# Development of Cement-Hardened Material Production Technology for Effective Use of Concrete Rubble

## (2013 JSCE Environmental Award Winning Technology)

Taisei Corporation

## 1. Summary of the technology

Enormous amounts of concrete rubble were generated in the Great East Japan Earthquake, and its disposal and reuse are an important issue in disaster recovery. There is a chronic shortage of natural aggregate for the concrete needed for reconstruction. This technology was developed as a means of rapidly processing concrete rubble and using it in a cement-hardened material as a substitute for concrete.

Concrete rubble is already used for recycled crushed stone and recycled aggregate concrete, as shown in Fig. 1, but recycled crushed stone does not provide adequate strength. Meanwhile, although recycled aggregate concrete provides strength, the cost is high because a great deal of labor is needed for crushing and sorting. The cement-hardened material of this technology is made by mixing cement and water with concrete rubble that has only been crushed to the minimum extent necessary and compacting it with a vibrating roller, as shown in Photos 1–4. The labor and cost requirements of concrete rubble crushing and cement-hardened material placement are much lower, although its compression strength is less than that of recycled aggregate concrete, at approximately 10 N/mm$^2$. As a quality controlled construction material, it is anticipated that this cement-hardened material will be used as an alternative to leveling concrete in structures and as a filling material in levees, for example.

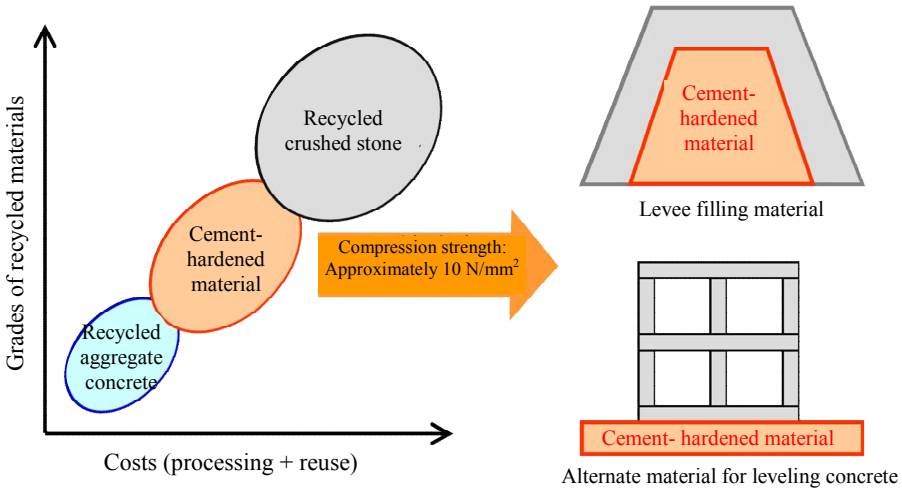



Fig. 1. Grade and uses of cement-hardened material

Photo 1. Crushing concrete rubble

Photo 2. Mixing with cement and water

Photo 3. Leveling with a bulldozer

Photo 4. Compacting with a vibrating roller

## 2. Use in a temporary structure

The cement-hardened material of this technology was used in the foundation of the large-scale temporary pavilion shown in Photos 5 and 6. This large temporary pavilion was constructed for the dismantling of an incinerator used in disaster waste processing in the city of Kesennuma, Miyagi Prefecture. The temporary pavilion was needed for about 3 months to prevent the release of dioxins and other pollutants into the atmosphere during dismantlement, and it was promptly demolished and removed after use. Because the required compression strength was conservatively only about 1.0 $N/mm^2$, cement-hardened material was used in place of ordinary concrete. In November 2013, a total of 68 $m^3$ of cement-hardened material was installed over an area of 500 $m^2$ to a depth of 0.10 to 0.20 m. It was re-crushed in February 2014 and then recycled as crushed stone.


Photo 5. Location where cement-hardened material was placed

Photo 6. Assembly of the temporary pavilion

## 3. Cyclic use of aggregate resources

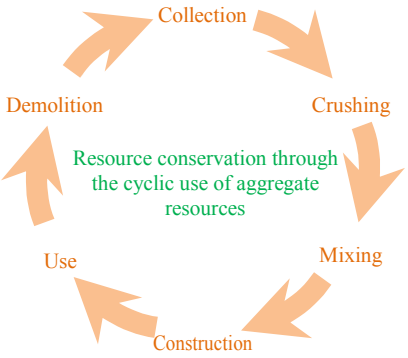
Fig. 2 shows the process by which concrete rubble was used as aggregate for cement-hardened material in the Kesennuma processing district. This is a cyclic process of gathering concrete rubble, crushing it, mixing with cement, placement with rolling compaction, use, and demolition, as illustrated here. Because the cement-hardened material can be re-crushed after use and then used again in a cement-hardened material, this technology is a promising means of recycling concrete rubble and achieving resource conservation through the cyclic use of aggregate resources.

In recognition of these contributions, this technology was awarded the Environmental Award of the Japan Society of Civil Engineers in 2013.

Demolition of cement-hardened material

Collection and removal of rebar, etc.


Simple crushing into fine particles





Used as the foundation of a temporary pavilion

Mixing with cement and water

Placement with rolling compaction

Fig. 2 Process of using concrete rubble as aggregate for cement-hardened material in the Kesennuma processing district