DESIGN OF HIGH STRENGTH CONCRETE-M100 BY USING SILICA FUME AND SUPER PLASTICIZERS

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ABSTRACT: *The advantages of using High Performance Concrete particularly with the structural advantages of using high strength concrete have been described in various researches. These include a reduction in member size, reduction in the self-weight and super-imposed Dead Load with the accompanying saving due to smaller foundations, reduction in form-work area and cost construction of High–rise buildings with the accompanying savings in real estate costs in congested areas, longer spans and fewer beams for the same magnitude of loading, reduced axial shortening of compression supporting members ,reduction in the number of supports and the supporting foundations due to the increase in spans ,reduction in the thickness of floor slabs and supporting beam sections which are a major component of the weight and cost of the majority of structures, superior long term service performance under static, dynamic and fatigue loading, low creep and shrinkage . Achieving high strength concrete by using various chemical and mineral admixtures is also a subject of research and different design mix methods and trial mix approaches have been proposed for the development of high strength concrete. The various parameters that govern the strength of concrete like the different constituent materials required, properties of constituent materials , proportions in which they are to be used and specifications for the production and curing technique to be used for the development of high strength concrete are also being a subject of continuous research for the development of high strength concrete which is now being seen as a logical development of concrete because of the numerous advantages that it is supposed to provide.Concrete, a composite consisting of aggregates enclosed in a matrix of cement paste including possible pozzalanas, has two major components – cement paste and aggregates. The strength of concrete depends upon the strength of these components, their deformation properties, and the adhesion between the paste and aggregate surface .With most natural aggregates, it is possible to make concretes up to 120MPa compressive strength by improving the strength of the cement paste, which can be controlled through the choice of water-content ratio and type and dosage of admixtures. However, with the recent advancement in concrete technology and the availability of various types of mineral and chemical admixtures, and special super-plasticizer , concrete with a compressive strength of up to 100MPa can now be produced commercially with an acceptable level of variability using ordinary aggregates .These developments have led to increased applications of high strength concrete(HSC) all around the globe.*

In this paper we design M100 or more than 100Mpa by using silica fume and super plasticizers in the proportions of 4-10 percentage and 4-8 percentage by its dry weight respectively. Design and analysis of buildings by using M100 checking with Indian standards. We propose the mix proportion of M100 in terms of cement, fine aggregates and coarse aggregates including silica fume percentage by replacing of cement and super plasticize percentage by replacing of water.

- *Keywords: High Strength Concrete, High Performance Concrete Plasticizers and Super-plasticizers*

INTRODUCTION

The bottom range of the strength of HSC varies with time and geographical location depending primarily on the availability of raw materials and technical know-how, and the demand from the industry. Concretes that were considered to be high strength 50 years ago are now regarded as low strength. For instance, concrete produced with compressive strength of 30 MPa was regarded as high strength in the 1950's. Gradually, concretes with compressive strength of 40-50 MPa in the 1960's, 60 MPa in the 1970's, and 100 MPa and beyond in the 1980's have evolved and used in practical structures. Inspite of the rapid development in concrete technology in recent years, concrete with compressive strength higher than 40-60 MPa is still regarded as HSC. In the North American practice (ACI 318, 1999), high strength concretes are those that attain cylinder compressive strength of at least 41MPa at 28 days. In the FIP/CIB (1990) state-of-the-art report on high strength concrete, it is defined as concrete having a 28-day cylinder compressive strength of 60 MPa.

Production of HSC may or may not require special materials, but it definitely requires materials of highest quality and their optimum proportions. The production of HSC that consistently meets requirements for workability and strength development places more stringent requirements on material selection than that for lower strength concrete (ACI 363R, 1992). However, many trial batches are often required to generate the data that enables the researchers and professionals to identify optimum mix proportions for HSC. Practical examples of mix proportions of HSC used in structures already built can also be the useful information in achieving HSC.

MATERIALS REQUIREMENT FOR HIGH STRENGTH CONCRETE

CEMENT

Cement is the most common binder which allows to make products and structures of the highest strength. Cement is the result of highly dispersed grinding of clinkering products of one of the clay type –marl or mixture of Lime-stone and clay. The stuff and raw materials used for cement producing are the following

- Limestone
- clay
- gypsum
- granulated
- pyrite
- coal

Cement is divided into Portland cement and Slag Portland cement depending on the feedstock and admixtures. There are high-early-strength Portland cement and Portland cement with mineral additives. The concrete structures where certain cement grade is used can acquire unique properties. First of all, these are extra hard concrete which is used, for example, for airdrome takeoff runways and rocket launch pads as well as frost-resistant, fireproof and salt-resistant grades. The notion of grade is used to indicate the maximum strength properties of cement. Grade 400 indicates that when trial testing a 100-mm-edge cement block in the factory lab by press crushing, it took a load of at least 400 kg/cm2. The most common grades are 350 to 500. Cement grades up to 600 and even 700 are also made.

Cement ranks the leading place among building materials. In the modern construction techniques, the role of cement in producing the new advanced materials and products for prefabricated building construction has been constantly increasing. It is used for making cast-in-place and precast concrete, reinforced concrete, asbestos-cement products, mortars, and many other man-made materials, as well as for binding the individual structural elements (parts), heat insulation, etc. Cement is much used in the oil and gas industry. Cement and cement-based advanced building materials successfully substitute for scare timber, bricks, lime, and other conventional materials used in construction activities.

AGGREGATES

The properties of aggregates are decisive for the compressive strength and modulus of elasticity of HSC. In normal strength concrete (NSC), the aggregate has a higher strength and stiffness than the cement paste. Failures in NSC are characterized by fractures in the cement paste and in the transition zone between paste and aggregate .Reduced water-cement ratio, therefore, causes a great improvement in compressive strength of cement paste and hence of concrete.

Fig. 1 Aggregates at stone crusher

Coarse aggregate

In HSC the capacity of the aggregate can be the limiting factor. This may be either the result of the aggregate being weaker than the low water-cement matrix, or alternatively it is not sufficiently strong and rigid to provide strengthening effect. This is mainly related to the coarse aggregate(CA). For optimum compressive strength with high cement content with low water-cement ratios the maximum size of the CA should be kept to a minimum, at ½ in or 3/8 in .The strength increases were caused by the reduction in average bond stress due to the increased surface area of the individual aggregate. Smaller aggregate sizes are also considered to produce higher concrete strength because less severe concentrations of stress around the particles, which are caused by differences between the elastic moduli of the paste and the aggregate .Many studies have shown that crushed stone produces higher strength than rounded gravel .The most likely reason for this is the greater mechanical bond, which can develop with angular particles. However , accentuated angularity is to be avoided because of attendant high water requirement and reduced workability. The ideal CA clean, cubical, angular , 100% crushed aggregate with minimum of flat and elongated particles(ACI 363R,1992). Among the different crushed aggregate that have been studied –trap rock, quartzite, limestone, greywacke, granite, and crushed gravel-trap rock tend to produce the highest concrete strength. Limestone, however, produces concrete strengths nearly as little difference in strength of HSC. Optimum strength and workability of HSC are attained with a ratio of CA to FA above that usually recommended for NSC. Also, due to the already high fines content of HSC mixes, use of ordinary amounts of CA results in a sticky mix.

Fine aggregate

Fine aggregates (FA) with a rounded particle shape and smooth texture have been found to require less mixing water in concrete and for this reason are preferable in HSC. HSC typically contain such high contents of fine cementitious materials that the grading of the FA used is relatively unimportant. However, it is sometimes helpful to increase the fineness modulus (FM) as the lower FM of FA can give the concrete a sticky consistency (i.e. making concrete difficult to compact) and less workable fresh concrete with a greater water demand. Therefore, sand with a FM of about 3.0 is usually preferred for HSC (ACI 363R, 1992).

WATER

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully. In practice, very often great control on properties of cement and aggregate is exercised, but the control on the quality of water is often neglected. Since quality of water affects the strength, it is necessary for us to go into the purity and quality of water.

If water is fit for drinking it is fit for making concrete. This does not appear to be a true statement for all conditions. Some waters containing a small amount of sugar would be suitable for drinking but not for mixing concrete and conversely water suitable for making concrete may not necessarily be fit for drinking. Some specifications require that if the water is not obtained from source that has proved satisfactory, the strength of concrete or mortar made with questionable water should be compared with similar concrete made with pure water. Some specifications also made accept water for making concrete if the pH of water lies between 6 and 8 and the water is free from organic matter.

TOLERABLE CONCENTRATIONS OF SOME IMPURITIES IN MIXING WATER

Impurity	Tolerable concentration
sodium and potassium carbonates and bi-carbonates	1000 ppm (total). If this is exceeded, it is advisable to make tests both for setting and 28 days strength
Chlorides	10000 ppm
Sulphuric anhydride	3000 ppm
Calcium chloride	2 percent by weight of cement in non-pre-stressed concrete
Sodium iodate, sodium sulphate,	Very low Even 100 ppm warrants testing
Sodium arsenate, sodium borate	0.5% by weight of cement, provided quick set is not induced
Sodium sulphide	2000 ppm. Mixing water with a high content of suspended solids should be allowed to stand in a settling basin before use.
Sodium hydroxide	15000 ppm
Salt and suspended particles	3000 ppm. Water containing humic acid or such organic acids may adversely affect the hardening of concrete; 780ppm.
Total dissolved salts	Humic acid are reported to have seriously impaired the strength of concrete.
Organic material	In the case of such waters there-fore, further testing is necessary.
pH	Shall not be less than 6.

PERMISSIBLE LIMIT FOR SOLIDS AS PER IS 456 OF 2000:

Material	Tested as per	Permissible limit max.
Organic	IS 3025 (pt 18)	200 mg/l
Inorganic	IS 3025 (pt 18)	3000 mg/l
Sulphates (as so3)	IS 3025 (pt 24)	400 mg/l
Chlorides (as cl)	IS 3025 (pt 32)	2000 mg/l for concrete work not containing embedded steel and 500 mg/l for reinforced concrete work.
suspended	IS 3025 (pt 17)	2000 mg/l

Algae in mixing water may cause a marked reduction in strength of concrete either by combining with cement to reduce the bond or by causing large amount of air entrainment in concrete. Algae which are present on the surface of the aggregate have the same effect as in that of mixing water.

ADMIXTURES

Admixture is defined as a material, other than cement, water and aggregate, that is used as an ingredient of concrete and is added to the batch immediately before or during mixing. Additive is a material which is added at the time of grinding cement clinker at the cement factory. These days concrete is being used for wide varieties of purposes to make it suitable in different conditions. In these conditions ordinary concrete may fail to exhibit the required quality performance or durability. In such cases, admixture is used to modify the properties of ordinary concrete so as to make it more suitable for any situation. The following admixtures and construction chemicals are dealt with.

- Plasticizers
- Super-plasticizers
- Retarders and retarding plasticizers
- Accelerators and accelerating plasticizers
- Air-entraining admixtures
- Mineral admixtures
- Damp-proofing and water proofing admixtures
- Gas forming admixtures
- workability admixtures

Chemical admixtures

SUPER PLARICIZER

Super plasticizer constitute a relatively new category and improved version of plasticizer, use of which was developed in Japan and Germany during 1960 and 1970 respectively. They are chemically different from normal plasticizers. Use of super-plasticizers permit the reduction of water to the extent up to 30% without reducing workability in contrast to the possible reduction up to 25% in case of plasticizers.
The use of super plasticizer is practised for production of flowing, self levelling, self-compacting and for the production of high strength and high performance concrete.
The mechanism of action of super plasticizers are more or less same as explained earlier in case of ordinary plasticizer. Only thing is that the super plasticizers are more powerful as dispersing agents and they are high range water reducers. They are called high range water reducers in American literature. It is the use of super plasticizer which has made it possible to use w/c ratio as low as 0.25 or even lower and yet make flowing concrete to obtain strength as the order of 120mpa or more. It is the use of super plasticizer which has made it possible to use fly ash, slag and particularly silica fume to make high performance concrete.
The use of plasticizer in concrete is an important milestone in advancement of concrete technology. Since their introduction in the early 1960 in Japan and in the early 1970 in Germany, I is widely used all over the world. India is catching up with the use of super plasticizer in the construction of high rise buildings, long span bridges and the recently become popular ready mixed concrete industry. Common builders and government departments are yet to take up the use of this useful material.
Super plasticizers can produce:

- at the same w/c ratio much more workable concrete than the plain ones,
- for the same workability, it permits the use of lower w/c ratio,
- as a consequence of increased strength with lower w/c ratio, it also permits a reduction and cement content.

The super plasticizers also produce a homogeneous, cohesive concrete generally without any tendency for segregation and bleeding.

Mineral admixtures

Finely divided mineral admixtures, consisting mainly of fly ash and silica fume (SF), and slag cement has been widely used in HSC. Fly ash for HSC is classified into two classes. Class F fly ash is normally produced from burning anthracite or bituminous coal and has pozzolanic properties, but little or no cementitious properties. Class C fly ash is normally produced from burning lignite or sub-bituminous coal, and in addition to having pozzolanic properties, has some autogenous cementitious properties (ACI 363R, 1992). When adding fly ash during concrete production, the workability is normally improved due to the 'lubricating' effect of the spherical particles (FIP/CEB, 1990).

SILICA FUME

Silica fume (SF) is a by-product of the melting process used to produce silicon metal and ferrosilicon alloys. The main characteristics of SF are its high content of amorphousSiO2 ranging from 85 to 98%, mean particle size of 0.1 – 0.2 micron (approximately 100times smaller than the average cement particle) and its spherical shape. Because of its extreme fineness and high silica content, SF is a highly effective pozzolanic material. The SF reacts pozzolanically with the lime during the hydration of cement to form thes table cementitious compound calcium silicate hydrate (CSH). Normal SF content ranges from 5 to 15 percent of Portland cement (ACI 363R, 1992) . The use of SF as replacement of a part of the cement gives considerable strength gain. For most binder combinations, the use of SF is the only way of producing concrete of normal workability with a strength level exceeding 80 MPa. To ensure a proper dispersion of the ultra-fine SF particles, plasticizers should be used in these mixtures

Silica fume, also referred to as micro silica or condensed silica fume, is another material that is used as an artificial pozzolanic admixture. It is a product resulting from reduction of high purity quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy. Silica fume rises as an oxidised vapour. It cools, condenses and is collected in cloth bags. It is further processed to remove impurities and to control particle size. Condensed silica fume is essentially silicon dioxide (more than 90%) in non-crystalline form. Since it is an airborne material like fly ash, it has spherical shape. It is extremely fine with particle size less than 1 micron and with an average diameter of about 0.1 micron, about 100 times smaller than average cement particles. Silica fume has specific surface area of about 20,000 m2/kg, as against 230 to 300 m2/kg.
Silica fume as an admixture in concrete has opened up one more chapter on the advancement in concrete technology. The use of silica fume in conjunction with super-plasticizer has been the backbone of modern High performance concrete. In one article published in 1998 issue of 'Concrete International' by Michael Shydlowski, President, Master Builder, Inc states "Twenty five years ago no one in the concrete construction industry could even imagine creating and placing concrete mixes that would achieve in place compressive strengths as high as 120 MPa . . . . . The structures such as Key Tower in Cleave land with a design strength of 85 MPa, and

Wacker Tower in Chicago with specified concrete strength of 85 MPa, and two Union Square in Seattle with concrete that achieved 130 MPa strength – are testaments to the benefits of silica fume technology in concrete construction".

Influence on Hardened Concrete

Concrete containing micro silica showed outstanding characteristics in the development of strength. It has been also found out that modulus of elasticity of micro silica concrete is less than that of concrete without micro silica at the same level of compressive strength. As regards, the improvement in durability aspects many published reports, of this investigation carried out, indicate improvement in durability of concrete with micro silica. There are some investigations indicating contradiction, particularly with reference to resistance against frost damage. With regard to whether or not, silica fume is effective for alkali-aggregate reaction, some research workers report that it is effective, others conclude that while it is effective, addition of silica fume in small quantities actually increases the expansion. The mechanical properties of the concrete can be improved by obtaining a denser packing of the solids. The paste-aggregate bond can also be improved. The first effect might be explained by so-called 'DSP-concrete' (Densified Systems containing homogeneously arranged ultra-fine Particles). (Larger amounts of silica fume (SF) (more than 10% of the cement weight) are used to 'refine' the particle structure and thereby reduce the total pore volume and the average pore size. The size and spherical geometry of SF particles allow them to fill effectively the voids between the larger and angular cement grains Extreme dosages of dispersing agents are used to overcome the surface tensions, permitting dense particle packing. Very low water demand is obtained and, thus, pastes of very low water-cement ratios can be produced. The SF eventually also contributes to the formation of CSH-gel through pozzolanic reactions, causing a denser and more homogeneous gel structure.

Basic considerations of mix design of high strength concrete

Matrix bond may not be strong enough. In NSC the interfacial zone is often a weak link, since it tends to be more porous and heterogeneous than the bulk paste matrix. The addition of SF can drastically change the microstructure of the paste at the interface, causing it to be as dense as that of the matrix. This provides a much more efficient bond between the aggregate and the matrix. This effect of SF is associated with its ability to pack densely at the aggregate surface, as well as to reduce the internal bleeding of the concrete. Due to these interfacial effects, the aggregates in high strength silica fume concrete are becoming active load-bearing components in the concrete, contributing to the overall strength, and not just inert mechanical fillers as in NSC. Therefore, the pillars of practical mix design for HSC are:

i. Reduced water-cement ratio
ii. Extensive use of plasticizers.
iii. Application of cement with a high strength potential.
iv. Applications of pozzolans and in particular SF.

REQUIREMENTS OF INGREDIENTS FOR HIGH STRENGTH CONCRETE

From the preceding discussions on information found from literature, the necessary requirement of different ingredient materials required for producing HSC can be summarized as stated in Table 1.

Material /issue	**Requirements**
Cement	- Portland cement. - Higher content (8 to 10 sacks per cu.yd.of concrete).
Water	- Portable quality. - w/b ratio 0.22 to 0.40.
Fine aggregate	- Sand with rounded particle shape. - Higher FM (around3.0). - Smaller sand content or coarser sand .
Coarse aggregate	- Grading is not critical for concrete strength. - Smaller maximum size (10-12mm) is preffered. -Angular crushed with a minimum flat and elongated particles. - Type of aggregate depending on the conctere strength targeted. - Gradition with in ASTM limits has a little effect on concrete strength.
Admixtures (chemical/mineral)	-Type of admixture depends on the property of the concrete to be improved. - Reliable performance on previous work can be considered during selection.
Overall basic considerations	- Optimum dosage - Quality materials - Improved quality of cement paste as well as aggregates - Denser packing of aggregates and cement paste - Improved bond between aggregate surface and cement paste - Minimum numbers as well as smaller sizes of voids in the paste

LABORATORY WORK

A. Material properties

S.No	**Material properties**	**Result**
1	Fineness of cement	**7.5%**
2	**Specific Gravity of coarse aggregates**	**2.73**
3	**Specific Gravity of Sand**	**2.717**
4	**Bulk density of coarse aggregates**	**1798 kg/cu.m**
5	**Fineness modulus of sand**	**3.58**

As per IS 383/1970
Observed
Cumulative %wt. retained gives sand comes under **Zone (ii)** Category
Confirming to IS 383/1970 given aggregates comes under **Zone(i)** aggregates

B. **MIX DESIGN CALCULATIONS**

Specific gravity of sand = 2.717
Specific gravity of C.A. = 2.7
Density of F.A. = 2717 kg/m3
Density of C.A = 2730 kg/m3
Fineness modulus of F.A. = 3.58
Density of cement = 2960 kg/m3

AS PER T-11.4 ACI 211.1-91
Volume of C.A. based on maximum size of aggregate used for 20MM
Volume of C.A. = 0.57
Volume of F.A. = 0.43
Adopt W/C ratio 0.30 for optimum case of workability & compressive strength.
W/C = 0.30

ACI 211.1-91
ASSUMING 1% AIR ENTRAINED WITH A SLUMP OF 20-30MM.
ADOPT W/C OF 155 lit/m3.

As given by ACI 211.1-91.
The density of fresh concrete using a maximum size aggregate of 20MM as 2280 kg/m3.
DESIGN

a) ASSUMING 5% OF RESULTS ALLOWED TO FALL BELOW SPECIFIED DESIGN STRENGTH.

f1 = fmin + 1.65*5
= 100 + 1.65*5
= 108.25 Mpa

b) W/C ratio = 0.30
Amount of water = 155 lit/m3
W/C = 0.30

C = 155/0.30 = 516.67
C = 517 kg/m3.

c) DRY ROUNDED COARSE AGGREGATE BULK DENSITY = 1798 Kg/m3.
Weight of C.A. = 0.57 * 1798.
Weight of C.A = 1025.86 kg/m3.

d) ASSUMING THE DESIGNING CONCRETE AS AIR ENTRAINED WITH 1%
Density of concrete = 2280 kg/m3.
Weight of water = 155 kg/m3.
Weight of cement = 517 kg/m3.
Weight of C.A. = 1025 kg/m3.
Weight of F.A. = 762.19 kg/m3

Cement weight = 517 kg/m3. Absolute volume = (517/3.15) * 103 = 164.12 * 103 cm3.	Water = 155 kg/m3. Absolute volume = 155 * 103 cm3
Coarse aggregate = 1025 kg/m3. Absolute Volume of C.A.= (1025/2.7) * 103 = 379.629 cm3	Volume of F.A.= 281251 cm3 weight of F.A. = 281251 * 2.71 Sand = 762.19 kg/m3

Volume of AIR = 2% = 2/100 * (106) = 20 * 103.
TOTAL ABSOLUTE VOLUME = 718749 cm3.

C : F.A : C.A : Water
517 kg : 762.19 kg : 1025 kg : 155
With 155 lit of Water.

C : F.A : C.A : Water
1 : 1.47 : 1.98 : 0.299

Adopt with TRIAL MIXES OF 4%, 5%, 6%, 8%,10% of SILICA FUME with 4-8% of SUPERPLASTICIZER. By varying the proportions of aggregates and cement

DETAILS OF MIX PROPORTIONS AND THEIR DESIGNATIONS:

S No	Mix Discription	cement kg/m3	fine agg. kg/m3	coarse agg. kg/m3	water lit/m3	w/c ratio	silica fume	super plasticizer lit/m3
1	M1	517	762.19	1025	155	0.3	4%	4%
2	M2	517	762.19	1025	155	0.3	4%	5%
3	M3	517	762.19	1025	155	0.3	6%	5%
4	M4	517	762.19	1025	155	0.3	8%	6%
5	M5	517	762.19	1025	155	0.3	10%	7%
6	M6	517	762.19	1025	155	0.3	10%	8%

- **Mineral admixture i.e.. silica fume % is replacing in cement**
- **Super plasticizer used is sikamet % is replacing water**

C.MAKING AND CURING OF COMPRESSION TEST SPECIMEN:

The compression test specimens are cast as per IS : 516 – 1959. It involves

- Sampling of Materials
- Preparation of Materials
- Proportioning
- Weighing
- Mixing Concrete
- Compacting
- Curing

Fig. 4 making of concrete by hand mixing

D.TEST FOR COMPRESSIVE STRENGTH OF CONCRETE SPECIMEN:

Compression Test specimens (150*150*150 mm) are cast using cubical moulds as per IS : 516 – 1959 and tested for compressive strength .Three samples for each batch were tested and the results obtained are as follows:

S No.	Mix number	28 days compressive strengths (Mpa)
1	M1	60
2	M2	74
3	M3	80
4	M4	92
5	M5	101
6	M6	107

COMPARISON OF BUILDING DESIGN BETWEEN HSC AND NSC

DESIGN OF A REINFORCED CONCRETE BUILDIND FRAME USING M20 AND M60, M70, M80, M90, M100 AND COMPARISION :

A reinforced concrete building frame which was taken to be a library building has been analyzed and designed using Staad.Pro 2004 using concrete of grade M20 and M60 and has been compared as regards to the beam and column concrete consumption, steel reinforcement required and the cost aspect for concrete consumption and steel reinforcement required .

ANALYSIS DESIGN USING StaadPro 2004:

CREATING THE MODEL:

The model of the Reinforced concrete building frame was created using the graphical model generation mode, or graphical user interface (GUI).

Load Data for the building:

1.Dead Load

(a) Finishes=2.5 KN/sqm

Floor Finishes=1.0 KN/sqm

(b) Slab=25 D KN/sqm where D is the depth of the slab

(c) Walls=External 250mm thick =20*.25=5 KN/m/ m height

Internal Walls=150 mm thick=20*.15=3KN/m/m height

2.Live Load

(a) Roof=1.5 KN/sqm

(b) Library=10KN/sqm

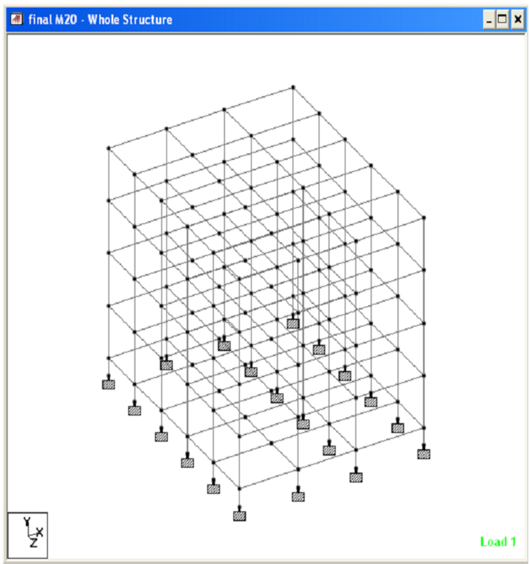


Fig. 5 Model of the building

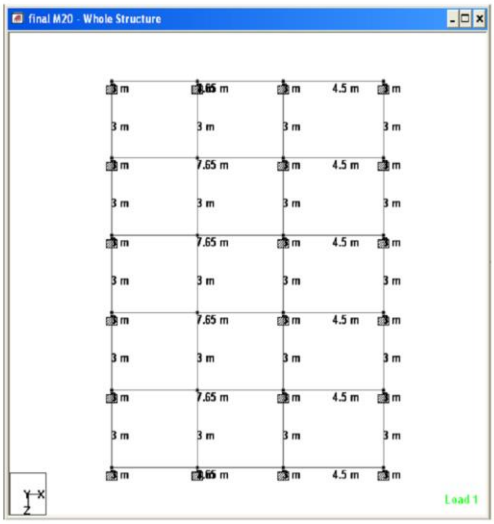


Fig. 7 Key Plan of slab beam of the building

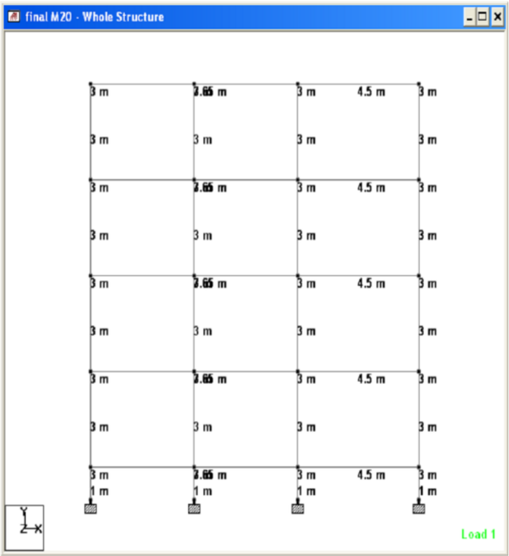


Fig. 9 Front View of The Building

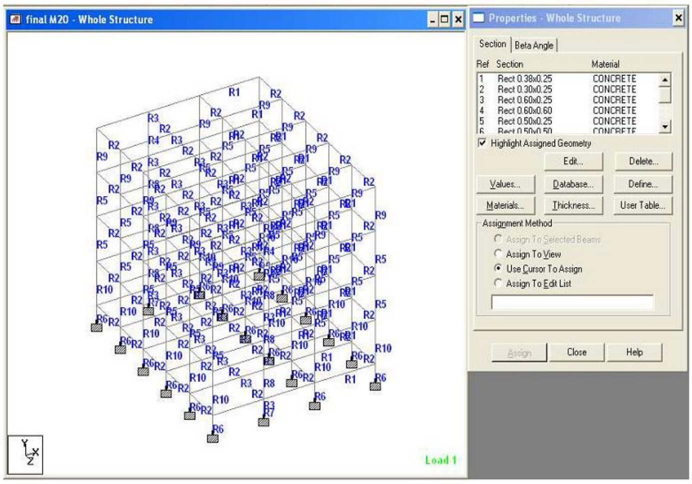


FIG. 6 GENERATION OF MEMBER PROPERTY

R1 = 375mm*250mm
R2= 300mm*250mm
R3=600mm*250mm
R4=600mm*600mm
R5=500mm*250mm
R6=500mm*500mm
R7=600mm*600mm
R8=500mm*500mm
R9=350mm*250mm
R10=450mm*450mm

Fig. 8 Materials for the structure:

The materials for the structure were specified as concrete with their various constants as per standard IS code of practice.

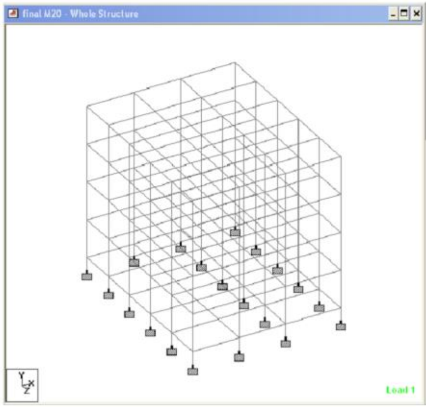


Fig. 10 Supports

THE FRAME WAS ANALYZED UNDER A REPEAT LOAD OF 1.5 DEAD LOAD + 1.2 LIVE LOAD.

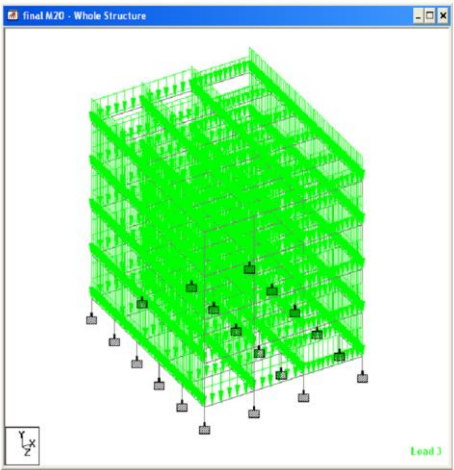
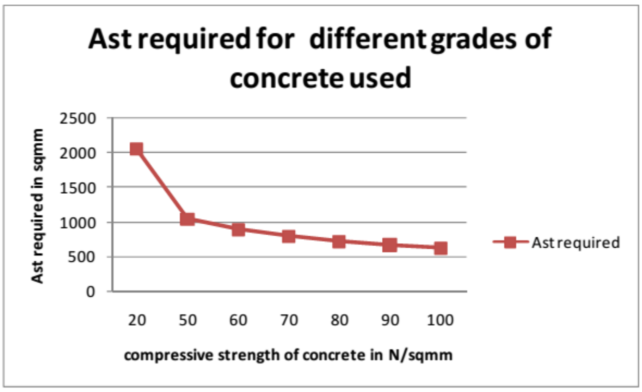


Fig. 11 Loading

Design Specifications:

The structure was designed for concrete in accordance with IS code. The parameters such as clear cover, Fy, Fc, etc were specified. Then it has to be specified which members are to be designed as beams and which member are to be designed as columns. The specification for grade
of concrete was first taken as Fc=20 N/sqmm for case 1. and then it was changed to be Fc=60 N/sqmm was taken in case 2 and then Fc=60N/sqmm with reduced section were taken in case 3.

Analysis and design results:
Two beams , Beam no 109 and Beam no.132 and column no.177 were analysed .Beam no.109
forms the beam B2 at exterior roof level at the second floor. Beam no 132 forms the beam B1 at
the exterior roof level of the second floor whereas the Column no.177 forms the column of
second floor were analyzed and the reinforcement required were obtained.



Variation of steel area required with increase in the strength of concrete to be used

CONCLUSIONS

On the requirement of strength, design and analysis of buildings the following procedure explain high strength concrete M100 by using silica fume and super plasticizers.

- Using Portland cement with higher content of 8-10% with fineness 7.5% and sand with rounded particle shape with higher fineness modulus 3.58 with specific gravity 2.717 under zone-ii aggregates.
- For coarse aggregates with specific gravity 2.73 and bulk density is 1798 kg/cu.m under zone-i aggregates.
- By adding mineral admixture i.e.. silica fume 4-10% is replacing in cement and super plasticizer used is sikamet 4-8% is replacing water.
- For proportions followed by AS PER T-11.4 ACI 211.1-91, the results of the proportions cement:fine aggregates:coarse aggregates:water is 1:1.47:1.98:0.299.
- From the mix description M1 to M6 regarding silica fume varying from 4,4,6,8,10 and 10 percentage and super plasticizers sikamet varying from 4,5,5,6,7 and 8.
- Among this descriptions M6 gives maximum compressive strength is 107Mpa at 28 days curing.
- By using staad pro design and analysis completed.

The best combination of cement, fine aggregates, coarse aggregates, water, silica fume and super plasticizer in the ratio of 1,1.47,1.98,0.299,10% and 8% for giving more strength, durability and workability.

REFERENCES:

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Pathakota Brahma Reddy

- M.S.Shetty (1982), "concrete technology(theory and practice)", ISBN : 81-219-0003-4.
- Mohammad Abdur Rashid and Mohammad Abul Mansur,"considerations in producing high strength concrete".
- "Standard practice for selecting proportions for heavy weight and mass concrete", ACI Committee 2111.1-91, ACI manual of concrete practice,1994
- Papayianni,I, "Influence of superplasticizer type and mix design parameters on the performance of them in concrete mixtures.", Cement & Concrete Composites 27 (2005)
- "Design Aids For Reinforced Concrete" To IS: 456-1978 -SP:16-1980, Indian Standard Institution.
- "STAAD Pro 2004 – Getting started & tutorials"- Published by: R .E. I.
- Carrasquillo, R. L. (1985), "Production of High Strength Pastes, Mortars, and Concrete," Very High Strength Cement-Based Materials, Materials Research Society Symposia Proceedings, Vol. 42, pp.151-168