

This section applies to all building system concrete work and cast-in-place site structural concrete outside building envelopes.

### Mix Design and Materials

1. Concrete strengths will be specified in accordance with actual requirements. Concrete mix will be specified with minimum cement content, as well as maximum water/cement ratio.
2. All exposed concrete (including precast concrete) will be air entrained according to the following:

<u>Maximum Aggregate Size</u>	<u>Average Total Air Content</u>	<u>Total Air Content Range</u>
3/8"	7.5%	6.5% - 9.5%
1/2"	7.0%	6.0% - 9.0%
3/4"	6.0%	5.0% - 8.0%
1"	6.0%	5.0% - 8.0%

3. Flint and chert will be limited to 1% maximum, by weight of the course aggregate, in all exposed concrete (cast-in-place or precast). Lignite will be limited to 0.07%, by weight of the fine aggregate in all exposed concrete. Some applications may be required to be lignite free (Project Manager [PM] will advise).
4. *The use of calcium chloride in concrete mixes will not be permitted.*
5. *Portland cement replacement levels with fly ash should never exceed the 15% range in concrete slabs. High levels of silica-based products, like fly ash, can create problems with floor adhesives and require costly procedures to correct, including shot blasting and the use of cementitious or polymeric sealers.*
5. *Site accessories touching the exposed surface of the concrete or come in contact with soil will be coated with plastic or epoxy to prevent rust.*
6. Precast concrete
  - Fabricator must show compliance with the following codes and standards:
    - ACI-318 "Building Code Requirements for Reinforced Concrete"
    - CRSI "Manual of Standard Practice"

- Pre-stress Concrete Institute MNL117, "Manual for Quality Control for Plant and Production for Architectural Precast Concrete Products"
- The Fabricator will have a minimum of three (3) years successful experience in the fabrication of precast concrete units similar to the units required for this project. Fabricator will guarantee the connections and will submit their design to the consultant for review.
- The Erector will have a minimum of two (2) years successful experience erecting similar precast units.
- Shop drawings shall be prepared by a Registered Professional Engineer licensed to practice in the State of Missouri.

### **Testing**

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1. Consultant will specify inspection and testing requirements and will include procedures for evaluation of test data. For UMSL and UMKC projects, contractor will retain the services of a concrete testing firm. For MU and S&T projects, the University will retain services of a testing firm. Contractor will be responsible for scheduling the tests. Contractor will be required to notify the Owner's representative a minimum of 48 hours prior to all placement of concrete.
2. Specifications will require strength, air entrainment, temperature, and slump tests, and will indicate allowable limits for each measure. Strength tests will require four (4) cylinders (3 to be broken and 1 spare). Test results will be specified to be sent directly to the contractor, architect, and the Owner's representative.
3. Concrete will be tested at the minimum rate of one test for the first 25 CY placed each day, and one test for each additional 50 CY placed. Concrete may be tested more often at the discretion of the Owner's representative.
4. Test data from concrete cylinder breaks will be evaluated using procedures of the American Concrete Institute (latest edition of ACI 214) to determine if the compressive strength of the concrete tested is acceptable.

## **Placement**

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### **Joints and Concrete Flatwork**

1. Contraction joints shall be tooled during finishing or sawed within 18-hours of concrete placement. If the joint edge ravel, stop, do not proceed until concrete has sufficient cure to saw without damage.
  - Contraction joints shall have a minimum depth of 1/4 of the pavement thickness and a minimum width of 1/8".
  - Transverse contraction joints will be provided at a maximum of 2.5 times the pavement thickness (in inches) in feet for street pavements and 2.0 times for all other pavements.
  - Longitudinal joints shall have a maximum separation of 12 feet for streets and 9 feet for sidewalks.
  - The ratio of slab width to length should not exceed 1.67 for street pavements and 1.25 for all other pavements.
  - Some variance in spacing will be permitted to achieve desired architectural effect.
2. Concrete flatwork will be isolated from columns, existing walls, etc., by use of non-extruding expansion joint material.
3. Base course and under-slab drainage system for slabs will conform to geotechnical engineer recommendations. For projects without a geotechnical report, slabs will be constructed on a minimum 4" base of 3/4"-1" clean rock with a plastic vapor barrier.
4. MU Only: all slabs below grade shall have a sump hole. Provide an electrical outlet by the sump hole. The campus will provide the sump pump.
5. Slab flatness and levelness will be within 1/8" in 10'. ASTM E1155 will not be used to specify flatness and levelness unless the particular use requires a high level of accuracy. Areas having floor drains will have positive slope to the floor drain. Amount and direction of slope for floor drains will be indicated on the drawings.
6. Construction joints will be located at expansion joint locations wherever possible. Construction joints at other locations will be keyed.

7. Joint spacing and joint detail will be shown on the drawings.

**Exposed Concrete**

1. Exposed concrete intended as a finish material shall be clearly defined in the drawings and specifications. Areas to be addressed should include special formwork, form liners, acceptable defects (if any), surface repairs and surface treatments (i.e.: sandblast, rubbing, etc.).

*Please note that concrete guidelines for utility tunnel walls and slabs; steam manholes; chases; pre-cast items and other miscellaneous structures associated with underground utilities are in Division 33.*

END OF SECTION