Describe the different particle shape and surface texture of aggregate and discus...

Engineering

THE PARTICLE SHAPE AND SURFACE TEXTURE OF AGGREGATES AND THEIR IMPORTANCE Location The Particle Shape and Surface Texture of Aggregates and Their Importance

Aggregate is a term used to describe inert mineral materials such as gravel, sand and crushed stone that are used together with a binding material (such as Portland cement, water, lime, bitumen etc.). They form a compound material (such as Portland cement or asphalt cement). They can also be used as sub-base and base a material for both rigid and flexible pavements (Smith et al., 2001). However, aggregates may not completely be inert as in some cases their chemical composition may affect the properties of in both plastic and hardened state. Aggregates can be classified as natural, manufactured or re-cycled. Natural aggregates are extracted from large rocks found on the surface and underground, manufactured aggregate is a product of the manufacturing industries, and recycled aggregates come from by-products of industries (Best 1978).

Particle shape

The particle shape of aggregates has two properties: Roundness and its Spherical shape. Roundness is the relative sharpness or angularity of the particle corners and edges. Sphericalness can be termed as the measure of whether the particle is compact in shape. In other words, if it is close to being a cube or a sphere as opposed to being elongated or flat (disk-like). The higher the sphericalness of the particle the closer it is to being a sphere or a cube and the lower its surface area will be. The smaller the surface area of the particle, the lesser the amounts of water needed for mixing and the lower the amount of sand need to achieve desired workability. The

aggregate shape can affect the properties of concrete in both the hardened and plastic states. The shapes vary from rounded to angular. The form of the aggregates can be assessed by observation and the classification in accordance with the table below.

No.

Classification

Description

1

Rounded

Fully water-worn or completely shaped by attrition.

2

Irregular

It’s naturally irregular or partly shaped by attrition and having round edges.

3

Angular

Possess well-defined edges formed at the intersection of roughly planar faces.

4

Flaky

Materials with the thickness being smaller compared to the other two dimensions.

5

Elongated

Materials normally angular, with the length be considerably longer than the other two dimensions

6

Flaky and elongated

Materials having the length considerably longer than the width, and the width considerably longer than the thickness.

Surface texture

Surface texture is a term used to describe the roughness and level of irregularity of the particle surface. Generally, terms such as granular, rough, smooth, glassy, or crystalline are used to describe the surface texture of an aggregate rather than using any scientific or quantitative method (Kandhal et al., 1998). The surface texture of aggregates affects the properties of concrete in both hardened and the plastic state. Smooth particles will need less water for mixing and, therefore, cement material at a fixed water-cement ratio. Consequently, it produces concrete that has the desired workability, but at the same time, it will have less area to bond with the cement paste than rougher particle (American Concrete Institute 2005).

Conclusion

The surface texture and shape of particles of gravel, sand, rock, slag, or lightweight aggregate have a significant influence on the strength of hardened concrete and workability of freshly mixed concrete. Fine particle texture and shape affect the workability of fresh. Angular and rough sands need more water than rounded and smooth fine aggregates to achieve desired slump or workability. It will change the cement water ratio and will require an adjustment of the cement content. The effect of fine aggregate shape and texture on the strength of hardened is entirely related to the final water-cement ratio of the concrete. Coarse aggregate texture and shape will

also affect the water needs, and this will have an influence on the water-cement ratio similar to that of the fine aggregate. However, because of their smaller ratio of surface area to volume, course aggregates affect the strength more, they affect the cement paste bonding properties concrete water-cement ratio more compared to the fine aggregates.

References

American Concrete Institute., 2005. Specifications for structural concrete, ACI 301-05, with selected ACI references: Field reference manual. Farmington Hills, MI (P. O. Box 9094, Farmington Hills 48333: American Concrete Institute.

Best, C. H., 1978. Significance of Tests and Properties of Concrete and Concrete-Making Materials.

Kandhal, P. S., Parker, F., National Research Council (U. S.)., American Association of State Highway and Transportation Officials., & United States., 1998. Aggregate tests related to asphalt concrete performance in pavements. Washington, D. C: National Academy Press.

Smith, M. R., Collis, L., Fookes, P. G., Lay, J., Sims, I., West, G., & Smith, M. R., 2001. Aggregates: Sand, gravel and crushed rock aggregates for construction purposes. London: Geological Society.