



# Facilities Development Manual

ORIGINATOR Director, Bureau of Highway Construction		PROCEDURE 14-5-5
CHAPTER 14	Pavements	
SECTION 5	Base Course	
SUBJECT 5	Base Aggregate Open Graded	

## General

The Department uses only one type of Base Aggregate Open Graded. The following elements are essential to ensure maximum performance of a drained pavement structure.

1. A permeable Base Aggregate Open Graded (**BAOG**)
2. A filter layer
3. A longitudinal edge drain collector system

## Base Aggregate Open Graded Filter Layer

The target permeability of BAOG is 1000 ft/day.

BAOG can be used in two different applications; the first is placed directly on subgrade when the subgrade soils are coarse-grained, sandy soils with AASHTO classifications of A-1, A-3, and possibly some A-2 classifications. These soils are naturally permeable and can help drain the pavement structure. However, the subgrade soils must be analyzed to ensure they are compatible with the BAOG based upon the filter criteria. The particle size of the soil and BAOG must meet the following three filter criteria.

D <sub>15</sub> BAOG			
$\frac{D_{85} \text{ SUBGRADE}}{D_{15} \text{ BAOG}}$	$\leq 5$	$\frac{D_{15} \text{ BAOG}}{D_{15} \text{ SUBGRADE}}$	$\geq 5$
D <sub>50</sub> BAOG			
$\frac{D_{50} \text{ BAOG}}{D_{50} \text{ SUBGRADE}}$	$\leq 25$		

The symbol "D" represents the diameter of the particle at the indicated percent passing on the grain size distribution curve of each material. All three criteria must be met to ensure that the subgrade does not contaminate the BAOG. Contamination of the layer will result in a decrease in permeability, a loss of structural support, and clogging of the edge drains. If the filter criteria are not met, it is not a good practice to increase the thickness of the BAOG layer with the assumption that only part of the layer will be lost to contamination. Research has shown that the pumping action of water will continue to move the contamination through the entire depth of the layer.

If the subgrade soil has an AASHTO classification of A-1, A-3 or A-2, BAOG should be proposed on the project, and placed directly on the subgrade. The subgrade soil type will be identified in the Soils Report. That report will also furnish the necessary inputs to perform the filter criteria analysis, provide a range of subgrade permeability values and make a recommendation for the use of this material. The minimum thickness of the BAOG layer, when placed directly on subgrade, is 8 inches regardless of pavement type (refer to sheet 'c' of SDD 8D15). This thickness is required to provide enough hydraulic capacity to obtain a good level of drainage as per the criteria outlined by AASHTO and FHWA.

The other condition for use of BAOG is when the filter criteria cannot be met. In this situation, a filter layer of 6 inches of crushed aggregate base course is required to protect the BAOG layer from contamination. A geotextile fabric can also be considered if it can be economically justified and construction operations will facilitate its use. A minimum thickness of 4 inches is required for the BAOG layer (refer to sheet 'b' of SDD 8D15).

### **Use of BAOG**

The use of BAOG does not depend on ESALs. The designer will determine if BAOG is to be used. Particular situations, such as sag areas, should be considered. The feasibility and necessity of BAOG is still being researched.

### **Stabilization**

There might be cost and constructability advantages to stabilizing BAOG. This will be left to the discretion of the contractor. Stabilization will be at the contractor's option with no cost to the Department.

The effect of stabilization should not be factored into the design of the pavement structure and the strength coefficients for unstabilized open graded base course should be used.

### **Edge Drains**

An edge drain system is required for installation with BAOG. The edge drain used shall be a conventional circular pipe underdrain with a 6-inch diameter. The advantage to these edge drains is their flow capacity and, more importantly, their ability to be maintained. The edge drain should not be wrapped with geotextile fabric due to the potential for the fabric to become plugged and/or reduce the hydraulic capacity of the system.

Interchanges have proven to be difficult locations for the placement of BAOG, edge drains and outlets. Pavement drainage must be maintained through the interchange. The base aggregate open graded layer should be extended out to drain the ramp tapers and gore. The edge drain should also be moved out and placed at the edge of the ramp taper and gore pavements so that they can be maintained. Outlets must be strategically placed such that all water entering the pavement is allowed to drain.

Note: Edge drains should not be retrofit under concrete pavements with dense graded base course. WisDOT's experience indicates concrete pavements do not receive any benefit from this combination of features.

**Trench**

In an urban situation it is recommended that the edge drain and trench be located under the concrete curb and gutter to protect the system from utilities and other activities that take place in the right-of-way in an urban area.

Connect the edge drains to inlets, manholes or catch basins of the storm sewer system to drain them in an urban situation ([refer to sheet 'a' of the SDD 8D15](#)).

**Outlet Pipe**

Careful attention must be given to the location of the outlet pipes such that outlets are placed at the sags of vertical curves and prior to bridge abutments. The practical maximum spacing for the outlets is 250 feet for maintenance purposes. To prevent damage to the outlet, the location of the endwall should be marked with a flexible marker post or some other method for easy identification by county maintenance forces.

Refer to the SDDs, titled "Reinforced Concrete Apron Endwall for Pipe Underdrain" and "Edgedrain Outlet and Outfall Markers" in [Chapter 16](#). ★