in the trial mixes, though IS10262 does not mention about air content.**
- **Verification of early age cube compressive strength can be helpful to gauge the hardening of concrete.**

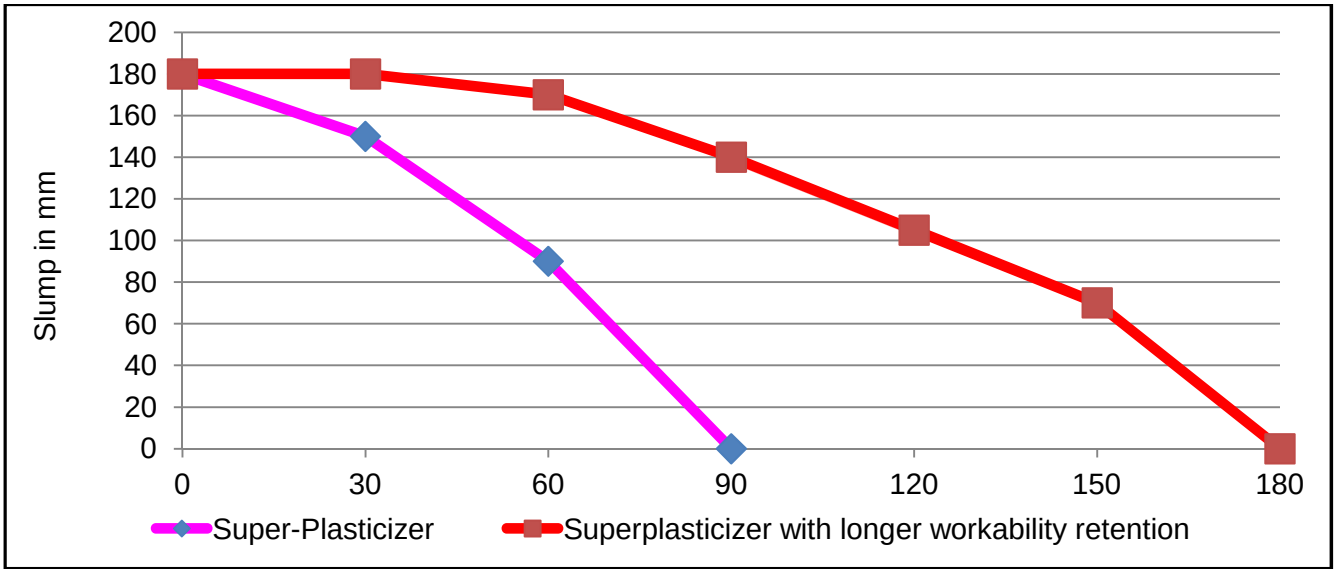
Physical Properties verification for Superplasticizing Admixture – Mid Range

	Control Mix	Mix with SNF based SP
Material	**Design**	**Design**
OPC	**310**	**310**
20 to 4.75 mm	1091	1105
River Sand	833	868
Water	192	168
SNF based MRWR SP	0	2.7 (@ 0.89%
Total	**2426**	**2451**
Yield	**980 litres**	**980 litres**
Ambient Temperature	32.8°C	32.2°C
Concrete Temperature	31.0°C	31.0°C
Slump Measurement		
Initial	100 mm	100 mm
@ 60 minutes	65 mm	70 mm
Cube Compressive strength		
17 hours	9.3 MPa	5.5 MPa
3 day	20.7 MPa	28.9 MPa
7 day	26.0 MPa	37.5 MPa
28 day	35.3 MPa	43.2 MPa
Water Reduction Efficiency	NA	((192-168)/192) X 100 = 12.5%
Air Content	1.1 %	1.2 %
Bleeding	Nil	Nil
Initial Setting Time	9 hours 10 minutes	11 hours 30 minutes
Final Setting Time	10 hours 20 minutes	13 hours 40 minutes

Physical Properties verification for Superplasticizing Admixture – High Range

	Control Mix	Mix with PCE based SP
Material	**Design**	**Design**
OPC	**350**	**350**
20 to 4.75 mm	1067	1124
River Sand	813	856
Water	185	146
PCE based HRWR SP	0	2.1 (@ 0.6%)
Total	**2415**	**2476**
Yield	**980 litres**	**980 litres**
Ambient Temperature	27.0°C	27.6°C
Concrete Temperature	28.0°C	28.4°C
Slump Measurement		
Initial	95 mm	90 mm
@ 45 minutes	65 mm	65 mm
Cube Compressive strength		
17 hours	14.1 MPa	17.8 MPa
7 day	38.8 MPa	47.0 MPa
28 day	51.7 MPa	60.5 MPa
Water Reduction Efficiency	NA	((185-146)/185) X 100 = 21%
Air Content	0.9 %	1.9 %
Bleeding	0.65 %	Nil
Initial Setting Time	8 hours 20 minutes	8 hours 40 minutes
Final Setting Time	9 hours 40 minutes	9 hours 50 minutes

Slump and Slump Retention



Varying workability Requirements

IS456:2000 suggested values (as given below, are too low and perhaps the suggestive values are based on control towards water/cement ratio. It could have been thought higher the workability higher the water/cement ratio would be.

7 WORKABILITY OF CONCRETE

7.1 The concrete mix proportions chosen should be such that the concrete is of adequate workability for the placing conditions of the concrete and can properly be compacted with the means available. Suggested ranges of workability of concrete measured in accordance with IS 1199 are given below:

Placing Conditions	*Degree of Workability*	*Slump* (mm)
(1)	(2)	(3)
Blinding concrete; Shallow sections; Pavements using pavers	Very low	*See* **7.1.1**
Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns; Floors; Hand placed pavements; Canal lining; Strip footings	Low	25-75
Heavily reinforced sections in slabs, beams, walls, columns; Slipform work; Pumped concrete	Medium	50-100 75-100
Trench fill; *In-situ* piling	High	100-150
Tremie concrete	Very high	*See* **7.1.2**

7.1.1 In the 'very low' category of workability where strict control is necessary, for example pavement quality concrete, measurement of workability by determination of compacting factor will be more appropriate than slump (*see* IS 1199) and a value of compacting factor of 0.75 to 0.80 is suggested.

7.1.2 In the 'very high' category of workability, measurement of workability by determination of flow will be appropriate (*see* IS 9103).

However workability is enhanced by Superplasticizers

- **Decision and Design on specific Slump / Flow value depends on method of placing, compaction and finishing. Since SP admixtures are used to achieve the workability with control on w/c, higher workability is not necessarily undesirable (Example SCC).**
- **Importance shall be given to obtain uniform and cohesive mix at any workability for a design w/c.**

Suggested Slump / workability values

Structures	Slump @ Site
Precast Elements	< 75 mm
Footing / Raft / Flooring	100+/-25 mm
Pile caps / Roof Slabs / Floor Slabs	125+/-25 mm
Columns / Walls	150+/-25 mm
Piles / Diaphragm walls	200+/-25 mm or 500 to 600 mm flow
Critical Structures with respect to access to pour and compaction	SCC Flow of 550 to 850 mm

Different Workability can be obtained for same water/cement ratio with the aid of SPs

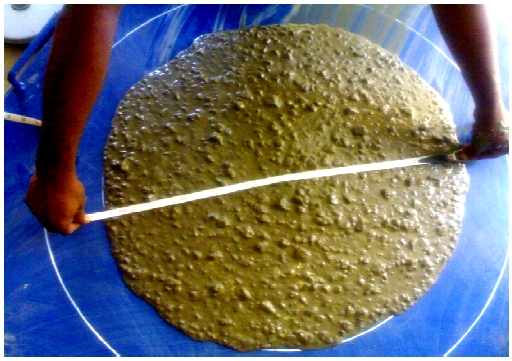
Slump < 75mm

Slump 100mm

Slump 160mm

Slump 225mm

Concrete with very high workability / Flowability

	
Workability measurement through Flow Table test (IS 9103)	Self Compacting Concrete – Slump Flow test (European Guidelines)