



# USING OPEN-GRADED AGGREGATE BASE WITH BELGARD INTERLOCKING CONCRETE PAVERS

Belgard interlocking concrete pavers (ICP) have traditionally used dense-graded aggregate base in conjunction with a sand setting bed to provide structural support for the paver wearing course. As permeable pavement systems have grown in popularity; the use of open-graded aggregate base and bedding layers has shown to provide numerous benefits. In some applications, Belgard interlocking concrete pavement system can benefit from using open-graded aggregate. This Technical Note provides guidance in determining when open-graded aggregate base can be used, and how to design and construct an interlocking concrete paver system utilizing open-graded aggregates.

## APPLICATIONS

Open-graded aggregate base projects can be divided into two major categories: 1) Residential; and 2) Commercial. Open-graded aggregate base can be used for most single-family residential applications including driveways, patios, and pool decks. For multi-family residential, open-graded base can be used for most pedestrian applications but should limit vehicular applications to low-traffic areas with traffic loading similar to a single-family residential driveway.

In commercial applications, open-graded aggregate base should be limited to pedestrian and commercial plaza applications (ESALs ≤ 10,000). Please contact your local Belgard Sales Representative if you have questions about the applicability of open-graded aggregate base under your interlocking concrete paver project.

Open-graded aggregate solutions can provide benefits where subgrade drainage is difficult to achieve and/or in freeze-thaw climates. Open-graded aggregate retains structural integrity when saturated and is not sensitive to moisture content like dense-graded aggregate. Since the open-graded aggregate base materials discussed below are typically between 30% to 40% voids, any water in the system that freezes only expands into the voids. Water trapped in a dense-graded aggregate base can freeze and can cause heaving at the surface.

## SYSTEM COMPOSITION

### Subgrade

Subgrade preparation is no different for open-graded aggregate base installations. The soil must be compacted as required by the construction documents in order to provide a stable base for the paver

system. In most cases, a highly permeable geotextile (Mirafi 140N or equal) is recommended along the bottom and sides of the system to act as a filter to prevent fine-grained soils (clay or silt) from migrating into the open-graded aggregate base. If the subgrade is weak or yielding, then a geogrid or undercuts may be required in addition to the geotextile.

### Drainage

Very little water will enter most open-graded aggregate base installations with fine sand (ASTM C144) joint fill, including polymeric sand, provided the pavers are set with a proper slope. If the project has fine-grained subgrade soils (silts and clays) and/or contributing water sources other than the area of pavers (area draining to the pavers, downspouts, groundwater, etc.) consider installing a perforated pipe underdrain which will drain the system to prevent saturation of the subgrade. The underdrain should either be daylighted to the surface or connected to a storm structure.

### Open-graded Aggregate Base

Install the open-graded aggregate base on top of the prepared subgrade and geotextile. The open-graded aggregate should be clean and free from foreign matter and manufactured from crushed rock. Do not use recycled aggregates or rounded river gravel. The open-graded base should conform to ASTM C33 size No. 57 as shown below or similar gradation:

ASTM C33 SIZE NO. 57	
SIEVE SIZE	% PASSING
1-½ in. (37.5 mm)	100
1 in. (25 mm)	95 to 100
½ in. (12.5 mm)	25 to 60
¾ in. (9.5 mm)	0 to 10
No. 4 (4.75 mm)	0 to 5

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If you cannot locate ASTM No. 57 stone locally, send the above gradation to your local supplier to see if they have a similar gradation. Material names vary geographically, so the local supplier may not call the above gradation ASTM No. 57 stone.

To provide similar structural capacity open-graded aggregate layers are thicker than dense-graded aggregate. The following chart provides equivalent open-graded aggregate thicknesses:

EQUIVALENT OPEN-GRADED AGGREGATE DEPTHS	
DENSE-GRADED AGGREGATE	OPEN-GRADED AGGREGATE
4"	6"
6"	8"
8"	11"

As a rule of thumb, open-graded aggregate will require 33% thicker layers than dense-graded, so multiply the thickness of the layer of dense-graded aggregate by 1.33 to calculate the equivalent open-graded aggregate thickness.

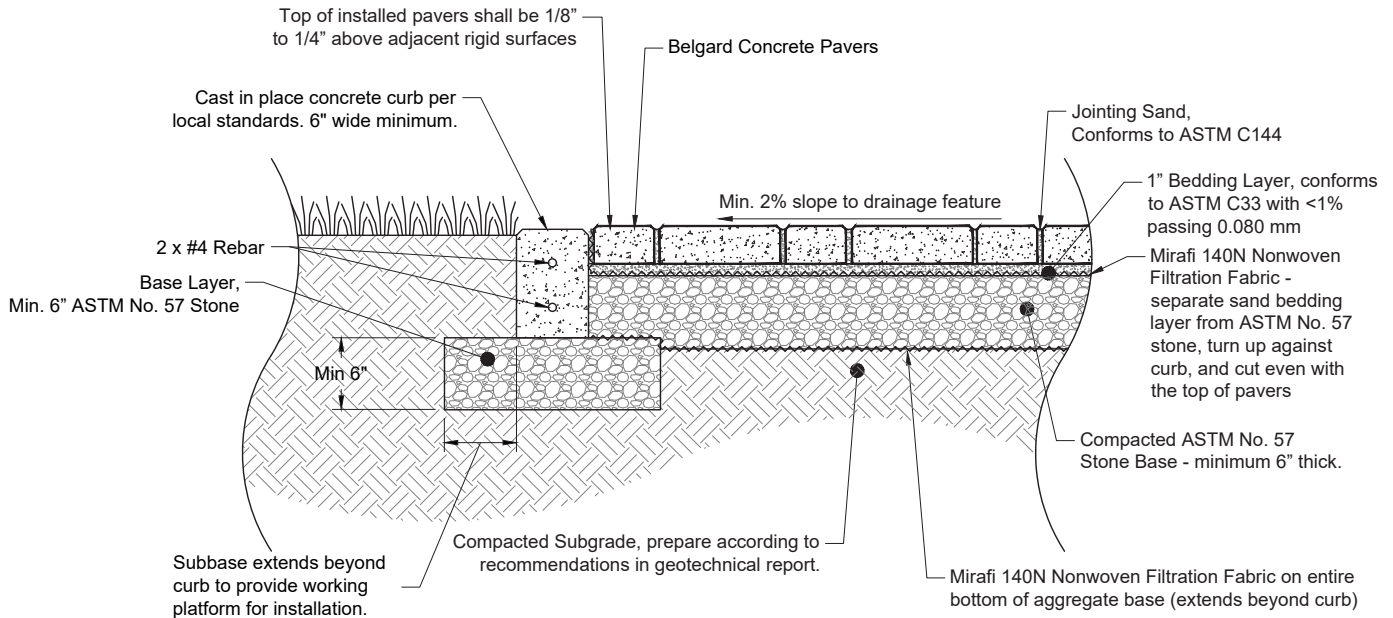
Place the open-graded base in 6" lifts and compact using a minimum 13,500 lbf plate compactor. Surface tolerance should be  $\pm 1/2$ " over a 10-foot straight edge laid in any direction.

**Bedding Course and Joint Fill Material**

When using open-graded aggregate base material, the bedding course can be either sand or open-graded aggregate. Depending on the bedding course chosen, the system components will differ slightly including the joint fill material.

When installing a sand bedding course over open-graded aggregate base, a highly permeable geotextile (Mirafi 140N or equal) is required to keep the sand from eroding into the base material. Once the base material has been placed and compacted to grade, the geotextile is then placed on top with minimum 12" overlapping joints constructed to 'shingle' moisture from the upstream panel to the downstream panel. Next, the sand bedding course is placed loose and screeded to a nominal thickness of 1-inch. Then the pavers are placed, compacted, and joints filled like any interlocking concrete paver system. The joint fill material can be either sand or polymeric sand.

**Sand Set on Open-graded Aggregate Base**



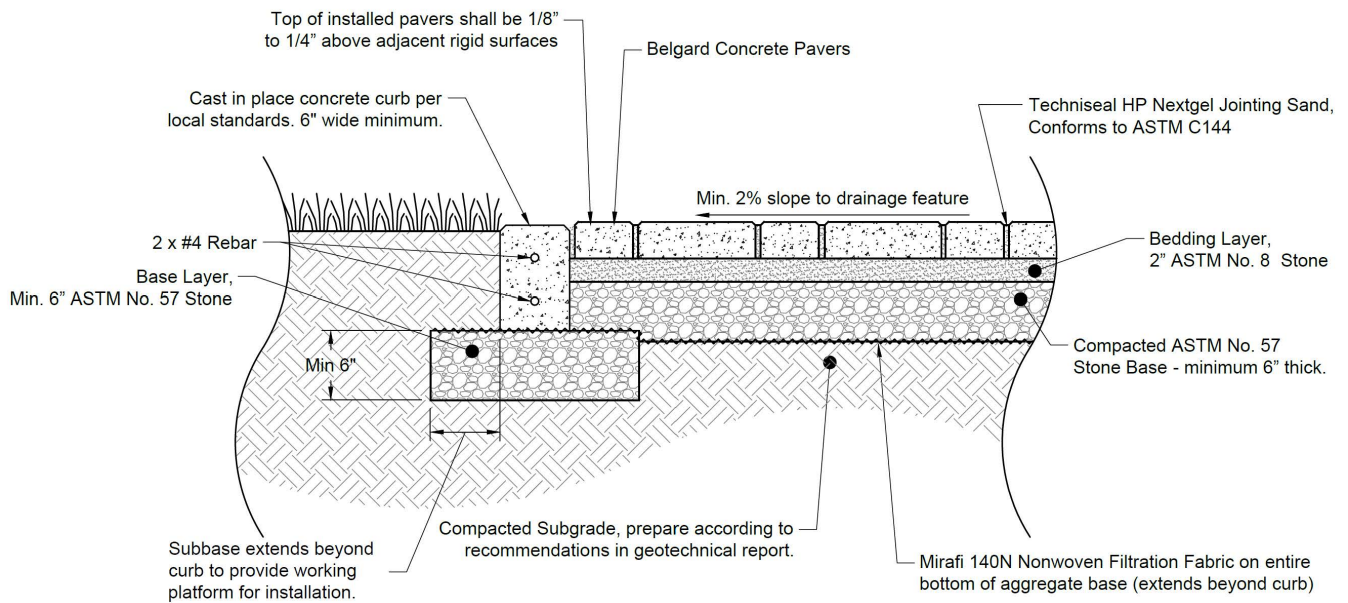
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When installing open-graded aggregate bedding course, the bedding material should conform to ASTM C33 size No. 8 as shown below or similar gradation, such as #78, #89 or #9 stone:

ASTM C33 SIZE NO. 8	
SIEVE SIZE	% PASSING
½ in. (12.5 mm)	100
¾ in. (9.5 mm)	85 to 100
No. 4 (4.75 mm)	10 to 30
No. 8 (2.36 mm)	0 to 10
No. 16 (1.18 mm)	0 to 5

Once the open-graded aggregate base course has been placed and compacted to the required grade, the open-graded aggregate bedding course is placed loose and screeded to a thickness of 2 inches. Then the pavers are placed, compacted, and the joints filled like any interlocking concrete paver system. The joint fill material should be polymeric sand for this application. Some polymeric sand will filter into the permeable bedding course requiring approximately 5% to 10% additional polymeric sand than a standard installation.

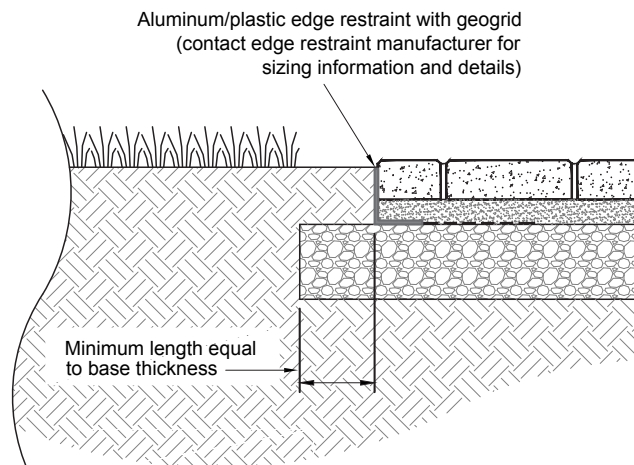
**Open-graded Bedding Course on Open-graded Aggregate Base**



**Edge Restraints**

Rigid (cast-in-place, precast, stone, concrete walls and sidewalks) – provides the best resistance to movement and should be considered in vehicular applications (detail above depicts a cast-in-place concrete curb edge restraint).

Plastic or Aluminum Edging – Plastic or aluminum edging can be used but is modified for open-graded aggregate base installations to include a geogrid attached to the edging. The pavers sit on top of the geogrid using the weight of the pavers to hold the edge in place instead of spikes. Other spiked edge restraint product solutions designed specifically for open-graded applications may also be utilized.



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