

A Comparison of the Environmental Impact of Various Building Materials

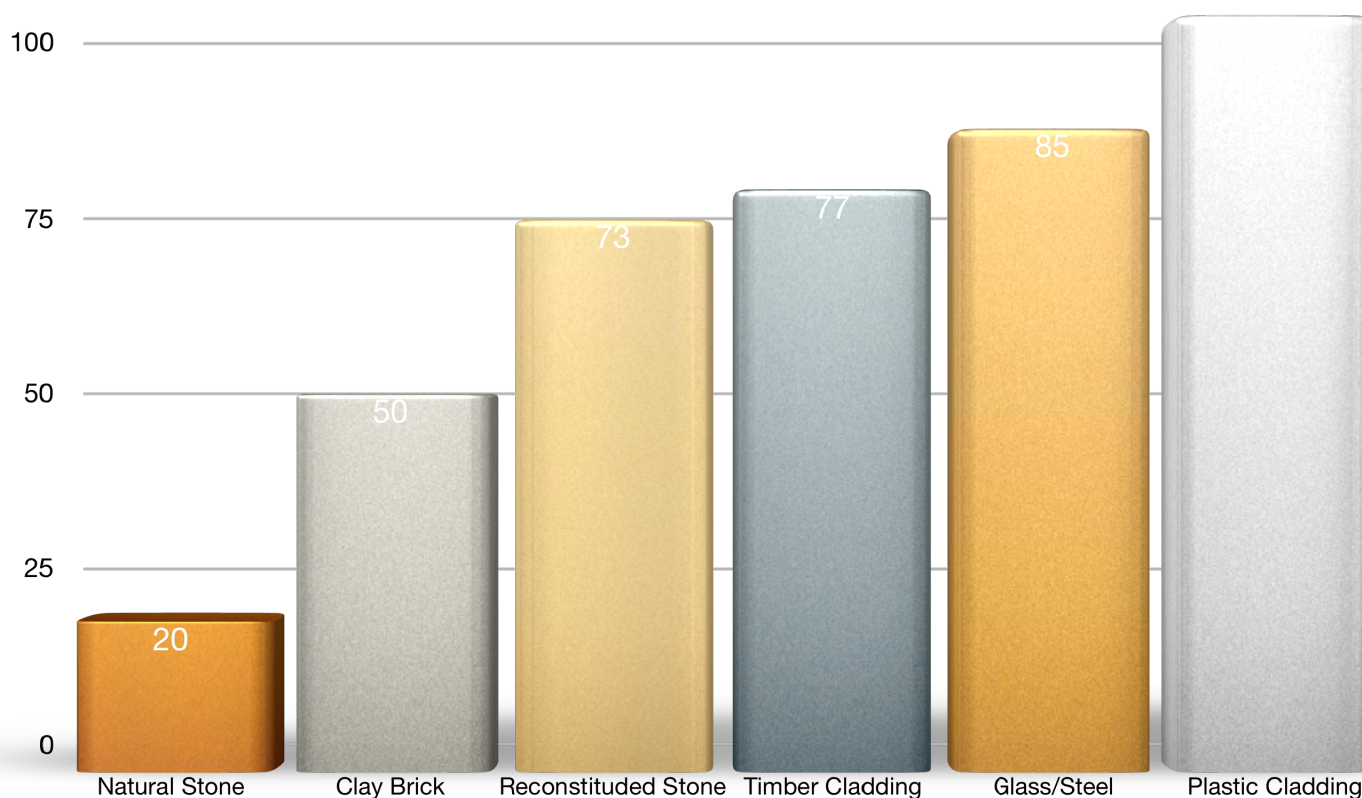
A study researched and compiled by Halletec Associates on behalf of Goldholme Stone Ltd

Different construction materials have widely variable environmental impacts in terms of their manufacture, use in service and potential for re-use at the end of the buildings life. Many attempts have been made to quantify these impacts on a scientific basis, but the variables and the weighting attributed to their impacts are subject to debate. For this exercise, six construction materials have been assessed in an attempt to produce a simple but scientifically sound comparison.

A range of environmental impacts has been assessed for each material. Each impact has been given a weighting which is considered to be consistent with the scale of the impact, to allow the more environmentally damaging effects to affect the scoring. A high score indicates that an impact may be environmentally more or less significant. Thus, the life of the product is considered to be significant as products with a short life have to be replaced and therefore re-manufactured more often than those with a long lifespan. Alternatively, production waste has an impact, but it is much less significant in terms of damage to the environment.

The six materials have then simply been ranked in order, with the lowest rank having the least impact on the environment. This ranking (red in the following table) has then been multiplied by the weighting, and the results (blue) have been totalled to give an environmental impact score (green) for each material, where a high number indicates a greater impact and vice-versa. These scores are then presented in a chart for easy visual comparison.

Building Material													
Impact	Weighting	Natural Stone		Clay Brick		Reconstituted Stone		Timber Cladding		Glass/Steel		Plastic Cladding	
Energy usage in manufacture	8	1	8	3	24	5	40	2	16	6	48	4	32
Pollutants emitted	5	1	5	3	15	4	20	2	10	6	30	5	25
Waste in production	2	2	4	3	6	4	8	1	2	6	12	5	10
Impact of processing plant	2	1	2	3	6	5	10	2	4	6	12	4	8
Life of product	10	1	10	2	20	3	30	6	60	4	40	5	50
Maintenance in service	2	2	4	1	2	3	6	6	12	5	10	4	8
Carbon dioxide footprint	6	1	6	2	12	3	18	5	30	6	36	4	24
Recycling potential	3	1	3	2	6	3	9	5	15	4	12	6	18
ENVIRONMENTAL IMPACT SCORE			42		91		141		149		200		175



A Comparison of the Environmental Impact of Various Building Materials - Summary

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The methodology used here is recognised to be somewhat subjective, so it is considered important to discuss the reasoning behind the ranking of the materials in the table, This is done for each material.

Natural Stone This is a very small-scale extraction and processing operation. Stone is extracted by sawing, lifting with cranes or fork-lift machines, and dressing is carried out by sawing in sheds. The Jurassic Limestones produced by the applicant are very soft and take up to ten times less time, and therefore less energy, to cut than harder stones such as sandstone and Carboniferous Limestone. Off-cuts can be recycled for use as aggregate, and fines from the sawing operation can be settled out and used in the restoration of the quarry.

Saw sheds are generally small and hidden within the quarry. Historic buildings such as cathedrals and stately homes are testament to the longevity of natural stone as a building material, proving its potential to last for over 1000 years in-situ. Upon demolition, the stone can be re-used in other buildings or crushed for use as aggregate.

Maintenance in service is limited to occasional sand blasting if required, although weathering effects are often considered to enhance the aesthetic appearance of the building. The average bed height for a course of stone is much thicker than for brick, requiring over 50% less mortar for a given area of wall.

Clay Brick Brick also has a long life, with numerous buildings surviving in the UK for over 500 years. Brick needs no maintenance in service, the effects of weathering generally

being regarded as aesthetically pleasing. Energy use in production is relatively high, but variable, with Fletton bricks made of Oxford Clay containing sufficient fuel to be almost self-firing, whereas others contain no natural body fuel at all and therefore use significant amounts of energy to dry and fire the ware. There is virtually no waste in production, with clay being re-used in the process and fired waste being used as aggregate, often within the quarry or even the product. The level of pollutants emitted is also highly variable, with some clays containing high levels of fluorine and sulphur whereas others contain very low levels. Brick works are generally large factories with tall chimneys and adjacent quarries. Brick can be re-used or crushed for aggregate, giving a high recycling rate.

Timber Cladding

it is considered by some that timber cladding is the most environmentally friendly building material, but this fails to take into account the negative ecological and hydrological effects of timber felling, the relatively short life of the product and the requirement for frequent treatment with chemical preservatives. The slow growth rate of trees would be a limiting factor if substantially more buildings used this material. The recycling potential at end of life is very poor. Trees also absorb carbon dioxide and emit oxygen, so the felling of woodland has a very significant impact upon carbon balance in the atmosphere.

Reconstituted stone and concrete brick

This requires a three-stage process, involving quarrying and crushing aggregate, cement production and reconstituted stone/brick production. The use of cement is the most environmentally damaging part of the process, requiring large amounts of energy, large and highly visible production plants (often situated in very attractive countryside) and emitting large quantities of pollutants including dust and carbon dioxide. Whilst great improvements have been made by the industry in recent years, its effects are still significant. The life of the product is expected to be less than stone or brick, although these products are a relatively recent innovation. Recycling for aggregate is possible at end of life.

Plastic cladding

Plastic is an oil based product, and thus has a very high environmental impact through the extraction and refining of oil. Waste generated in production cannot be recycled, neither can the material itself after the building has been demolished, resulting in waste disposal to landfill. The life of such buildings is relatively short.

Glass/steel

Numerous modern buildings use these materials in great quantities. Both products require high levels of energy in production and generate relatively high proportions of waste. High levels of pollution are produced from steel works, and the environmental impact of steel and glass production is high. With so much glass in a building, the environmental cost of cleaning is high in terms of the use and disposal of water and detergents, and at the end of life it is debatable how much of the materials can actually be segregated and recycled. Whilst this method of construction is relatively new, it is anticipated that it will be less than other materials.