Concrete Parking Lots

For designers, contractors, developers and planners

Concrete is a mixture of natural sand and stone that is glued together with portland cement, supplementary cementitious materials, water, and admixtures. You can expect some variations in surface and performance because concrete is mostly made of natural materials. Concrete can provide long-term durability and value when you use quality materials, place, cure and maintain it properly. This document provides guidance on how to design concrete parking lots.

Introduction:

This brochure explains "Concrete Parking Lot" design with the following sections: subgrade, materials and proportions, jointing guidelines, construction practices and thickness design. These sections provide a brief overview. More detailed information is provided in the American Concrete Institute's Technical Bulletin 330 (ACI 330) or on the concrete industry's pavement design website at www.pavementdesigner.org .

1. Subgrade

Preparing the subgrade is important for better performance. While no substantial subbase is required, it is important that the soil type, moisture content, and density of the subgrade should be uniform. Replace nonuniform subgrade areas with materials that are similar to the rest of the area.

The subgrade must also be reasonably smooth and without tire ruts, in order to provide the concrete pavement with uniform support. Unbound aggregate subbases are often incorporated between the pavement and subgrade to provide uniform support and a drainage layer.

2. Materials and proportions

Quality concrete starts with a mixture according to exposure classes defined in ACI 301-16.

In regions where the pavement will be subjected to freeze-thaw cycles, air entrainment is essential. See Table 1 below for recommended air contents.

ACI 201.2R-16, for F3 exposure class, recommends the following concrete properties:

- Minimum strength 4500 psi at 28 days
- Water to cementitious ratio 0.45 maximum
- Air Content as given for severe exposure F3 (ACI 201.2R-16) in Table 1.

Table 1. Recommended air contents according to ACI 201.2R-16 (for 3/8-1.5 in. Max . size aggregate)

Maximum Aggregate Size	Total Target Air Content for severe exposure F3(%)*
3/8 in.	7.5
1/2 in.	7
3/4 in.	7
1 in.	6.5
1 1/2 in.	6.5

*Field tolerance on air content is recommended as ±1.5 percent.

3. Jointing guidelines

Joint spacing should not exceed the values given in Table 2. (ACI 330R-08)

Table 2. Spacing between joints

Pavement thickness (in)	Maximum Spacing, ft
4-4.5	10
5-5.5	12.5
6 or greater	15

- Lay out joints to form square panels. When this is not practical, rectangular panels can be used if the long dimension is no more than 1.5 times the short.
- Control joints should have a depth of at least one-fourth the slab thickness

You can see some jointing suggestions for manhole and inlet boxes below in Figure 1. For more detailed information on jointing see FHWA " Concrete Pavement Joints" T 5040.30 Date: January 2019.

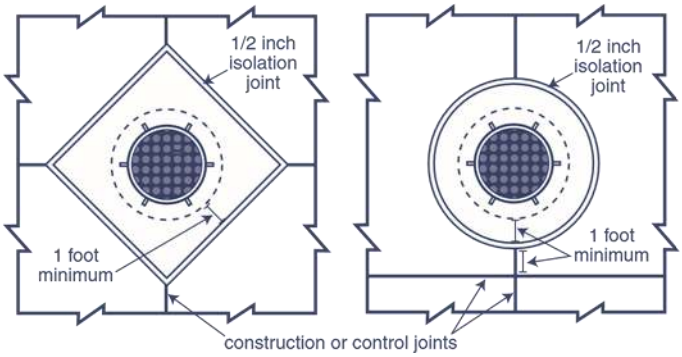

Figure 1. Jointing example for manholes

4. Construction practices

Along with the practices recommended in ACI 330, the following practices can help deliver a successful product:

- Minimum slope of pavement should be 1% or 1/8 inch per foot for drainage.
- Avoid over finishing slabs. Following bull floating, and after bleed water has dissipated, it is generally accepted that an adequate surface can be provided with a simple artificial turf drag, broom finish, or burlap drag.
- Cure fresh concrete immediately after imparting the final surface finish. Liquid membrane-forming curing compounds are usually recommended. Refer to ARM "Exterior Concrete Guidelines" for curing guidelines. Apply curing compound at the rate recommended by the manufacturer and cover all exposed surfaces. Consult your contractor or concrete producer for further curing compound recommendations.

- Consult your ready-mix producer or contractor to open your project to traffic. With the use of maturity method, concrete pavement's strength can be estimated and opened to traffic according to your design.

- Refer to ARM "Exterior Concrete Guidelines" for sealing. Consult your concrete producer or contractor for maintenance.

5. Thickness Design

ACI 330[2] notes that distributed steel reinforcement is not typically necessary in pavements with joint spacings that minimize intermediate cracking. It further indicates that shorter panels without reinforcement are typically more economical. However, ACI 330 recognizes that there may be cases where reinforcement may control opening of random cracks that occur due to "uncorrectable subgrade conditions". In these cases, reinforcement (steel or fiber) is intended solely to hold the cracked faces together.

For concrete parking lot pavement design www.pavementdesigner.org can be used as follows.

Step 1. Open www.pavementdesigner.org in chrome or safari browser

Step 2. Click on "Start Designing" if you want to design without registering. You can also register by clicking "Register Now".

Step 3. Click on "Parking"

Step 4. Choose spectrum type (For examples on next page: ACI 330 – Traffic Spectrum A "1. Car parking areas and access lanes—Category A" is used for Car Lots and Driveways; ACI 330 – Traffic Spectrum D "Multiple units (tractor trailer units with one or more trailers), Entrance and exterior lanes" is used for Large Truck Lots)

Step 5. Choose design years (20 years is used for the examples on the next page)

Step 6. Trucks per day (1 or 300 is used for the examples on the next page)

Step 7. Choose reliability (85% is used for the examples on the next page)

Step 8. Choose number of slabs cracked at the end of the design life (25% is used for the examples on the next page)

Step 9. Click on Pavement Structure

Step 10. Choose Soil type from table (R=15 is used for Low support, R=50 is used for High support)

Step 11. If only know compressive strength is known, choose "Compressive strength" from pull down menu under "Concrete". (28 day Flexural strength 650psi is used for the examples)

Step 12. Choose base material, if appropriate

Step 12. Click on "Design Summary"

CAR LOTS & DRIVEWAYS (1 Truck per day), SUBGRADE SOIL GOOD R>50

CAR LOTS & DRIVEWAYS (1 Truck per day), SUBGRADE SOIL POOR R<15

LARGE TRUCK LOTS (300Trucks per day), SUBGRADE SOIL GOOD R>50

LARGE TRUCK LOTS (300Trucks per day)SUBGRADE SOIL POOR R<15

AP: Asphalt

Asphalt designs are made according to “ASPHALT PAVING DESIGN GUIDE Minnesota Asphalt Pavement Association, Section 4-7, 2014.

Concrete thickness designs are made with www.pavemendesigner.org with the following variables:

1. ACI 330 – Traffic Spectrum A "1. Car parking areas and access lanes—Category A" is used for Car Lots and Driveways,
2. ACI 330 – Traffic Spectrum D "Multiple units (tractor trailer units with one or more trailers), Entrance and exterior lanes" is used for Large Truck Lots
3. Design Life: 20 year
4. Truck per day: 1 for Car lots and 300 for Large Truck Lots.
5. 85% reliability
6. 25% cracked slabs at the end of 20 years
7. Low support is used for R=15, High support is used for R=50
8. 28-day flexural strength 650psi

For more information, call your local concrete contractor, ready mix producer or www.chooseconcrete.com. 06/14/2020

References:

1. ACI 201.2R-16 Guide to Durable Concrete - Reported by ACI Committee 201 – 2016
2. ACI 301-16 Specifications for Structural Concrete - 2016
3. ACI 330R-08 Guide for the Design and Construction of Concrete Parking Lots – 2008
4. Asphalt Paving Design Guide - Minnesota Asphalt Pavement Association, 2014
5. Concrete Pavement Joints – FHWA T 5040.30 Date: January 2019