# Construction Materials

The aggregates industry is a major provider of construction materials such as sand and gravel, crushed stone. One of the biggest consumers of the aggregates industry is the transportation industry. High quality aggregates are used for maintenance and repair of state highways to increase the durability, as well as for the development of new roads.

Today, one mile of interstate highway construction consumes about 20,000 tons of aggregate per lane (Zettler, Rick)1. With the growing traffic volume on state highways and increasing durability standards, the demand for construction aggregate continues to grow.

This document describes the transportation and operational characteristics of the mined products industries. Data on the construction materials industry can be obtained from:

* + State Departments of Natural Resources (DNR) which provides permits for and monitors mine activity
  + US Geological Survey

The two main sources of natural aggregates, construction sand and gravel and crushed stone, are the most extractable and most demanded natural resources (Wallace P. Bolen, USGS Construction Sand and Gravel Statistics and Information,2004).

Below are definitions of aggregate types that are broadly discussed in this paper.

o *Natural aggregates* can be defined as materials that are composed of rock fragments and are used in their natural condition except for such operations as crushing, sizing and washing.

o *Rocks* are solid, consolidated materials derived from the earth and usually have relatively small size.

o *Gravel* is a granular material mostly retained on the No. 4 (4.75 mm) sieve that is received from natural disintegration and abrasion of rock or processing of weakly bound conglomerates.

o *Crushed gravel* results from the artificial crushing of gravel or small cobblestones with substantially all fragments having at least one face resulting from fracture.

o *Crushed stone* results from the artificial crushing of rock, boulders, or large cobblestones, (all faces result from crushing operation).

o *Coarse aggregate* is composed of mainly gravel-size particles and predominantly retained on the No. 4 (4.75 mm) sieve.

o *Fine aggregate* mainly composed of sand-size particles (passing the 3/8 inch (9.5 mm) and No. 4 (4.75 mm) sieves).

o *Sand* is a granular material passing the 3/8 inch (9.5 mm) sieve, almost entirely passing the No. 4 (4.75 mm) sieve, and mainly retained on the No. 200 (75 μm) sieve that is received from natural disintegration and abrasion of rock or processing of completely friable sandstone.

o *Sand and gravel aggregate* is a mixture (or aggregation) of sand and gravel where gravel is accounted for 25% or more of the mixture (McLaughlin, et al. 1960).

Residential and commercial construction industries are other consumers of the aggregates, given that 80% of concrete is construction aggregate. As an example, the average home construction requires about 400 tons of construction aggregates (National Stone, Sand and Gravel Association). Recently, the average level of annual aggregate consumption in the US reached 10 tons per person, which is 80 times of the volume consumed in early 1900s. Concurrently, increasing demand for extraction of aggregates results in growing pressures from environmental agencies and local communities (Zettler, Rick). *The Aggregates Industry in Washington* study conducted by Pacific Lutheran University in 2000 found about 52% of aggregates and ready mix was used by the transportation industry. Projects were classified as road maintenance, street & runway construction and bridges. About twenty two percent was attributed to residential, 18.5% to commercial and offices, and 7.5% to public sectors’ uses (B. Finnie, J. Peet 2003).

Mines for aggregates, sand, gravel, and crushed stone are common due to the high cost of transporting material and the availability of the product. For example, there were 2,807 surface mines in the state of Washington, 1,645 of which are currently terminated (Norman, D., Figure 2.1.1). Terminated status represents mines that were depleted and fully reclaimed. Active mines4 can be further categorized as currently operational or non-operational. Non-operational represents mines that are not operating because of various obstacles such as high transportation costs or absence of construction projects in the economically feasible region, or mines that are kept as a reserve for further use.

Data Sources: Geographic site information was obtained from Washington Department

of Natural Resources, Division of Geology and Earth Resources. County GIS files were

downloaded from the WSDOT GeoData Distribution Catalog.

The aggregates industry is highly affected by transportation in terms of high cost of movement. More than 90% of transported mined commodities were hauled using trucks as a mode of transportation from mine pit to points of sale or processing plant, 3% used waterway and 1% used rail (Wallace P. Bolen, USGS Construction Sand and Gravel Statistics and Information, 2004, Table 1, Appendix A).

Mines are owned by states, local governments, and are privately held. Sand and gravel produced from mines is delivered directly from the mine to the consumer (typically a construction site). Rock or stone can either be delivered directly to the consumer, or can be delivered to a third party that may additionally process the material or sell as-is. A recent survey in Washington State found 65% of shipments for all products to construction or road sites, 15% to the consumer’s location, 8% to farms, and 5% to factories (SFTA 2005 Transportation of Mining/Mineral Survey Summary Report). Most mines operate under normal business hours. The industry is quite sensitive to economic conditions and seasonalities, with most construction projects taking place during the summer, yet the strength of the seasonal variation and the construction period are dependent on local conditions.

In the same survey in Washington State, 56% of aggregates were shipped within 10 miles, with almost no shipments travelling more than 100 miles. Almost all shipments move by truck (97%) with straight trucks and trailers. The majority of the shipments are made by the mines own trucks (65% from the Washington Survey), with another 15% performed by private higher carriers for the mine.