A practical guide to

Concrete Parking Lots

for designers, contractors, developers and planners

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AGGREGATE & READY MIX ASSOCIATION OF MINNESOTA

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Preparing the subgrade for best performance

Proper subgrade preparation will ensure superior performance of your concrete pavement. While no special subbase is required, it is important that the soil type, moisture content, and density of the subgrade 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 so that the concrete placed over it will be uniform in thickness.

Materials and proportions

Quality concrete starts with a well chosen mixture using consistently high quality materials.

In regions where the pavement will be subjected to freeze-thaw cycles air entrainment is essential. Air entrainment is so important in providing freeze-thaw durability that it pays to test the concrete frequently for air content at the job site and make the necessary corrections as soon as possible. See the table below for recommended air contents.

Because air entrainment also enhances workability and reduces the amount of bleed water, it is wise to consider its use even where freeze-thaw conditions do not exist.

Compressive strength (f'c) is the most common and easiest property of concrete to measure, and as such, it is the property most used when specifying concrete. Concrete with a minimum design strength of 4,000 psi at 28 days and maximum water cementitious ratio (w/c) of 0.45, is adequate for most areas of the country.

In areas subjected to freeze-thaw cycles, it is further recommended that the mix contain at least 564 lb of cementitious per cubic yard. A mixture with a maximum slump of 4 inches is acceptable. If a water reducing admixture is specified, slumps can be higher.

Jointing guidelines

It is recommended that you follow these guidelines unless local experience indicates otherwise.

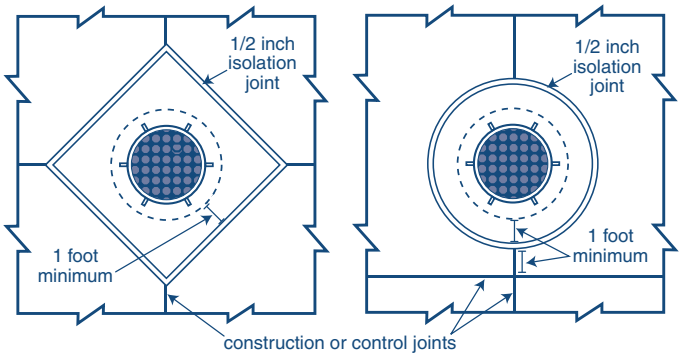
- Joint spacing should not exceed 24 to 30 times the pavement thickness with a maximum spacing of 15 feet.
- Lay out joints to form square panels. When this is not practical, rectangular panels can be used if the long dimension is no more than 1-1/2 times the short.
- Control joints should have a depth of at least one-fourth the slab thickness.

Construction practices

Procedures that ensure a quality job are:

- Slope pavement 1% or 1/8 inch per foot to drainage.
- Moisten subgrade just prior to placement of concrete.
- Avoid overfinishing slabs. Generally a bullfloat finish is adequate. Sometimes a burlap drag is added in the finishing process to provide a textured finish.
- Cure fresh concrete. Liquid membrane-forming curing compound is usually recommended as the most cost-effective curing agent.
- Keep automobile traffic off the slab for three days and truck traffic off the slab for seven days, unless tests are made to determine that the concrete has gained adequate strength. This is usually 3000 psi.

Manhole or inlet box



Recommended air contents for durable concrete

Maximum size aggregate	Total target air content percent*	
	Severe exposure	Moderate exposure
3/8 in (9.5 mm)	7 1/2	6
1/2 in (12.5 mm)	7	5 1/2
3/4 in (19.0 mm)	6	5
1 in (25.0 mm)	6	4 1/2
1 1/2 in (37.5 mm)	5 1/2	4 1/2
2 in (50.0 mm)	5	4

*A reasonable tolerance for air content in field construction is -1 to +2 percentage points

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Parking Area Thickness Design Worksheet

from American Concrete Institute Committee 330

Step 1: Determine concrete compressive strength requirement. For all concrete exposed to freeze-thaw cycling and de-icers, use no less than 4000 psi. 4500 is recommended.

Step 2: Determine modulus of subgrade reactivity, k. Use guidelines at right.

Step 3: Determine traffic categories (car parking area, entrances, etc.)

Step 4: Determine average daily truck traffic (ADTT) on the pavement. It is safe to always assume at least one ADTT.

Step 5: Read across row that corresponds to your traffic category and ADTT to column that represents your concrete strength and k value.

Example: Car parking area truck access lane.

- Soil is sandy gravel with some clay and silt; k value 130-170 therefore use k = 100
- Under area k = 100, read across row with traffic category A-1 (ADTT = 1) to column under f'c = 4500
- Traffic category A-1 (ADTT = 1)
- Concrete strength of 4500 psi
- Thickness necessary for this situation is 4.5

20-year design thickness recommendations, inches (no dowels)

Traffic category	k = 500 (CBR = 50)				k = 400 (CBR = 38)				k = 300 (CBR = 26)			
	f'c				f'c				f'c			
	5000	4500	4000	3500	5000	4500	4000	3500	5000	4500	4000	3500
A-1 (ADTT = 1)	3.5	3.5	4.0	4.0	3.5	4.0	4.0	4.0	4.0	4.0	4.0	4.5
A-1 (ADTT = 10)	4.0	4.5	4.5	5.0	4.5	4.5	5.0	5.0	4.5	4.5	5.0	5.5
B (ADTT = 25)	4.0	4.5	4.5	5.0	4.5	4.5	5.0	5.5	4.5	4.5	5.0	5.5
B (ADTT = 300)	5.0	5.0	5.0	5.5	5.0	5.0	5.5	6.0	5.0	5.5	5.5	6.0
C (ADTT = 100)	4.5	5.0	5.5	6.0	5.0	5.0	5.5	6.0	5.0	5.5	5.5	6.0
C (ADTT = 300)	5.0	5.5	5.5	6.0	5.0	5.5	6.0	6.0	5.5	5.5	6.0	6.5
C (ADTT = 700)	5.5	5.5	6.0	6.0	5.5	5.5	6.0	6.5	5.5	6.0	6.0	6.5
D (ADTT = 700)	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5

Traffic category	k = 200 (CBR = 10)				k = 100 (CBR = 3)				k = 50 (CBR = 2)			
	f'c				f'c				f'c			
	5000	4500	4000	3500	5000	4500	4000	3500	5000	4500	4000	3500
A-1 (ADTT = 1)	4.0	4.0	4.5	4.5	4.0	4.5	4.5	5.0	4.5	5.0	5.0	5.5
A-1 (ADTT = 10)	4.5	5.0	5.5	5.5	5.0	5.5	6.0	6.0	5.5	6.0	6.5	7.0
B (ADTT = 25)	4.5	5.0	5.5	6.0	5.0	5.5	6.0	6.5	5.5	6.0	6.5	7.0
B (ADTT = 300)	5.0	5.5	6.0	6.5	5.5	6.0	6.5	7.0	6.5	6.5	7.0	7.5
C (ADTT = 100)	5.5	5.5	6.0	6.5	6.0	6.0	6.5	7.0	6.5	7.0	7.5	8.0
C (ADTT = 300)	5.5	6.0	6.5	7.0	6.0	6.5	7.0	7.5	6.5	7.0	7.5	8.0
C (ADTT = 700)	6.0	6.0	6.5	7.0	6.5	6.5	7.0	7.5	7.0	7.5	8.0	8.5
D (ADTT = 700)	7.0	7.0	7.0	7.0	8.0	8.0	8.0	8.0	9.0	9.0	9.0	9.0

ADTT = Average Daily Truck Traffic. Trucks are defined as vehicles with at least six wheels; excludes panel trucks, pickup trucks, and other four wheel vehicles.
f'c = compressive strength (of concrete).
K value = a measure of soil strength (Westergaard's modulus of subgrade reaction).
CBR (California Bearing Ratio) = a measure of subgrade resistance to deformation under load

Modulus of subgrade reactivity

Type of subgrade soil	K value	CBR
Fine grained soils in which silt and clay-size particles predominate	75 to 120	2.5 to 3.5
Sands and sand-gravel mixtures with moderate amounts of silt and clay	130 to 170	4.5 to 7.5
Sands and sand-gravel mixtures relatively free of plastic fines	180 to 220	8.5 to 12

Most untreated Minnesota soils have k values in the 100-300 range. Cement or fly ash treated bases have k values from 300 to over 500.

Traffic categories

			Category
Car parking areas and access lanes (autos, pickups, and panel trucks only)			A
Truck access lanes			A-1
Shopping center entrance & service lanes			B
Bus parking areas, city and school buses	Parking and interior lanes		B
	Entrance and interior lanes		C
Truck parking areas	Single units	Parking and interior lanes	B
		Entrance and interior lanes	C
	Multiple units	Parking and interior lanes	C
		Entrance and interior lanes	D

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Equivalent parking lot and pavement designs

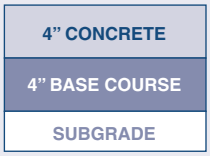
Based on AASHTO* Design Methodologies and Procedures. Values and comparisons are to be used for quick reference and estimating purposes only. **Project specific design assistance available upon request.**

Residential

SN = 1.52**

SN = 2.00

SN = 2.48



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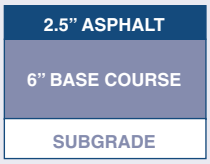

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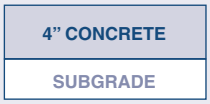

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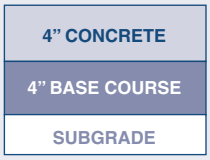

Light commercial / retail

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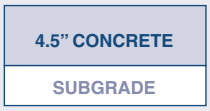

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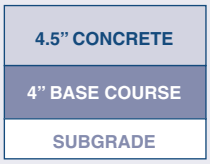

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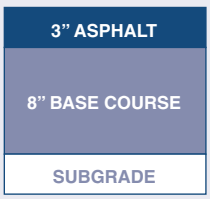

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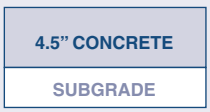

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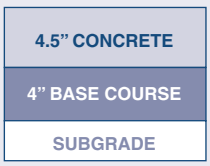

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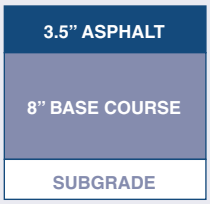

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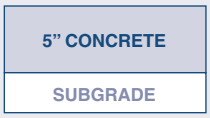

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Commercial

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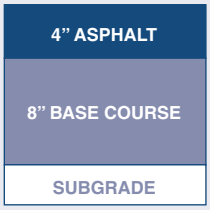

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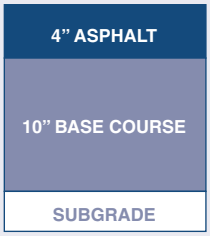

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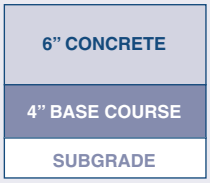

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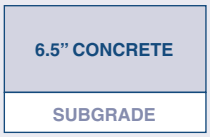

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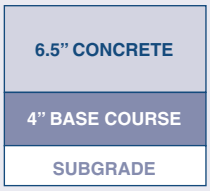

Layer coefficients of materials (1")

Concrete		.50
Asphalt	Wear coarse	.40
	Base coarse	.32
Aggregate base (Class 5)		.12

* AASHTO = American Association of State Highway and Transportation Officials
** SN (Structural Number) = an abstract number expressing the structural strength of a pavement. The measure of the ability of a pavement to withstand anticipated axle loads.