

III. DESIGN

In order to understand what is required to construct a project, an understanding of what information is specified on the plan and within the contract documents is essential. This chapter will present some of the important pieces of information that are contained on the project plans and road standards that will be necessary in order to define what work is to be accomplished.

A. Project Plans

Project plans prepared by the Iowa Department of Transportation or by private consultants are arranged with a specified format. The following sections contain information that will be important when building a pavement project.

1. Title Sheet, Location Map, & Legend - A Sheets

These sheets provide information on the project location and length, vehicle counts, index of sheets, and beginning/ending stations of the project and divisions within the project. A very important piece of information that is found here is the list of the applicable Road Standards.

2. Typical Cross Sections- B Sheets

These sheets provide dimensions and other information with cross section views. These views are typical for the locations listed in tabs. There can be several different typicals with each set of plans, which make the location information important to help decide which typical is used where. In a set of plans the typical sections include mainline pavement, superelevations, curbs, ramp grading and paving, and shoulder details. Also, it's important to look for any references to other plan sheets for special details.

3. Estimate of Quantities and General Information- C Sheets

These sheets give you the design quantities and additional information for the project. Many bid items have reference notes which

further define the item. These are where the class of concrete, thickness of the pavement, and often the required durability class of the aggregate are given. Also included are general notes for the project and storm water pollution prevention requirements.

4. Mainline Plan and Profile Sheets- D Sheets

These sheets give a plan and profile view of the entire project. They usually begin with the lowest station number and go to the highest station number. Note that profile elevations for top of slab at any given station are provided on these sheets. New and existing drainage features, entrances, and ditch cut information are also shown.

5. Side Road Plan and Profile Sheets- E Sheets

These show basically the same information for side roads as listed above for mainline.

6. Interchange Geometrics- K Sheets

These sheets show interchange staking, jointing, and edge profile information as well as centerlines and base lines in relationship to each other. Jointing at ramp intersections are also shown.

7. Intersection Geometrics- L Sheets

These sheets show intersection staking, jointing, and edge profile information along with pavement jointing details at side road intersections.

B. Joints

Articles 2301.22, 2301.23, 4151

Road Standards RH 50-52, RH 55

As cement hydrates, water is chemically combined with compounds in the cement particles. As this process continues, the space taken up by the water closes as the water leaves. This causes the concrete to shrink. When concrete is placed in large amounts, as in pavement, the volume change causes stresses. These stresses eventually



Joint sawed at the top of the pavement and cracked below

will be greater than the tensile strength in the concrete and a crack in the concrete results. A joint is simply a designed crack.

A sawed joint provides a plane of weakness to allow the pavement to crack at designated locations. Controlled cracks are much easier to maintain than random cracks. By designing the pavement with joints, the natural cracks can occur without affecting the rideability and performance of the concrete pavement.

Article 4151 specifies the steel that is used in some joints. All bars used in pavement, either smooth dowels or deformed tie bars, are specified to have an epoxy coating. This helps to prevent the bars from corroding.

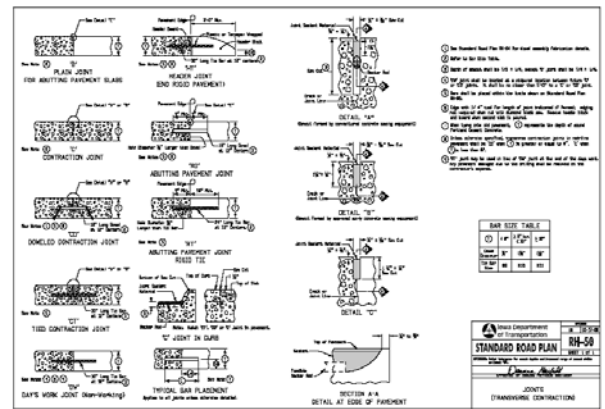
1. Joint Types

Many types of joints are used in a concrete paving project. The plans will specify where each type of joint will be used. The following is a discussion of the types of joints, the Road Standards where they are specified and a discussion of the types of saw cuts that are used to create the joint in the finished pavement.

a. Transverse Contraction Joints
RH 50, RH 55

Transverse contraction joints are constructed laterally from centerline and spaced to control cracking from stresses caused by shrinkage, moisture, and thermal changes. Joints may either be oriented at right angles to the centerline or skewed to the centerline.

Pavements that carry a significant amount of truck traffic will have dowel bars placed in the joint in order to transfer the load as truck tires cross the joint from one slab to the next. This prevents vertical movement of the slabs and thereby pumping of the subgrade material.



Road Standard RH 50
Transverse Contraction Joints



Transverse joint with 6 to 1 skew

Most primary pavements will have dowel bars at the joints. Often secondary roads and city streets do not.

As the pavement expands and contracts with change in temperature, the joints open and close. The dowels are smooth bars to allow for movement. They are coated with an asphalt or wax material to prevent bonding with the concrete.

b. Day's Work and Header Joints

RH 50

Joints installed at the end of the daily paving operation are called Days Work Joints.

Transverse construction joints are also placed when there is a significant delay with concrete delivery to the site or other gaps in continuous paving operations and are called headers.

These are installed at a location between planned contraction joints and utilize deformed bars.

c. Longitudinal Contraction Joints

RH 51

These are tied joints that are constructed between lanes or other pavement adjacent to a lane. They are intended to prevent adjacent lanes from separating.

The sawing of these joints may be delayed until after the sawing is completed for the contraction joints. A light early saw may be allowed for sawing these joints provided the correct depth and width of joint can be achieved. Deformed tie bars are



Dowel in baskets placed on the grade at joint locations prior to paving



Header joint



Longitudinal joint on the roadway centerline

2. Saw cuts

The Iowa Department of Transportation requires joints to be sawed with one pass. The alternative procedure is to make an initial narrow, deep cut and then come back and make a widening reservoir cut later. The two cut procedure has not been a part of the Iowa specifications for a number of years, but it is still in use in many other states.

Timing of the saw cut is critical. To begin sawing when the concrete is too green will result in raveling of the joint. If the sawing operation is delayed too long, random cracks will form. There is a window of time between the two extremes when the sawing operation must take place. It is the contractor's responsibility to determine the proper time to saw the pavement. The specifications require that cracks be prevented, but the inspector can only advise the contractor to watch the set of the concrete in order to accomplish the sawing within the necessary time.

The depth of the saw cut at the joint is determined by the category of saw used and thereby the timing of the saw cut. Road Standard RH 50 gives the specific requirements for each of these two joint types, as determined by the type of saw used.

There are two categories of saws that can be used for sawing.



Raveled joint due to sawing too early



Typical late sawing crack

a. Conventional Saws

The conventional saw is a large powerful saw that begins the sawing operation once the concrete has obtained enough strength to support the weight of the saw. It must complete the sawing operation before the concrete begins to contract and build up tension within the concrete to the point of cracking.

The conventional saws are of two types, wet saws or dry saws. Wet sawing uses diamond blades and requires a stream of water to cool the blade. Dry sawing uses abrasive or diamond blades and does not use water during the sawing operation.



Conventional saw- dry



Conventional saw- wet

b. Light Early Saws

The other category of saws are light, early saws. The age of the concrete when early entry sawing begins is much sooner than with the conventional saws. The window for sawing the concrete is also smaller with this type of saw. If the concrete starts to contract and develop stresses, it is too late to saw the slab with a light early saw. The light early saw is used to cut a shallow cut (about 1 1/4 inch deep) instead of the traditional one-third the thickness cut. This shallow cut provides adequate stress relief for the concrete if it is cut when the concrete is very green.



Light early saw