DOWNLOAD PDF METHODS OF CONCRETE MIX DESIGN

Chapter 1 : IS Code Method of Concrete Mix Design

Concrete mix design is the process of finding the proportions of concrete mix in terms of ratios of cement, sand and coarse aggregates. For e.g., a concrete mix of proportions means that cement, fine and coarse aggregate are in the ratio or the mix contains one part of cement, two parts.

Just what is mix design? It is everything that makes the concrete work well for your application: What slump do you need? Do you need entrained air? What happens if the day is particularly cold or hot? What size of aggregate is best? Should you ask for fly ash in the mix? When most contractors think about concrete mix designâ€”if they think about it at allâ€”the first thing that comes to mind is "bags" or "sacks. A bag is 94 pounds of cement, or about 1 cubic foot; but if you order a 6-sack mix, all that tells you is how much portland cement is in the mix. That mix could be completely wrong for your application and could even be inferior concrete. Rather than only specifying how much cement is in the mix, we should be considering things like permeability, shrinkage, workability, pumpability, stampability, and stainability. Placeability is an important attribute of a good mix design. Placeability is simply the traits that the wet or plastic concrete has that allow it to be placed and finished. The ability to be pumped is another consideration. The classic way to measure placeability is slump, although two different mixes can have the same slump and behave very differently depending on the aggregates, the air content, and the admixtures. Strength is nearly always specified for a concrete mix. The International Residential Code, for example, specifies that interior slabs have a minimum compressive strength of psi. For flatwork, though, strength is seldom the controlling factor, because higher-strength concrete mixes that produce very stiff concrete can result in more shrinkage which shows up as curling and cracking. Long-term durability is at least as important as placeability and strength, but it is sometimes sacrificed if there are compromises to be made. Durability is achieved by getting a low-permeability, low-shrinkage concrete that has the proper amount and distribution of entrained air. Durable concrete must resist freeze-thaw action and prevent chloride from penetrating to the reinforcing steel to contribute to corrosion. Appearance issues are obviously more important for decorative concrete than other applications. Nothing sours a client more than a beautiful floor that is cracked or spalled, or a decorative wall that is honeycombed. With slabs, shrinkage is the number one concern and lower strength concrete with less cement paste will often shrink and curl less. With decorative concrete, surface hardeners will provide a higher strength, more wear resistant and less permeable surface layer, the overall concrete strength can be less. The requirements for good performance in each of these three stages can actually conflict. As we all know, wet, easy-to-place concrete is not likely to be durable concrete. Properly proportioned mixes will remain beautiful for many years. Best Stamped Concrete Inc. One way to get the right mix for your application is to have a great relationship with your ready mix supplier. You can then tell him what your application is, when you plan to place, and what the specification requires and he can develop the ideal mix. A program currently being promoted by the National Ready-Mixed Concrete Association called P2P Prescriptive-to-Performance takes that concept to the ultimate conclusionâ€”completely relying on the producer to provide the right mix. Using the ACI Choose the target slump Choose the maximum aggregate sizeâ€”remember that the larger the better for reducing shrinkage and curling. Estimate the water and air content using ACI Select the water-cement ratio. Calculate the cement content by dividing the water content by the water-cement ratio. Estimate the coarse aggregate content. Estimate the fine aggregate content. Adjust for aggregate moistureâ€”wet aggregate can significantly reduce the amount of water to be added. After all these fancy calculations, the bottom line is that concrete is still designed by experience with previous mixes or by making trial batches in a lab and testing the concrete. Nothing beats experience with a mix. Many decorative contractors will have 4 or 5 mixes that they use for different applications or weather conditions. The standard for designing a concrete mix is ACI Like most ACI committee reports, this document is excellent, albeit highly technical. Learn more about the choices in concrete materials. Related Information Ordering Concrete Learn how to order the right concrete, in the right quantity, and delivered at the right time. Concrete Admixtures Learn about the common types of admixtures for concrete and the applications for each type to help you control set time.

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Chapter 2 : Download Engineered Concrete Mix Design and Test Methods PDF Book - Iamcivilengineer

Modern advances in mix design methods have built upon the necessity of maximum density gradation, using the concept of 'particle packing'. This concept talks about the optimization of the granular skeleton of the concrete mix to obtain the best packing density.

The main ingredient of the concrete is cement, aggregates, water and admixtures. Due to the varying properties of the materials used in concrete, the design of concrete is not an easy task. The objective of designing a mix is to produce a concrete of required strength, durability and workability as economically as possible. In our country, generally Indian Standard Institution ISI concrete design method is preferred and hence has been discussed. The use of Indian standard institution ISI concrete design method is illustrated with the aid of an example. The proportioning of constituents of concrete is governed by the performance of concrete in the plastic and the hardened states. The concrete cannot be properly placed and compacted If the plastic concrete is not workable. Therefore, the workability of concrete becomes vital. The compressive strength of hardened concrete depends upon many factors, e. The actual cost of concrete is related to the cost of materials required for producing a minimum mean strength called characteristic strength which is specified by the structure engineer. This depends on the quality control measures, but it is a fact that the quality control adds to the concrete cost. The extent of quality control is often an economic compromise, and depends on the size and type of job. The cost of labor depends on the workability of mix, e. Requirements of Concrete Mix Design The requirements which form the basis of selection and proportioning of mix ingredients are: Compressive strength It is one of the most important properties of concrete and influences many other describable properties of the hardened concrete. The mean compressive strength required after 28 days, determines the nominal water-cement ratio of the mix. The other factor affecting the strength of concrete are age, cured and degree of compaction. Workability The degree of workability required depends on three factors i. For the narrow and complicated section with numerous corners or inaccessible parts, the concrete must have a high workability so that full compaction can be achieved Durability The durability of concrete is its resistance to the aggressive environmental conditions. High strength concrete is generally more durable as compared to low strength concrete. When the high strength is not required but the conditions of exposure are severe in such situations, high durability is vital. To meet the durability requirement, the mix design is the necessity. Maximum nominal size of aggregate The compressive strength tends to increase with the decrease in size of aggregate whereas the workability of concrete increases with increase in maximum size of the aggregate. Grading and type of aggregate The grading of aggregate influences the mix proportions for a specified workability and water-cement ratio. Coarser the grading, leaner will be mixed which can be used. An important feature of a satisfactory aggregate is the uniformity of the grading which can be achieved by mixing different size fractions. Quality Control The degree of control can be judged statistically by the variations in test results. The variation in strength results is due to lack of control of accuracy in batching, mixing, placing, curing and testing. The lower the difference between the mean and minimum strengths of the mix lower will be the cement-content required. The factor controlling this difference is called as quality control. Mix Proportion designations The common method of expressing the proportions of ingredients of a concrete mix is in the terms of parts or ratios of cement, fine and coarse aggregates e. The proportions are either by volume or by mass. The water-cement ratio is usually expressed in mass. Information Required For Mix Design For the design of concrete mix, the following information is required: Grade of concrete Maximum temperature of fresh concrete Type of cement.

Chapter 3 : Concrete Mix Design - The Right Concrete Mix - The Concrete Network

KEYWORDS: Concrete, mix design, ACI method, fine aggregate/coarse aggregate ratio, cement/fine aggregate ratio, void ratio 1. INTRODUCTION. Concrete is one of the most widely used construction materials throughout the world.

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. One of the ultimate aims of studying the various properties of the materials of concrete, plastic concrete and hardened concrete is to enable a concrete technologist to design a concrete mix for a particular strength and durability. The design of concrete mix is not a simple task on account of the widely varying properties of the constituent materials, the conditions that prevail at the site of work, in particular the exposure condition, and the conditions that are demanded for a particular work for which the mix is designed. Design of concrete mix requires complete knowledge of the various properties of these constituent materials, these make the task of mix design more complex and difficult. Design of concrete mix needs not only the knowledge of material properties and properties of concrete in plastic condition; it also needs wider knowledge and experience of concreting. Even then the proportion of the materials of concrete found out at the laboratory requires modification and re adjustments to suit the field conditions. With better understanding of the properties, the concrete is becoming more and more an exact material than in the past. The structural designer specifies certain minimum strength; and the concrete technologist designs the concrete mix with the knowledge of the materials, site exposure conditions and standard of supervision available at the site of work to achieve this minimum strength and durability. Further, the site engineer is required to make the concrete at site, closely following the parameters suggested by the mix designer to achieve the minimum strength specified by the structural engineer. In some cases the site engineer may be required to slightly modify the mix proportions given by the mix designer. He also makes cubes or cylinders sufficient in numbers and tests them to confirm the achievements with respect to the minimum specified strength. Mix designer, earlier, may have made trial cubes with representative materials to arrive at the value of standard deviation or coefficient of variation to be used in the mix design. In the method was revised to include, among other modifications, the use of entrained air. We shall now deal with the latest ACI Committee It has the advantages of simplicity in that it: Applies equally well With more or less identical procedure to rounded or angular aggregate To regular or light weight aggregates To air entrained or non-air-entrained concretes Concrete Mix Design Excel Sheets Comprehensive Excel spreadsheet for concrete mix design and batching can save up to mixes. Unique easy to use features for proportioning aggregates etc. Up to six aggregates, four cements and five admix can be blended in any one mix. Sieve analysis can be entered for up to twelve course and fine aggregates. Combined grading is graphed as you design a mix. Aggregate moisture can be adjusted and batch weights produced. Download Concrete Design and Batch Software.

Chapter 4 : DOE Methods of Concrete Mix Design | Concrete Technology

ACI Mix Design Process of measuring the slump of fresh concrete ACI Mix Design Process of measuring the slump of fresh concrete ACI Mix Design This drop in height is.

StonemontQC is fully integrated with the aggregate portion allowing for mix component properties to be easily kept current with data from aggregate plants. Automated features include email alerts on quality failures and automatic data analysis and reports that can be generated and emailed daily, weekly, or monthly. Automated analysis and reporting saves time and money by allowing quality managers to focus on quality rather than spending hours to compile reports for sales and operations personnel. StonemontQC integrates with concrete batching and dispatching software to allow for the seamless transfer of mix designs and batch results. Are you tired of having to hand-enter all of your break results from third-party labs?. Not only is hand-entering third-party results time consuming but it also is quite expensive when you consider the labor costs involved. Concrete Mix Design Unequaled concrete mix optimization toolsâ€¦ StonemontQC has many features to facilitate development of concrete mixtures including support for ACI and other design methods. Aggregate mix components can be easily updated or substituted in all mixes. Supports ACI and other mix design methods. Support a manual proportion method where a user enters weights for each component. Flexible data entry for aggregate matrix including entering coarse aggregates ssd or dry ; entering fine aggregates ssd or dry ; entering coarse bulk volume; pervious mix designs. Powerful drag and drop visual blending tools for coarseness factor charts, individual retained charts, power 45 charts, and semi-log sieve charts. Combined, coarse, and fine aggregate blends with the option to include cementitious material in the combined blend. The data entry form allows users to record batch information, standard plastic property tests associated with concrete mixes, and break information and results. The intuitive layout of the data-entry form allows for quick and efficient recording of batch information, break data, and other test results. Your technicians can be entering data within minutes. Furthermore, Stonemont offers an innovative, cost-effective, and time-saving service that can extract break data from PDF files. User Friendly, Intuitive Interface Support for common concrete plastic property test results and worksheets Record up to 5 compressive strength breaks per age i. Break schedule report that can be used with automated break machine import Evaluate results against multiple specifications Robust security features to limit and control use of the data entry form Attach external documents to samples Associate customer and job information to samples Powerful and Quick Analysis Automatic evaluations of your concrete mix performanceâ€¦ StonemontQC provides several different analysis tools all designed to provide you unique and detailed analysis of concrete mix results. These can be used to assess the performance of current results against historical data, and detect potential issues before they become customer problems. In addition, generating any of the analysis types is simple, because the search form used to find data for various analysis tools is intuitive, simple to learn, and is consistent among similar tools. Some frequently used tools are listed below: Strength Chart â€" A powerful run chart and range chart combination that shows within-batch strength variability as well as overall strength variability. Low Strength Analysis â€" Both an analysis tool and report that can be automated to detect low strengths Target Strength Analysis â€" Automates the required strength analysis and can provide recommended cementitious changes to maintain a user-definable target strength Batch Chart â€" Chart batch results directly from the batch system. Optionally, display other quality results along side batch results. Batch Classification â€" Automates the analysis of batch results quickly identifying batching problems Statistical Summaries â€" Provides a tabular summary of asphalt mix gradation, quality, process and other types of results Histograms, Normal Plots â€" Provides distribution analysis, and testing of normality of results Semi-Log, Power 45, Individual Retained Charts â€" Simple charts showing the entire gradation of product sieve results Run Charts, Time-Series Charts â€" Allows for detection and analysis of trends Multi-variable Charts â€" Compare process data against gradation or quality data, for example concrete temperature or air content versus strength of mixture. Product Search Tool â€" Enter a specification and find all products that meet that specification at selected plants Coarseness Factor Chart â€" Available from the concrete mix design form. Mix Comparison â€" Ability to

analyze and compare various costs associated with different mixes and the components in a mix. Trial Mix Analysis â€" Available from the concrete mix design form.

Chapter 5 : Concrete Mix Design (AS per ACI code) with Excel Sheets and Software Concrete Mix Ratio

Concrete Mix Design by DOE Method using Fly Ash: The use of fly ash as a part substitute of cement is fast gaining popularity throughout the world. Thus one should be acquainted with the procedure of concrete mix design containing fly ash.

The following points highlight the DOE methods of concrete mix design. This method of concrete mix design or proportioning mainly is based on the extensive field and laboratory experiments carried out by Road Research laboratory U. The Road Note 4 method was published for the first time in This method of mix design was most popular and widely used upto all over the world. Most of the Indian Concrete roads and air fields were designed by this method, but it is obsolete now. The DOE method was first published in and revised in This method can also be used for concrete containing fly ash. DOE method is a standard method of mix design in U. The water contents required to give various levels of workability, as very low, low, medium and high expressed in term of slumps or Vee Bee time or compacting factor, are determined for the two types of aggregates as crushed aggregate and gravel. This method is suitable for mix design of normal concrete mixes having 28 days cube compressive strength upto 75 MPa for non-air entrained concrete. The step by step procedure of mix design is given below: Determine the target mean strength from the specified characteristic strength. Now mark a point on the y-axis of the Fig. The method will be more clear from the example below. The higher of the two quantities should be adopted. This can be obtained from Fig. If the specific gravity of aggregate is not known its value for un crushed aggregate may be taken as 2. The aggregate content is determined by subtracting the weights of cement and water content from the weight of fresh concrete read from the Fig. The parameters involved in Fig. Knowing the proportion of fine aggregate from Fig. Knowing the fine aggregate, the weight of coarse aggregate can be found. The coarse aggregate can further be divided into different fractions depending upon the shape of aggregate. Generally figures given in Table From the proportions so obtained trial mix may be prepared and samples should be prepared and tested to confirm its suitability for the proposed concrete structure. If fly ash is used along with cement, then water content may be reduced as shown in Table Design a concrete mix for targeted 28 days cube strength of 45 MPa from the following data: Exposure to concrete is moderate 6. The cover to the reinforcement to be provided is 25 mm. Determine the target strength from the relation. From this table for ordinary port-land cement and uncrushed 20 mm aggregate the 28 days strength is 42 MPa. Through this point draw a dotted line curve parallel to the neighboring curve. For uncrushed aggregate of 20 mm max. Actually the lower value of the two should be adopted. Determination of Density of Fresh Concrete:

Chapter 6 : Illustration of Mix Design of Concrete by ISI Method

The various methods, developed for concrete mix design, are not universal because design mixes are specific to regional climate, local materials, and exposure.

Introduction Conventional mix design methods tend to use grading differently for coarse and fine aggregate. Typically, the available aggregates are proportioned in such a way that the grading of the combined aggregate is similar to a specific curve or lies in between given limits. These numbers or limits are typically obtained from maximum density considerations. In , Fuller proposed the formula for maximum density gradation: This was designed to give straight lines for maximum density gradations. This concept talks about the optimization of the granular skeleton of the concrete mix to obtain the best packing density. Over years ago, Feret proposed formulas showing that the maximum strength of cementitious material is obtained when the matrix initial porosity i. A cost-effective concrete is obtained by optimizing the paste composition, aggregate skeleton, and paste content. Selection of paste composition The paste that yields the best rheological properties should be chosen. The properties primarily include two parameters: Rheology will be studied more closely in a separate section under the Advanced Topics link. The Marsh cone test is used to evaluate the characteristics of different types of pastes and for optimisation of SP dosage. Time taken for certain volume of pastes to flow through the cone with a definite sized aperture is measured. The saturation point is defined as the SP dosage beyond which flow time does not decrease appreciably. Another test method for quantifying the effect of the superplasticizer is the mini slump test. The test involves the determination of spread of paste inside a truncated cone after lifting the cone vertically upwards. The cone is similar in proportion to the actual slump cone. This test is quick and can be conducted with a small sample size, so that many tests can be performed in a few hours by one person. The results of the mini-slump test on paste and slump test on concrete are generally correlated. The major effects observed in the mini-slump test correspond to the effects observed with slump of concrete. Aggregate skeleton The purpose of optimization of the aggregate skeleton is to minimize the void space between particles. The smaller the interparticle void space, the less paste required to separate the particles i. For a constant volume of paste, a lower interparticle void space will result in an improved workability. Control of particle packing has been applied in many branches of industry e. Achievement of optimal packing is of interest to the study of materials such as concrete, asphalt, and ceramics. Concrete mixture proportioning is a volumetric â€" packing problem. All existing methods of mixture proportioning incorporate in some way an indirect measure of particle packing by approximating the aggregate proportions to an ideal gradation curve. However, the ideal proportions for concrete depend not only on the grading curve of aggregate but also on the packing characteristics of the fine components such as cement, fly ash and micro silica. Using well - established empirical rules for estimating water demand and reference grading curves for mixture proportioning impose severe restrictions on developing new applications or extending the present range of application in concrete technology. These limitations may be overcome by re-examining the concept of particle packing and its applications to concrete technology. Furthermore, evaluation of the effects of packing density of mixtures on workability suggest that the maximum workability without bleed water is achieved when the porosity of the packed powder is just filled with water. Similarly, in hardened concretes, chloride permeability measurements showed a strong correlation with reduced charge flow with increased packing densities. As the properties of concrete are influenced by particle packing, there has been a revival of interest in this topic. Studies on particle packing involve selection of appropriate sizes and proportions of particulate materials to get suitable combination for optimal packing, i. Particle packing models seek to select proper sizes and proportions of small particles to fill larger voids. The small particles in turn contain smaller voids, that are filled with smaller particles and so on See Figure 1.

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designing concrete mixes and is based on the absolute volumes of.

Chapter 8 : Advanced Methods of Concrete Mixture Design

The common method of expressing the proportions of ingredients of a concrete mix is in the terms of parts or ratios of cement, fine and coarse aggregates e.g. a concrete mix of proportions means that the mix contains one part of cement, two parts of fine aggregate and four parts of coarse aggregate.

Chapter 9 : Concrete Mix Design | Stonemont Solutions

Page 1/7 04/10 MIX DESIGN METHODS CONCRETE MIX DESIGN 1. Scope. This method covers the procedure for designing concrete mixes and is based on the absolute volumes of.