SIGNIFICANT WATER CONTENT REDUCTION RESULTS IN ENHANCED DURABILITY PROPERTIES OF THE HARDENED CONCRETE

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ABSTRACT-Currently India has taken a major initiative in developing the infrastructures such as express highways, power projects and industrial structures etc., to meet the requirements of globalization, in the construction of building and other structures. Concrete plays the rightful role and a large quantum of concrete is being utilize. For the construction of these heavy structures initially high strength concrete is used. But the problem with high strength concrete arrives at workability and durability. Meeting the requirements high performance concrete came into existence.

This project describes about the partial replacement of cement by fly ash .As fly ash is obtained in million tons from power plants and these are dumped in to the ground so that there will be the occurrence of land pollution so by using this as a part of cement there will increase in strength and it will be economical. Whose continued use has started posing serious problems with respect to its availability, cost and environmental impact.

This project presents the feasibility of the usage of sika visco flow 50H Admixture in high performance concrete. Mix design has been developed for M30, M35, M40, M45, M50 & M60 grade using IS approach conventional concrete. Strength, workability and durability studies were conducted on cubes and cylinders and] beams. The results are observed that compressive strength and split tensile strength.

I. INTRODUCTION

The engineering of concrete structures is a continuous developmental process. Invention and development of new construction methods places ever higher demands on building materials. Concrete producers face this technological challenge daily alongside other factors such as economy, ecology, raw material and energy costs as well as increased logistical complexity. In the duration of the whole construction process time itself also becomes an increasingly important factor. Sika visco flow 50H technology brings several innovative options to concrete mix design. A major characteristic is the capability to substantially reduce the water content of a mix. Achievement of lower water / cement ratios results in dramatically enhanced durability, induced by remarkably low concrete permeability. Application of more economical mix designs is another option, with optimizations yielding more ecological and resource-friendly mixes at constant concrete quality.

Sika visco flow 50H technology responds to the current trend to use flow able concrete types. The trend demands new admixture technologies, and Sika visco flow 50H offers solutions for production of flow able concrete types for ready mix, onsite production and for the precast concrete industry. The target is to produce concrete with high flow ability sufficient for a period of time and with no negative side effects. Extended workability controlled over several hours and without retardation is especially important for urban construction sites with congested traffic, or in remote areas resulting in long transportation times. Sika visco flow 50H technology also meets the challenge of ensuring target consistency in a concrete mix in high-temperature climates. Strength gain is a present and continuous challenge in concrete technology and the construction business. All participants in the construction process desire achievement of sufficient early strength to allow formwork removal as quickly as possible, whether on construction sites or in production of precast concrete. In industrialized precast concrete production, early strength development is crucial because it influences the entire production process. High early strength development in concrete results in fast turnaround of formwork in a precast factory, in reduced or omitted heat or steam curing, more economical and ecological concrete mix designs, and earlier cutting of pre-stressing tendons. The inclusion of small fraction (usually 0.5 to 1% by volume) of the concrete, mortar and cement paste can enhance many of the engineering properties of basic materials such as fracture toughness, flexural strength and resistance to fatigue, impact and spelling.

By using of sika visco flow 50H Admixture into concrete has been found to improve several properties primarily cracking resistance, impact and wear resistance and ductility. For this reason, sika visco flow 50H Admixture is now being used in increasing amounts in structures such as airport pavements, highway overlays, bridge decks and machine foundations. Sika visco Admixture is composite material that has been developed in recent years. It has been successfully used in construction with its excellent compression strength and durability studies, resistance to spitting, impact resistance and excellent permeability and frost resistance. It is an effective way to increase toughness, shock resistance and resistance to plastic shrinkage cracking of the mortar.

II. SIKA VISCOFLOW:

Concrete admixtures are liquids or powders which are added to the concrete during mixing in small quantities. Dosage is usually defined based on the cement content. Concrete admixtures have significant impact on the fresh and/or hardened concrete properties. Admixtures can act chemically and/or physically.

In addition to the three main components of concrete, concrete admixtures and additives are also used in concretes with higher performance specifications again both fresh and hardened. Sika began developing the first admixtures for cementations mixes in 1910, the year in which it was founded. At that time the main aims were to shorten the setting time of mortar mixes, make them waterproof or increase their strength. Some of these early, successful Sika products are still in use today. Water is necessary in concrete for consistence and hydration of the cement, but too much water is unfavourable for properties of the hardened concrete, so Sika products were also developed to reduce the water content while maintaining or even improving the consistence (workability).

Ever since the company was founded, Sika has always been involved where cement, aggregates, sand and water are made into mortar or concrete – the reliable partner for economic construction of durable concrete structures. When the concrete is supplied, the following additional Criteria must be considered:

1. Delivery time (traffic conditions, potential hold-ups, etc.)
2. Define the necessary drum revolutions during the journey
3. Do not leave the ready-mix truck standing in the sun during waiting periods
4. For a fluid consistence (SCC), define the maximum capacity to be carried
5. Do not add water or extra doses of admixture (unless specified)
6. Mix again thoroughly before unloading (one minute per m3)

III. EXPERIMENTAL PROGRAMME:

The ingredients of concrete consist of cement, fine aggregate and coarse aggregates, water. When the reaction of water with cement takes place hydration process is done and a hard material is formed. In this project work we used waste glass Sika® ViscoFlow® The speed of the whole construction process is gaining importance, because fluid concrete implies: Sika® ViscoFlow® is especially suitable for concrete mixes with extended workability requirements as well as improved flow characteristics. Sika® ViscoFlow® is mainly used for the following applications: which results in overall reduced effort and time saving.

1. Fast casting
2. Fast discharge of mixer and truck
3. Easy placing and compaction
4. Good surface finish,
5. Any concrete in hot/cold weather with extended transportation and workability time
6. Suitable for a wide range of applications with high or low water / cement ratio and/or high or low environment temperatures
7. Define the workability time based on project requirements without a negative effect on early strength development

CONSTITUENT MATERIALS

The study deals with an investigation on behavior of concrete produced from cement with various Admixtures. Mix proportion was designed to produce workable concrete with target strength of (M30,M35,M40,M45,M50,M60) for the control mix. The effects of various Percentage of Admixture on concrete properties were studied by means of the fresh properties of concrete and mechanical properties such as flexural strength, compressive strength and splitting tensile strength.

The Indian standard Recommended Guideline give a procedure for proportion concrete mixes for general type of construction using concrete making materials normally available. The mix design is carried out for a desired workability and 28-days compressive strength of concrete. Using continuously graded coarse aggregates.

The following Basic data are required:

1. Grade of concrete (fck)
2. Degree of workability desired (sump or compacting factor value)
3. Degree of quality control expected to be exercised at the construction site.
4. Exposure condition at the construction site.
5. Type and maximum size of aggregate to be used.
6. Standard deviation (s) of compressive strength of concrete samples.

CEMENT

The Ordinary Portland Cement (OPC) 53 grade used in the project work. This is used as main binder in the mixes

FINE AGGREGATE AND COURSE AGGREGATE

Fine and coarse aggregate make up the bulk of concrete mixture. Sand, natural gravel and crushed stone are mainly used for this purpose. For fine aggregates natural sand is provided with maximum size of 4.75 mm. coarse aggregates are used with size between 20mm-4.75mm

EXPERIMENTAL WORK

The experimental work was carried out in our college concrete technology laboratory. In this study, total of Six groups of concrete mixes were prepared in laboratory. First, Second, third fourth, fifth and sixth group was water replacement by Sika® ViscoFlow® replacement from 0.55% respectively (M30,M35,M40,M45,M50,M60) Design mix grades.

CASTING AND TESTING

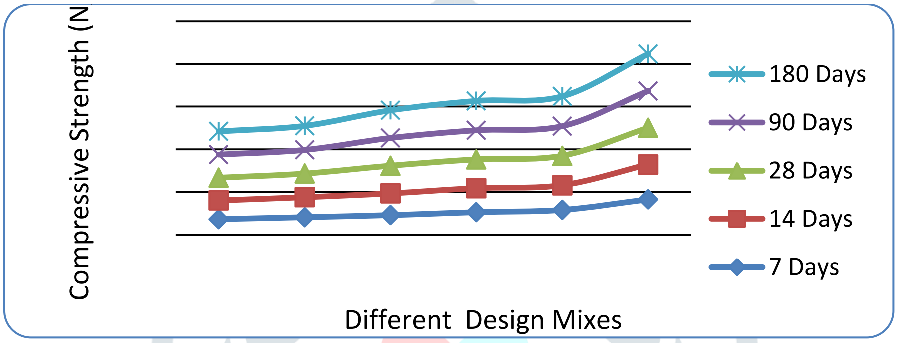
Six different mixes (M30,M35,M40,M45,M50,M60) were prepared using water replaced by Sika® ViscoFlow® at percentage of **0.55%** . Fifty Four number standard specimens of dimensions 150 × 150 × 150 mm were cast according to the mix proportion and cured in water at room temperature in the laboratory for 3,7, 2890 and 180 days. At the end of each curing period, nine specimens for each mixes were tested for compressive strength and the average strength was recorded. The size of the specimen is as per the IS code 10086 – 1982. The compressive strength test on both conventional and glass added concrete was performed on standard compression testing machine of 3000kN capacity, as per IS: 516-1959

IV. RESULTS AND DISCUSSION

A universal testing machine of capacity 100 tones was used for testing the compressive strengths of cube specimens at 7, 14, 28, 90 and 180 days from casting at a loading rate of 14 N/mm2/min. Results for compressive for all mixtures are presented From the results for compressive strength, it is evident that an enhancement in strength compared to control concrete occurs Admixture. However, the maximum increase in compressive strength is only of the order of 10 - 15%. Fig shows the graphical representation of compressive strength

Compressive strength (N/mm2)						
SI.No	**Diff. Mix Designs**	**7 Days**	**14 Days**	**28 Days**	**90 Days**	**180 Days**
1	M30	36.2	43.9	53.3	54.18	54.42
2	M35	40.8	46.9	55.4	55.4	56.4
3	M40	45.7	51.0	64.9	64.9	64.9
4	M45	52.6	56.4	67.5	68.12	68.8
5	M50	57.9	58.0	61.0	69.41	69.94
6	M60	82.6	82.0	85.9	86.9	86.9

The below graph shows the variation of the compressive strength(on y-axis) between the mixes M30, M35, M40, M45, M50, M60 for 7days,14days, 28 days,90 days and 180 days. i.e w.r.t time(on x-axis)



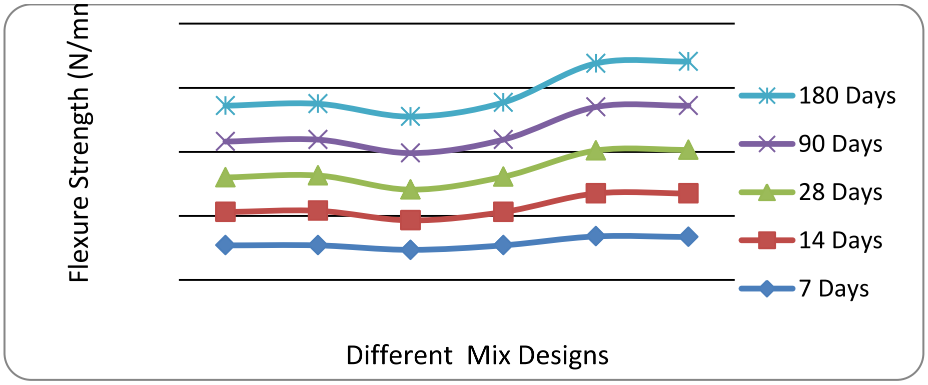
Variation Of Compressive Strength In Different Mix Designs

Flexure strength:

The flexural strength was reported to be increased by 2.5 times using 4 percent Sika visco Admixture

Flexure strength (N/mm2)						
SI.No	**Diff. Mix Designs**	**7 Days**	**14 Days**	**28 Days**	**90 Days**	**180 Days**
1	**M30**	**5.4**	**5.2**	**5.4**	**5.6**	**5.6**
2	**M35**	**5.4**	**5.4**	**5.2**	**5.6**	**5.6**
3	**M40**	**4.7**	**4.6**	**4.8**	**5.7**	**5.7**
4	**M45**	**5.4**	**5.2**	**5.4**	**5.8**	**5.8**
5	**M50**	**6.8**	**6.7**	**6.7**	**6.8**	**6.8**
6	**M60**	**6.7**	**6.8**	**6.8**	**6.9**	**6.9**

The below graph shows the variation of the Flexure strength(on y-axis) between the mixes M30, M35, M40, M45, M50, M60 for 7days,14days, 28 days,90 days and 180 days. i.e w.r.t time(on x-axis)



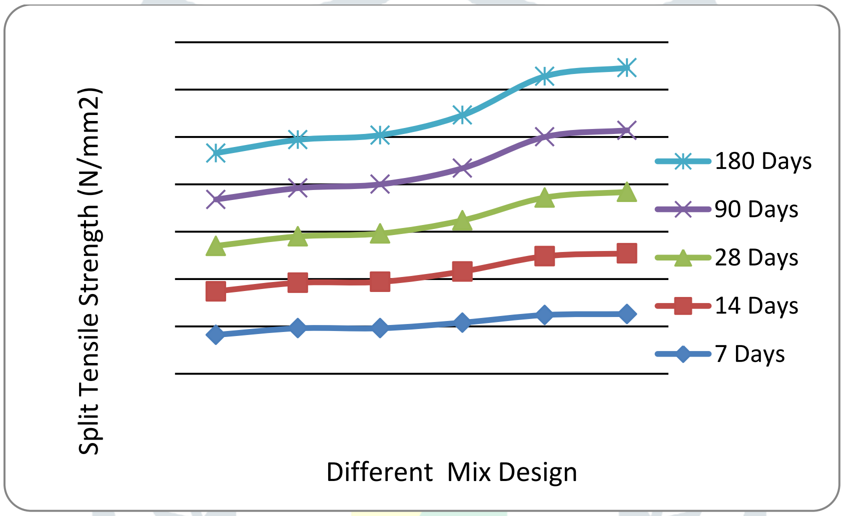
Variation Of Flexural Strength In Different Mix Designs

Split Tensile strength

A cylindrical test specimen is subjected to a compressive force applied immediately adjacent along its longitudinal axis. The resultant tensile force causes the test specimen to break under tensile stress.

Split Tensile strength (N/mm2)						
SI.No	**Diff. Mix Designs**	**7 Days**	**14 Days**	**28 Days**	**90 Days**	**180 Days**
1	M30	4.1	4.6	4.8	4.9	4.9
2	M35	4.8	4.4	4.1	5.1	5.1
3	M40	3.8	4.2	4.1	5.2	5.2
4	M45	5.4	5.4	5.4	5.5	5.6
5	M50	6.2	6.1	6.1	6.4	6.4
6	M60	6.1	6.4	6.3	6.5	6.6

The below graph shows the variation of the Split Tensile strength(on y-axis) between the mixes M30, M35, M40, M45, M50, M60 for 7days,14days and 28days i.e w.r.t time(on x-axis)

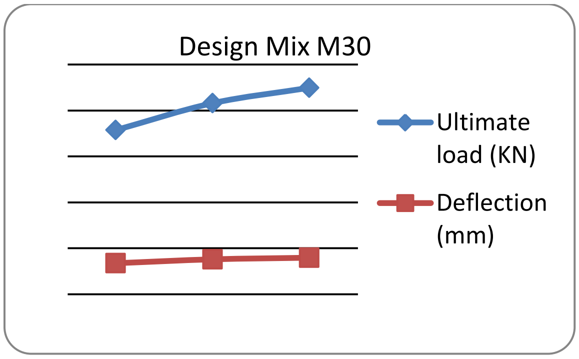


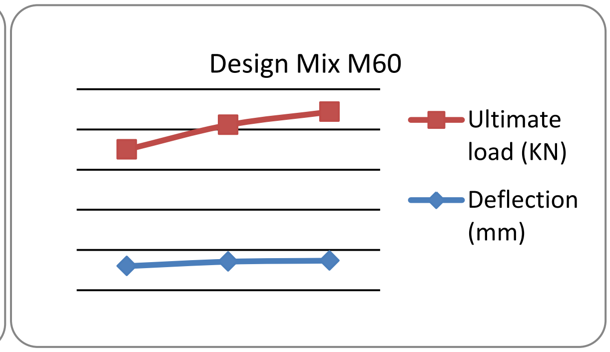
Variation of Flexural Strength In Different Mix Designs

S.No	Name of the test	Grade	Size mm	Results	Test Method
1	Compressive Strength of cubes	M30/M35	150X 150X150	63.21 N/mm2	IS : 516
2	Flexure Strength	M30/M35	150X 150X700	5.42 N/mm2	IS : 516
3	Split Tensile Strength	M30/M35	150X300	4.88 N/mm2	IS : 5816
4	Bleeding	M30/M35		3.89%	ASTMC 232
1	Compressive Strength of cubes	M35/M40	150X 150X150	70.09 N/mm2	IS : 516
2	Flexure Strength	M35/M40	150X 150X700	4.86 N/mm2	IS : 516
3	Split Tensile Strength	M35/M40	150X300	4.02 N/mm2	IS : 5816
4	Bleeding	M35/M40		4.15%	ASTMC 232
1	Compressive Strength of cubes	M45/M50/M60	150X 150X150	81.03 N/mm2	IS : 516
2	Flexure Strength	M45/M50/M60	150X 150X700	6.89 N/mm2	IS : 516
3	Split Tensile Strength	M45/M50/M60	150X300	6.13N/mm2	IS : 5816
4	Bleeding	M45/M50/M60		4.30%	ASTMC 232

Load Vs Deflection Graphs:

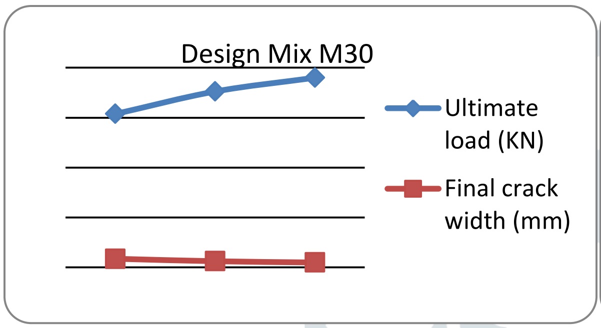
Total Six beams were tested in flexure on loading frame. Out of which two are plain beams and others are Sika® ViscoFlow® beams. While testing, the load and deflection values for each beam were noted. And also crack width is measured by using the crack width measuring scale. The graphs are drawn between the loadanddeflection and between the loadandcrack width.

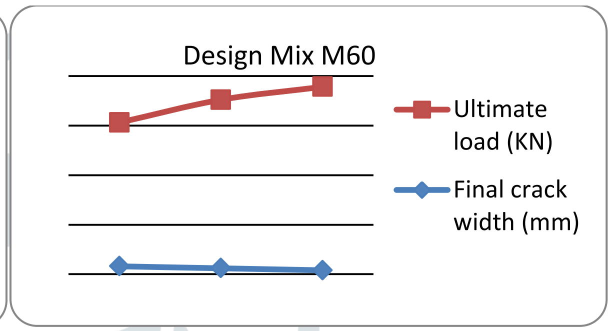




<u>Load Vs Crack Width Graphs:</u>

A graph is drawn between the load and crack width measured for 0%, 0.5% and 1% addition of Sika Visco Flow at the peak load. The graphs are shown in following figures.





The above graph shows the comparison between the 0%, 0.5% & 1% Sika Visco Flow. The crack width is reduced in the 0.5% and 1% Sika Visco Flow beams than compared to the plain concrete beams

<u>Crack Width, Failure Load and Deflection for tested beams</u>

Beam Notation M30	**Initial load (KN)**	**Ultimate load (KN)**	**Initial crack width (mm)**	**Final crack width (mm)**	**Deflection (mm)**
0%	28	58	0.18	3.5	13.5
0.50%	32	68	0.15	2.5	15.2
1%	36	74	0.14	2	15.9
Beam Notation M60	**Initial load (KN)**	**Ultimate load (KN)**	**Initial crack width (mm)**	**Final crack width (mm)**	**Deflection (mm)**
0%	28	58	0.2	3.2	12
0.50%	32	68	0.19	2.4	14.2
1%	36	74	0.17	1.6	14.7

V. CONCLUSION

Ever since the company was founded, Sika has always been involved where cement, aggregates, sand and water are made into mortar or concrete – the reliable partner for economic construction of durable concrete structures. Workability enhancing admixture Slump retention up to 7 hours. It is most useful to the Batching Plants to Site location, the construction location to long for Batching plant if is more useful.

<u>The following conclusions are drawn from the test results:</u>

1. The Engineering properties of concrete will be Admixture. However, the maximum increase strength is only of the order of 10 - 15%.
2. There is a decrease in the crack width was observed with increase in percentage of Sika because of bridging effect.
3. Any concrete in hot/cold weather with extended transportation and workability time Suitable for a wide range of applications with high or low water / cement ratiov and/or high or low environment temperatures
4. The split tensile strength for Sika Admixture concrete is 10% and 15% more than the plain concrete with the addition of 0.5% and 1% of Sika Admixture.
5. It can be observed that when there is increase of 0.5% to 1% addition of Sika there is increase in compressive and split tensile strengths of concrete.

The Engineering properties can't be changes . we can observed by above Results

The flexural strength was reported to be increased by 2.5 times using 4 percent Sika visco Admixtu

REFERENCES

S.C. Kou, C.S. Poon(2009) has done investigations on properties of self-compacting concrete prepared with coarse and fine recycled concrete aggregates. In this study, the fresh and hardened properties of self-compacting concrete (SCC) using recycled concrete aggregate as both coarse and fine aggregates were evaluated. Three series of SCC mixtures were prepared with 100% coarse recycled aggregates, and different levels of fine recycled aggregates were used to replace river sand. The cement content was kept constant for all concrete mixtures. The SCC mixtures were prepared with 0, 25, 50, 75 and 100% fine recycled aggregates, the corresponding water-to-binder ratios (W/B) were 0.53 and 0.44 for the SCC mixtures in Series I and II, respectively. The SCC mixtures in Series III were prepared with 100% recycled concrete aggregates (both coarse and fine) but three different W/B ratios of 0.44, 0.40 and 0.35 were used. Different tests covering fresh, hardened and durability properties of these SCC mixtures were executed. The results indicate that the properties of the SCCs made from river sand and crushed fine recycled aggregates showed only slight differences. The feasibility of utilizing fine and coarse recycled aggregates with rejected fly ash and Class F fly ash for self-compacting concrete has been demonstrated.

Y.Y. Chen, B.L.A. Tuan, C.L. Hwang (2013) have studied the effect of paste amount on the properties of self-consolidating concrete containing fly ash and slag .This paper is to compare the performance of concrete containing fly ash and slag under different water-to-cementitious materials ratios and different cement paste content. The densified mixture design algorithm (DMDA) was applied in the concrete mix design. Concretes designed by DMDA with excellent flow-ability and without bleeding and segregation were obtained. The proper paste amount the better the workability and the less the workability loss. On the basis of sufficient paste amount condition, the study discovers that the less the cement paste amount as well as the denser the blended aggregate, the lower the early-age compressive strength will be, on the contrary, the higher the long-term compressive strength becomes. To design of good quality concrete, the amount of cement paste and water should be minimized as low as possible to obtain the high ultrasonic pulse velocity.

Yeong-nain Sheena, Li-Jeng Huanga , Te-Ho Suna, Duc-Hien Leb has studied the engineering Properties of self-compacting concrete containing stainless steel slags. This paper presents the results of an investigation on engineering properties of self-compacting concrete (SCC) containing oxidizing and reducing slag generated from stainless steel making. The oxidizing slag was employed as fine and coarse aggregates substituting to natural materials with various percentages (0%, 50%, and 100%). Meanwhile, the reducing slag partially replaces for Portland cement (0%, 10%, 20%, and 30%). As a result, a total of 12 mixtures with a fixed water-binder ratio (w/b = 0.4) were developed in laboratory and its properties in hardened properties such as compressive strength, ultrasonic pulse velocity and surface resistivity were experimentally examined. The results indicated that 100 % stainless steel oxidizing slag (SSOS) substitutes to aggregates and 30 % stainless steel reducing slag (SSRS) substitutes to Portland cement in SCC, the values of compressive strength, electrical resistivity and the 91 day ultrasonic pulse velocity are within the good quality concrete requirement. It could save 43 % cost of SCC with this substitution. It will contribute to environmental protection and the resource recycling initiative.

N. Krishna Murthy, N. Aruna, A.V.Narasimha Rao, I.V.Ramana Reddy, M.Vijaya Sekhar Reddy reports that an experimental investigation on the mortar phase test with mini slump cone for self compacting mortar (SCM). Self-compacting concrete has to fulfill contradictory requirements of high flowing ability when it is being cast and high viscosity when it is at rest, in order to prevent segregation and bleeding. These requirements make the use of mineral and chemical admixtures essential for self-compacting concrete. The results of an experimental research carried out to investigate the effect of dosages of super plasticizer. The optimization of aqueous solution of modified carboxylic super plasticizer (SP) cum retarder is a high range water reducing agent (HRWRA). The water content and the dosage of super plasticizer were determined experimentally for each mortar. Different percentages of cement replacement materials were used in binary and ternary blends of cement with Metakaolin (MK), Fly ash (FA) and combination of Metakaolin and Fly ash (MK+FA) replaced with cement. The SCM mixes had 0%, 5%, 10%, 15%, 20%, 25% and 30% of replacement of cement with Metakaolin, 0%, 10%, 20%, 30% and 40% of replacement with class F fly ash and combinations of both Metakaolin and fly ash with MK15+FA10), (MK10+FA20), (MK5+FA30), and (MK20+FA20) water/cementitious ratios by weight (w/cm) 0.32 , 0.36and 0.40. Mortar mixes with w/cm 0.36 showed an increase in the rate of flow i.e., lower viscosity at each level of SP cum retarder dosage as compared to that of mixes with w/cm 0.32 and 0.40. A series of mortars were produced INTERNATIONAL JOURNAL OF CIVIL ENGINEERING AND TECHNOLOGY (IJCIET) ISSN 0976 – 6308 (Print) ISSN 0976 – 6316(Online) Volume 4, Issue 2, March - April (2013), pp. 369-384 © IAEME: www.iaeme.com/ijciet.asp Journal Impact Factor (2013): 5.3277 (Calculated by GISI) www.jifactor.com IJCIET © IAEME International Journal of Civil Engineering and Technology (IJCIET), ISSN 0976 – 6308 (Print), ISSN 0976 – 6316(Online) Volume 4, Issue 2, March - April (2013), © IAEME 370 with similar flow properties of spread measured by mini slump cone adequate to produce self-compacting concrete. It is also observed that the mortar mixes having w/cm 0.36 in order to arrest the bleeding. Practically the mini slump cone test is the best choice for SCM tests to evaluate the mortar spread and its viscosity (T20). Moreover, the experimental program leads to emphasize the effects of the mixing procedure on the rheological properties of cement pastes.

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