SUNY State University Construction Fund	**Policy Title: Directive 3-1 Concrete** **Responsible Office: Design & Construction** **Last Revised Date: January 2024**

Summary:
This Directive is intended to address the problems which are commonly associated with concrete structures.

Overview:
Provide drawings and specifications that comply with the requirements, recommendations, and guidance in the latest version of ACI 318 published by the American Concrete Institute. Where required by Directive 1B-2, use lower carbon concrete following the recommendations in the GreenNY Specification: Lower Carbon Concrete published by NYS Office of General Services.

Responsibility:
In this document, the word "Engineer" means the Structural Engineer responsible for structural design for the project.

Detailed Requirements

I. General

A. Comply with applicable requirements of Directive 1B-2. CLCPA, E.O. 22 and SUNY Policy Compliance.

1) In the technical specifications for concrete materials exceeding the quantity thresholds in Directive 1B-2, require submission of environmental product declarations (EPD) and documentation identifying the Global Warming Potential (GWP) for each of the concrete mixes. Specify maximum limits for the GWP for each mix based on the NYS Buy Clean Concrete Guidelines table included in Directive 1B-2.

B. Coordinate and comply with applicable requirements of Directive 1B-1 Building Codes, Code Review and Construction Permit Application Form, and Statement of Special Inspections Form.

II. Concrete Mix Design

A. Specify air entrainment on all concrete exposed to weather. Air entrainment shall not be used on interior concrete work unless the concrete is to be exposed to freeze/thaw cycles during the construction phase. Do not trowel finish concrete that is air entrained.

B. Specify the lowest water slump concrete practical for the application. It will reduce shrinkage and provide a more durable concrete surface. The use of a water-reducing admixture to achieve a 5 inch +/-1 inch placement slump is preferable as compared to use of additional water.

C. Good quality gravel is not available in many areas of the State. Consider specifying crushed stone only. The specifications should refer to NYSDOT specifications for concrete aggregate.

D. Specify as low a cement content as possible especially for slabs on grade. A five-bag-per-cubic-yard mix will generally provide adequate strength and greatly reduce shrinkage,

cracking and curling. Type II or Type I/II, where available, is generally most appropriate for slabs on grade.

E. Specifications shall not permit the use of an accelerator without specific Engineer approval. If the Contractor proposes its use in cold weather, he must submit a modified mix design and a thorough description of the procedure he proposes for cold-weather protection for the approval of the Engineer.

F. High early cement shall not be specified/permitted for concrete slabs.

G. Supplementary Cementitious Materials may be used in concrete when recommended by the Engineer. Require a placement schedule demonstrating that the concrete will be placed in environmental and temperature conditions that facilitate the concrete achieving the required 28-day compressive strength.

H. The mix design and pre-construction testing of the mix shall be performed by certified technicians from an accredited laboratory at the Contractor's expense.

I. Specify each type of concrete to be used on the project and show/schedule the typical locations for each type. Specify which ACI standards should be met for placing each type and location of concrete to be used in the project.

J. Specify rigid lines of at least 5" diameter for pumped concrete, except where flexible end line section is required for placement.

K. Specifications for all Fund projects shall state that all Portland Cement Concrete and/or Bituminous Concrete is to be delivered from automated batching plants as approved and listed by the New York State Department of Transportation. This requirement will be waived for projects in campus areas where approved plants, either fixed or movable, are unavailable or where this requirement would result in undue cost. Requests for waiving this requirement must be directed by the Consultant to the Fund Project Coordinator and be based on consultations the appropriate NYSDOT Regional Materials Engineer

III. Slabs on Grade Concrete

A. Specify/show a vapor barrier as currently recommended by ACI 360R Design of Slabs on Grade, and ACI 302.1R and 302.2R Guide for Concrete Floor and Slab Construction. Vapor barrier material should be puncture resistant and specifically manufactured for use below slabs on grade and conform to ASTM E1745 Class A. All seams shall be lapped and sealed. Coordinate product selection with below slab insulation. Proof of compaction of the subbase should be done with laser leveling. Final subbase should be without ruts.

B. Show/specify control joints for all exposed slab-on-grade concrete of the type, spacing, and other details recommended by ACI. Clean joints prior to installing final floor finish.

C. Specify flat sheets for wire mesh reinforcement and adequate supports so it does not wind up being pushed to the bottom of the slab. If installation means and methods displace the reinforcing, require that the Contractor reset it to its design location. Integral microfiber concrete reinforcement is acceptable to limit plastic shrinkage cracking if recommended by the Engineer. It should not be used in lieu of steel reinforcement.

D. Concrete must be placed properly to prevent segregation.

E. All fill material placed below slabs on grade, within the building envelope and to 2 feet outside building lines, shall be Engineered fill. Materials should be coordinated with all related earthwork specifications.

F. After placement, test flatness and levelness within the time recommended by ACI

IV. Elevated, Supported Slabs

A. Inform the Contractor of the anticipated deflection of the structure during concrete placement. Design and bid should include the additional concrete required to provide a level finish floor. Total deflection of deck, beams and girders, as measured on the bay diagonal, should not exceed the diagonal length divided by 360. Use adjustable pour stops at slab edges and construction joints.

B. Consider specifying installation methods that minimize cracking, such as rough filling entire bay prior to leveling, use of wet screeds and laser levels, etc.

C. Where light-weight concrete is used, anticipate extended drying time as moisture in aggregate is released. Specify floor finishes with greater moisture tolerance or require a mitigation coating be installed prior to floor finish installation. Integral water vapor reducing admixtures may be used based on recommendation by the Engineer.

D. Provide guidance to Contractor on permissible locations for joints in slabs (Typically offset from beams). Include details to ensure capacities of slab and supporting beams are not reduced.

E. Test levelness after placement within the time period recommended by ACI.

F. Require repair of cracking prior to installing finishes. Require grinding and/or filling with cementitious floor leveling underlayment to correct high and low areas.

G. Coordinate anticipated deck deflections with the interior partitioning. Provide slip tracks or compressible filler at tops of non-load-bearing partitions

V. Curing and Finishing

A. Curing is essential for good quality concrete. Wet curing for a minimum of seven days is preferred for exterior slabs.

B. Curing compounds must be coordinated with the specified floor finish, if any, since they may adversely affect the bonding of finish materials to the concrete. Sheet curing without additional water is suggested for interior slabs.

C. Floating should be performed as soon as possible. Water should not be permitted to be sprinkled on the surface during finishing. When the surface is firm, the final finishing should be performed. Require that adequate temporary lighting (20-footcandles) is available for finishing operations prior to commencing the pour. A steel trowel finish shall never be used for sidewalks or concrete terraces (where air-entrained concrete is used). Even where concrete is exposed in interior spaces, such as mechanical spaces and storage rooms, over-finishing should be avoided. Do not burnish (provide a densified surface by making multiple passes with a steel trowel) slab surfaces that will receive a floor covering.

D. Consider the thermal environment that elevated, supported slabs will be exposed to during construction. During winter construction, require use of high-low thermometers to verify overnight temperatures, especially at perimeters of elevated slabs. Moderate the speed at which temporary and final heating systems will heat the structure. Specify all heaters shall be vented and CO monitored during temporary heating period.

E. Coordinate the final Moisture Vapor Evaporation Rate (MVER), internal relative humidity, and pH of the slab with the scheduled floor finish. Require that concrete mix and drying time are adequate to achieve the required limits for the scheduled floor finish. Prior to installing floor finishes, test moisture and pH for compliance with floor covering warranties and installation instructions

VI. Reinforcing Steel

A. Sigmificant cracking and deflection problems can be largely avoided by proper design and installation of reinforcing steel in concrete structures. The Engineer must fully design all reinforcing steel for the structure and must thoroughly review all reinforcing steel shop drawings to assure compliance with the design intent. Special attention should be given to construction joint locations and details.

B. Special Inspections should include reinforcing observation prior to placement. In addition to making compression testing cylinders, the inspector shall also verify that reinforcing steel remains in place during concrete placement operations.

C. Negative reinforcing steel has been found to be an effective way to limit cracking over beams and girders in relatively thin concrete slabs-on-metal deck. The Engineer should strongly consider the use of negative reinforcement wherever slab cracking or deflection is a concern.

D. Coordinate locations of in-floor utilities with the reinforcing.

E. Provide sufficient cover over reinforcing and embedded items to limit plastic settlement cracking (1-1/2” minimum is suggested).

F. Provide sufficient cover over embedded items to prevent damage during saw cutting of joints in the slab.

G. Specify epoxy-coated reinforcing steel wherever the concrete will be exposed to de-icing or other harsh chemicals or a corrosive atmosphere.

H. Steel reinforcing bars should not be placed in the nose of cast-in-place concrete stair noses

VII. Shoring and Re-Shoring

A. Shoring is required and shall be specified as necessary to support dead loads, live loads, and construction loads. Shoring must remain in place until structure is fully capable of supporting imposed loads without excessive deflection or cracking of the slab. Formwork and shoring shall be designed by a competent person and reviewed by the Engineer. The actual strength of concrete shall be determined by testing and shall be at least 75% of design strength before shoring is removed. Field-cured cylinders and temperature

monitoring shall be used during cold weather to verify in-place strength prior to form removal.

B. Re-shoring may be allowed based on specific procedures approved by the Engineer.

C. Metal deck must be sized to avoid excessive deflection during placement and curing of concrete slabs. Where shoring of metal deck is required, it must be clearly shown in Construction Drawings.

VIII. Quality Control

A. Require a pre-installation conference attended by the Contractor, applicable trades and subs, Consultant, Engineer, the Fund, Special Inspector, and testing lab technicians. Review the means and methods the Contractor will employ compared to the design intent of the specifications. Confirm that all required submittals have been reviewed and approved.

B. On-site (at point of placement) testing of concrete shall be specified to be paid by the Fund. The contract documents should require the Contractor to cooperate with the testing lab technician, to furnish sufficient materials for testing, and provide reasonable time and means of access.

C. Specify acceptable dimensional tolerances for the finished concrete installation. Slab finish factors should be utilized to indicate acceptable tolerances. Horizontal concrete surfaces shall be tested for flatness and levelness by the F-number system, per ACI 117. Unless otherwise agreed to at the meeting held per Directive 1A-8, Constructability Review, this testing should be done by the Consultant as part of the Special Inspections program.

D. Specify acceptable surface characteristics of installed concrete. Coordinate maximum acceptable crack width with the scheduled floor finish. Specify the type of defects that may be repaired and should specify acceptable repair products and techniques.

IX. Precast Concrete

A. Vertical and horizontal support systems and connections of precast concrete panels/components to the primary building structure and support systems shall be fully designed and clearly indicated in the contract documents. Refer to Directive 1C-13 for delegation of design. Specify all design loads including component and cladding loads to be used for precast element design.

B. Commodity items such as hollow-core slabs, “creteplank” slabs, and similar structural components may be specified using the manufacturer’s product designation but specifications should include equivalent products by other manufacturers. Refer to Directive 1C-2 Specification of Materials.

C. Hollow-core floor slabs shall include a topping or leveling finish sufficient to provide a level floor surface. Proper grouting of plank keys and detailing of reinforcing are required to provide an adequate floor diaphragm load path.

D. Anchors, fasteners and hardware for exterior panels shall be stainless steel. Where precast structural elements have a fire-resistance rating, clearly explain when and how joints between panels, steel anchors, fasteners, and hardware will be fireproofed.

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