

II Examples of Iron and Steel Slag Adoption in Large-Scale Projects

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Tokyo International Airport Runway D Construction and Associated Work

Runway D of Tokyo International Airport, with a length of 2,500 m, was constructed on a new airport island measuring 3,120 m in length, offshore from the existing airport island. The new airport island features a hybrid structure, consisting of a 1,100 m section with a piled pier structure using steel jackets and a 2,020 m reclamation section. Approximately 1.8 million tons of iron and steel slag products, including artificial stone made by steel slag hydrated matrix, were used for partition dikes, liquefaction countermeasure materials, and temporary road materials.

Tokyo International Airport Runway D Construction and Associated Work



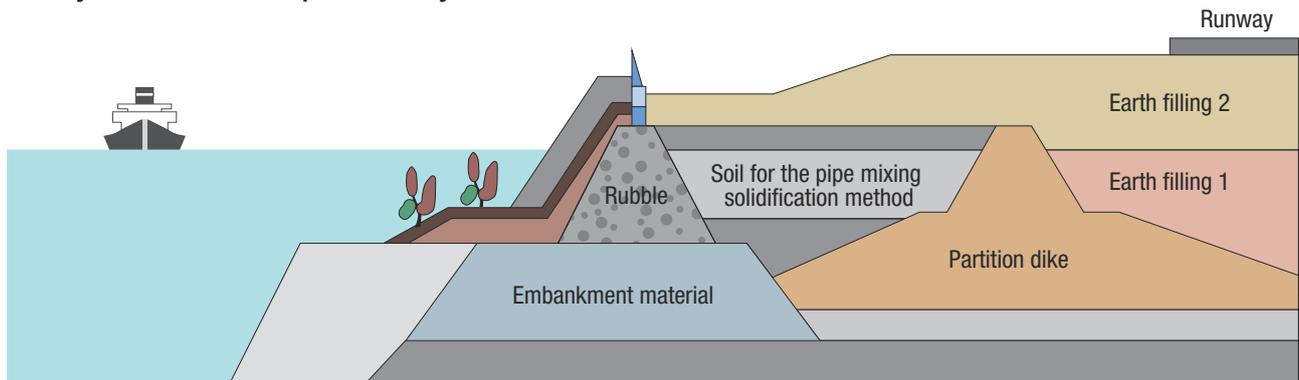
Usage of Iron and Steel Slag Products

(10,000 tons)

	Artificial stone made by steel slag hydrated matrix	Granulated blast furnace slag	Steelmaking slag	Total
Partition dike	23	74		97
Earth filling (for liquefaction prevention)	19			19
Earth filling (for temporary road construction)	60		9	69
Total	102	74	9	185

* In addition to the above, 360,000 tons of blast-furnace slag cement was used as the soil material for the pipe mixing solidification method.

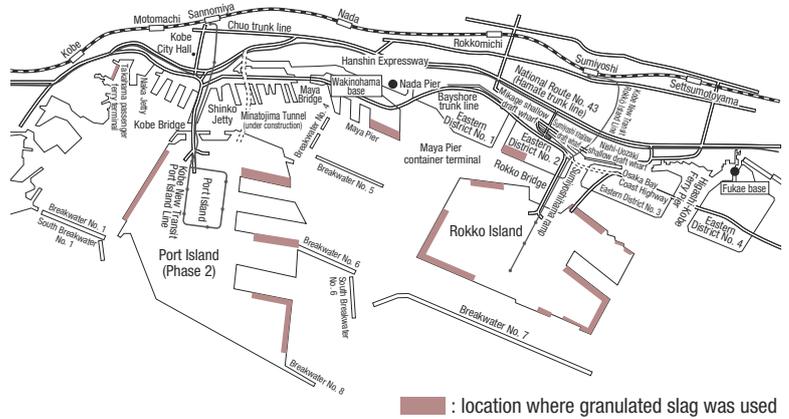
Work Items for Which Iron and Steel Slag Products were Used in Tokyo International Airport Runway D Construction and Associated Work



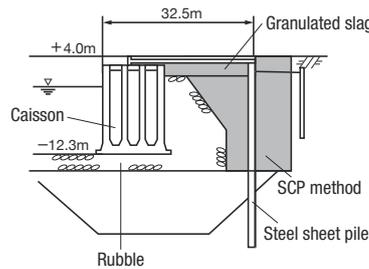
The Great Hanshin-Awaji Earthquake: Rokko Island in Kobe City

Approximately 1.1 million tons of granulated blast furnace slag were used in the Kobe Port quay wall restoration work following the Great Hanshin-Awaji Earthquake in 1995. The quay walls of the Rokko Island District in Kobe Port were severely damaged due to the large displacement of the foundations supporting structures known as caissons. During the restoration, it was necessary to minimize the loads applied to the existing structures. Therefore, to reduce earth pressure, a construction method using granulated blast furnace slag for backfilling was adopted over an area approximately 19 meters wide behind the caissons.

Locations where granulated slag was used in the Kobe Port restoration work



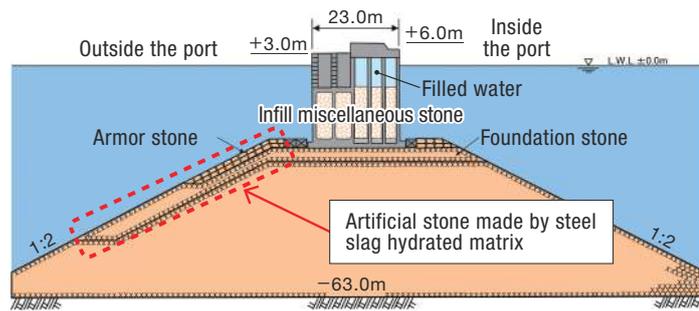
Kobe Port Quay Wall Restoration Work (Rokko Island, Kobe City)



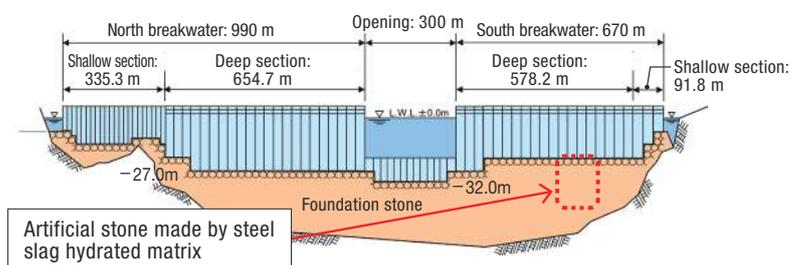
Great East Japan Earthquake: Breakwaters at the Entrance of Kamaishi Bay

Artificial stone made by steel slag hydrated matrix was used for the restoration work of the Breakwater at the Entrance of Kamaishi Bay as armor stone for the mounds of the caisson breakwaters that were damaged in the Great East Japan Earthquake. The restoration of the breakwater at the entrance of the bay covered the 370 m section of the south breakwater (total length 640 m), the 870 m section of the north breakwater (total length 990 m), and the 300 m opening. The work was completed at the end of March 2018, with approximately 200,000 m³ of artificial stone made by steel slag hydrated matrix being used.

Locations Where Artificial Stone Made by steel slag hydrated matrix (Armor Stone) were Used



Elevation of the Breakwater at the Entrance of Kamaishi Bay



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Examples of Iron and Steel Slag Adoption in Large-Scale Projects

Name	Usage (Unit: m ³)	Application (Type of slag)	Year of construction
Restoration Work for the Great Hanshin-Awaji Earthquake	1,200,000	Reinforcing earthquake resistance of quay walls (granulated slag products)	1996
Kitakyushu Airport	1,380,000	Improving soft ground (sand mat) (granulated slag products)	2000~2002
Chubu Centrair International Airport	1,170,000	Base course material for runway, etc. (granulated slag and steelmaking slag products)	2001~2004
Kobe Airport	900,000	Base course material for runway, etc. (steelmaking slag and granulated slag products)	2003~2004
Kansai International Airport Phase 2 Work	510,000	Base course material for runway, etc. (steelmaking slag and granulated slag products)	2004~2007
Tokyo International Airport Runway D Construction and Associated Work	1,180,000	Partition dike, base course material for temporary road, etc. (artificial stone made by steel slag hydrated matrix, granulated slag products, steelmaking slag products)	2007~2010

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Other Notable Adoption Examples

Granulated slag products for civil engineering works (100,000 m³ or more)

Name	Usage (Unit: m ³)	Application (Type of slag)	Year of construction
Shimotsu Port Work	227,000	Covering soil	1998
Mishima, Kawanoe-Kaneko District Work	203,000	Revetment backfill	1998~
Municipal Works in the Southeast Part of Ibaraki Prefecture	296,600	Roadbed, drainage foundation, etc.	2000~2004
Nagoya Port Tobishima Quay Wall No. 2 Work	100,000	Revetment backfill	2006~2007
New Kitakyushu Airport	184,000	Soft ground improvement (sand mat)	2010~2011

Steelmaking slag products for ground improvement (100,000 m³ or more)

Name	Usage (Unit: m ³)	Application (Type of slag)	Year of construction
Nagoya Port Nabeta Pier West Section No. 5 Work	125,000	SCP	1997~1998
Onomichi-Itozaki Port Kaino District Revetment Work	158,000	SCP	1998~2000
Otake Port Quay Wall Repair Work	146,000	SCP	1998~2000
Kure-City Aga Marinopolis Work	268,000	SCP	1998~2000
Onomichi-Itozaki Port Kaino District Revetment Work	110,000	SCP	1999~2000
Otake Port Higashi-Sakae District Quay Wall Construction Work	242,000	SCP	2001
Otake Port Higashi-Sakae District Quay Wall Construction Work	210,000	SCP	2002
Niihama Port Waste Disposal Site Revetment Construction Work	168,000	SCP	2002
Tokyo Port Lot No. 10 Work	231,000	SCP	2007
Nagasaki Port (Kogakura-Yanagi District) Quay Wall Ground Improvement Work	120,000	SCP	2009
Nabeta Pier in Aichi Prefecture	120,000	SCP	2009~2010
Nagasaki Port Repair Work	342,500	SCP	2009~2011
Breakwater at the Downstream Section of Kitakami River in Miyagi Prefecture	150,000	SCP (on land)	2013~2014
Haneda Airport Offshore Expansion Work	1,366,000	Loading embankment and paving	1985~1993
Daikoku Pier Container Yard in Yokohama Port	205,000	Loading embankment and paving	1990
Yokohama City Daikoku Pier Phase 2 Work	144,000	Loading embankment and paving	1991~1992
Port Island in Kobe City	257,000	Reclamation material	2004~2005
Samukawa Eastern Coast Land Formation Work	370,000	Partition dike	2005~2007
Fukuyama Port Main Waterway District Temporary Road Work	250,000	Temporary road and backfill	2006~2007
Fukuyama Port Main Waterway District	644,800	Embankment	2006~2008

*) The usage was excerpted from the Iron and Steel Slag News (the Nippon Slag Association) in the Handbook for Recycled Products Recommended for Port Works published by the Recycle Report Promotion Council.