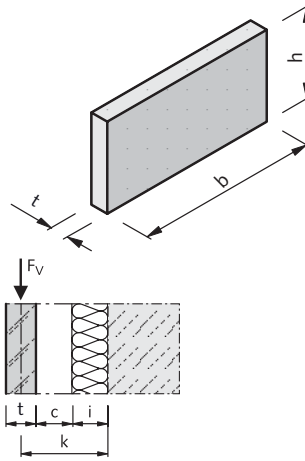


DESIGN PRINCIPLES FOR NATURAL STONE FACADES

Calculating the weight of the panel

Material	$\gamma/\text{kN/m}^3$
Ceramics, volcanic stone	20
Chalk conglomerate, travertine	24
Sandstone	26
Limestone, marble	27
Granite, porphyry, slate	28
Basalt, diorite, gabbro, gneiss	30

γ = Density of natural stone panels



Dimension of natural stone panels

G = Panel weight ($l \times h \times t \times g$)

t = Thickness of panel

h = Height of panel

l = Length of panel

g = Density of material

Designing size and thickness of panels

When used as cladding and lining, natural stone can be produced in varying panel sizes and thicknesses. When used as traditional masonry it is possible to produce units 3m long x 1.5m high, however, more typically units of 600-900mm long in 250-

450mm course heights are used. Thickness of traditional stone units tend to vary from between 50mm to 100mm, but can be larger for special features, e.g. cornices. If stone is to be used as curtain or rain-screen cladding where each panel is

individually supported and restrained, the thickness of the panels may be reduced subject to calculation.

Guidance on the selection of the thickness of stone for cladding and lining is set out in the table below:

Stone location	Stone type							
	Stone thickness t^*				Min thickness of stone behind a pin			
	G Mw Sl Q	T LsH	Mb	Ls Ss	G Mw Sl Q	T Ls H	Mb	Ls Ss
External								
Less than 3.7 m above ground floor level and continuously supported (incl. fascias)	20	20	20	50	7	7	7	25
Fascias less than 3.7 m above ground or floor level (incl. fascias)	30	30	NA*	50	12	12	NA*	20
More than 3.7 m above ground or floor level (incl. fascias)	40	40	NA*	75	15	15	NA*	30
Soffits (including inclined soffits)	40	40	NA*	75	15	15	NA*	30
Sills, copings and supported reveals	30	30	NA*	50	12	12	NA*	20
Stone facade concrete units	30	30	NA*	50	NA	NA	NA*	NA
Internal								
Less than 7 m above ground floor level and continuously supported (incl. fascias)	20	20	20	50	7	7	7	20
Fascias less than 7 m above ground or floor level (incl. fascias)	30	30	NA*	50	12	12	NA*	20
More than 7 m above ground or floor level (incl. fascias)	30	30	NA*	75	12	12	NA*	30
Soffits (including inclined soffits)	40	40	NA*	75	15	15	NA*	30

* Unless otherwise proven by calculation

* NA: not applicable

G Granite
Ls Limestone (e.g. Portland, Bath, Clipsham)
LsH Hard Limestone (e.g. Roman Stone)

Mb Brecciated marble
Mw Homogeneous marbles
Q Quartzites

SL Slates (those unlikely to delaminate)
Ss Sandstones (e.g. York, Northumberland, Scottish)
T Travertines

Table based on BS8298 stone thickness table

DESIGN PRINCIPLES FOR NATURAL STONE FACADES

Standards and Design information

Selection

On most projects appearance, suitability, availability and cost are likely to be the determining factors. Ideally the stone selected will be the most appropriate for the application, readily available, produced to the required tolerances and within budget. In all instances detailed research should be undertaken to establish the technical competency of the stone at an early stage.

Discussions between the architect, fixing system designer (please contact HALFEN Ltd) and stone designer should take place at the initial design stage.

Rainscreen Cladding

Rainscreen cladding is generally defined as stone panels that are individually supported and restrained allowing construction to take place with open joints. Differential movement is accommodated in each joint, which negates the need for larger compression and expansion joints. Open jointed systems provide a ventilated cavity and require waterproof rainscreen insulation systems. Ventilated cavities assist in achieving the demands of the new European energy saving requirements.

Movement Joints

Where stone is used as handset cladding the movement in the stone and deflection of the structure are accommodated by horizontal movement joints at each floor level which need to be of sufficient width to allow for the movement.

A stainless steel support system should be installed above any horizontal

movement joint and fixed to the structure.

Differential lateral movement is accommodated by the introduction of vertical movement joints.

Stone panels that are individually supported may incorporate soft mastic joints between stones thus allowing their individual expansion and contraction. A horizontal soft joint may still be required at slab level to allow for deflection in the structure.

See BS EN 8298 Section 3.11

Testing

To meet the latest requirements and to confirm the stones suitability for use in a specific application, tests should be undertaken in accordance with the appropriate standards as set out in BS EN 1469.

Index tests will affirm petrographic description, porosity, density and water absorption and establish the saturation co-efficient.

Strength tests will measure compressive and flexural capacity, and determine both the modulus of rupture and strength around a fixing.

See BS EN 1469

Dowel Pins

For most types of stone, such as Granite or Hard Limestone, the designer should allow a minimum thickness of material behind the dowel hole as indicated in the relevant standard. For example 12mm for panels fixed less than 3.7m above ground, 15mm for panels fixed above 3.7m.

See BS EN 8298 Section 3 Table 4

References

DIN 1045, DIN 1053, DIN 1055, DIN 4420, DIN 18 516, DIN 18 800, Eurocode 3,

Guidelines for the packing and laying of natural stones published by:

Deutscher Naturwerksteinverband eV.
BS EN 8298 BS EN 1469

Approval Certificate:

'Building components and joints and fastenings made of stainless steels' No.Z-30.3-6, dated December 5th 2003, issued by the German Institute for Structural Engineering, Berlin.

