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## GROUND GRANULATED BLAST FURNACE SLAG

**Ground-granulated blast-furnace slag (GGBS or GGBFS)** is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder.

### APPLICATION

GGBS is used to make durable concrete structures in combination with ordinary Portland cement and/or other pozzolanic materials. GGBS has been widely used in Europe, and increasingly in the United States and in Asia (particularly in Japan and Singapore) for its superiority in concrete durability, extending the lifespan of buildings from fifty years to a hundred years.[2]

Two major uses of GGBS are in the production of quality-improved slag cement, namely Portland Blast furnace cement (PBFC) and high-slag blast-furnace cement (HSBFC), with GGBS content ranging typically from 30 to 70%; and in the production of ready-mixed or site-batched durable concrete.

Concrete made with GGBS cement sets more slowly than concrete made with ordinary Portland cement, depending on the amount of GGBS in the cementations material, but also continues to gain strength over a longer period in production conditions. This results in lower heat of hydration and lower temperature rises, and makes avoiding cold joints easier, but may also affect construction schedules where quick setting is required.

Use of GGBS significantly reduces the risk of damages caused by —alkalisilica reaction (ASR), provides higher resistance to chloride ingress — reducing the risk of reinforcement corrosion — and provides higher resistance to attacks by sulfate and other chemicals.

### Strength

Concrete containing GGBS cement has a higher ultimate strength than concrete made with Portland cement. It has a higher proportion of the strength-enhancing calcium silicate hydrates (CSH) than concrete made with Portland cement only, and a reduced content of free lime, which does not contribute to concrete strength. Concrete made with GGBS continues to gain strength over time, and has been shown to double its 28-day strength over periods of 10 to 12 years.<sup>[citation needed]</sup>

### Sustainability

Since GGBS is a by-product of steel manufacturing process, its use in concrete is recognized by LEED etc. as improving the sustainability of the project and will therefore add points towards LEED certification. In this respect, GGBS can also be used for superstructure in addition to the cases where the concrete is in contact with chlorides and sulfates. This is provided that the slower setting time for casting of the superstructure is justified.





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## PHOTO'S OF PRODUCT



# TECHNICAL SPECIFICATION

## GROUND GRANULATED BLAST FURNACE SLAG

Sr.No		Range (%)	Typical Result (%)
1	SiO <sub>2</sub>	32.00 to 38.00	35.00
2	Al <sub>2</sub> O <sub>3</sub>	14.00 to 18.00	17.50
3	CaO	32.00 to 38.00	36.82
4	MgO	6.00 to 10.00	6.70
5	Fe <sub>2</sub> O <sub>3</sub>	0.70 to 1.50	1.50
6	MnO	0.30 to 0.90	0.32
7	Tio <sub>2</sub>	0.10 to 0.50	0.12
8	Alkalis	0.20 to 0.50	0.20
9	Sulphide Sulphur	0.20 to 0.50	0.24
10	Insoluble residue	1.00 to 1.50	1.40
11	Loss On Ignition	0.50 to 0.80	0.60
12	Specific Surface(cm <sup>2</sup> /gm)	3200 to 4100	4088
13	Specific Gravity	2.70 to 2.95	2.80
14	Bulk Density T/M <sup>3</sup>	1.1 to 1.3	1.15
15	Residue on 45-µm	4 to 9	4.00
16	Glass Content %	90 to 94	93.50