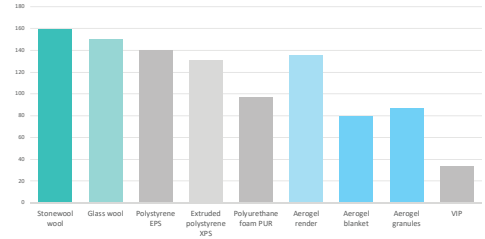
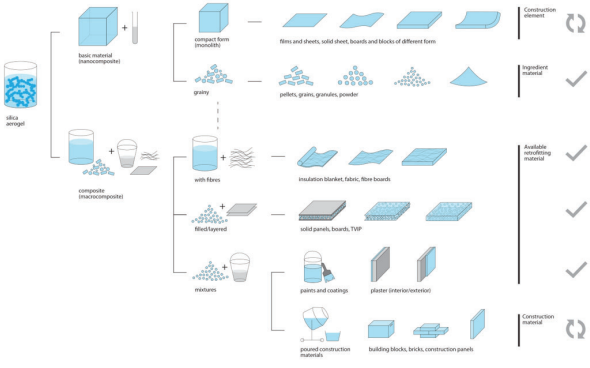
AEROGEL MATERIALS FOR BUILDING APPLICATION

Aerogels are open-porous, high-performance insulation materials that can be used for very thin building thermal insulation. So far, the application conditions of these materi-als and their potential in heritage buildings have not yet been described comprehensively.

This review shows the technical properties of commercially available aerogel materials – such as blankets, boards and render – and their use positions in heritage buildings, taking into account the heritage criteria of authenticity, integrity, reversibility and com-patibility. Additionally, historic buildings that were refurbished using aerogels are pre-sented.

The study indicates that superinsulating aerogel materials have an exceptional potential in the refurbishment of heritage buildings. The presented examples show the feasibility of refurbishments with aerogel and the resulting improvements in terms of both com-fort and thermal properties. Hence, aerogel materials can be used in preservation of heritage objects according to generally known rules and conditions of heritage preser-vation, thus contributing to the reduction of energy consumption in the building sector.





aerogelanwendungen.ch

Paper Ganobjak, Brunner, Wernery 2019 update link Aerogel Materials for Heritage Buildings: Materials, Properties and Case Studies, J. of Cultural Heritage

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Empa
Materials Science and Technology

MARIE CURIE ACTIONS

European Commission

Horizon 2020
European Union funding for Research & Innovation

AERO GEL GRANU LATE

PROPERTIES

Product type	**granulate Cabot P30015**
Thermal conductivity λ *[mW/(m·K)]*	**19**
Density *[kg/m3]*	**65-85 (bulk)**
Water vapour resistance factor Mu μ [-]	**2-3**
Reaction to fire *[class]*	**B**
Thickness for U=0.5 W/(m²·K) *[mm]*	**35**
Price for U=0.5 W/(m²·K) *[€/m2]*	**122**
Recommended application	**• Cavity walls** **• Cavity insulation**
Processing	**material for filler and mixtures** **potentially high dust release**

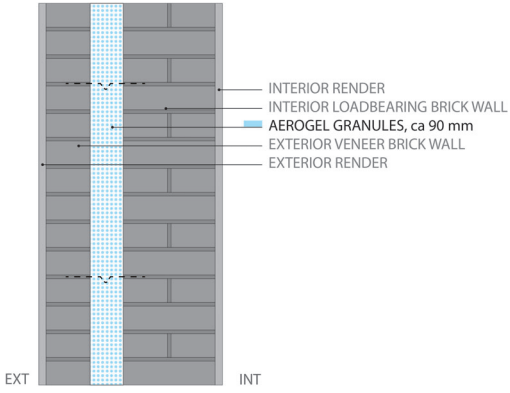
Aerogel Granules

In some applications, cavities, for example those in double walls, are filled with loose aerogel granulate. This application is convenient, as an existing space, namely the cavi-ty between the interior and the exterior brick wall, is used for insulation purposes. It al-so allows – in principle – for a renovation without any disruption of the building use. Unfortunately, the filling of aerogel granulate into the cavity produces dust, which can escape through small cracks in the walls so that it can enter the building. Hence, better filling methods are necessary in order to allow for a wider use of this method.
nly intended for in-terior application and smaller areas on the exterior. Aerogel

MULTIFAMILY HOUSE BIEL, CH

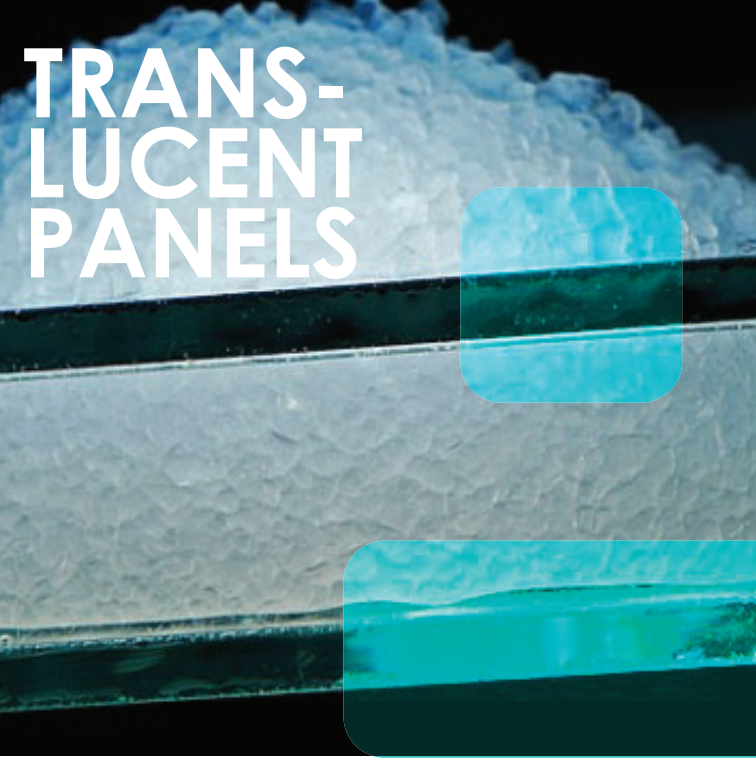
DETAILS

MULTI-FAMILY HOUSE
BIEL, CH



WALL SECTION DETAIL

AEROGEL GRANULATE



TRANS-LUCENT PANELS

PROPERTIES

Product type	**translucent panel, OKAGEL, 60 mm fill**
Thermal conductivity λ [mW/(m·K)]	**19 (fill)**
Density [kg/m3]	**n.a.**
Water vapour resistance factor Mu μ [-]	**∞**
Reaction to fire [class]	**not rated**
Thickness for U=0.5 W/(m²·K) [mm]	**ca. 59**
Price for U=0.5 W/(m²·K) [€/m2]	**variable**
Recommended application	**skylights** **lighting walls**
Processing	**mounting in frame**

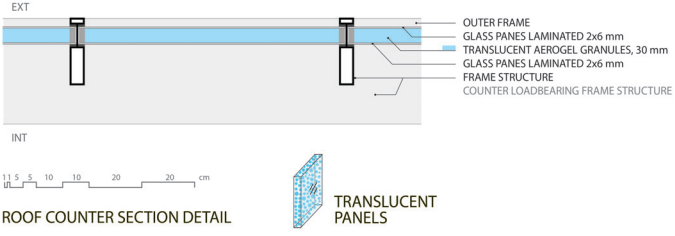
Translucent Panels

Translucent panels sandwich an aerogel granulate filling between two transparent or translucent panes made from glass or plastic. The panels are completely sealed, so that dust can only occur in the case of breakage of the panel. These panels reach relatively low U-values, as the granular bed inside the panel has a thermal conductivity of around 19 mW/(m·K). Their advantage is that they combine good insulation properties with the transmission of diffuse light, but without allowing too high a solar gain [28].

FORMER STOCK EXCHANGE ALTE BÖRSE, ZURICH, CH

DETAILS

FORMER STOCK EXCHANGE
ALTE BÖRSE, ZÜRICH, CH



ROOF COUNTER SECTION DETAIL

TRANSLUCENT PANELS

AEROGEL BOARDS

PROPERTIES

Product type	**board Heck AERO**	**board Sto Aevero**
Thermal conductivity λ [mW/(m·K)]	**17**	**16**
Density [kg/m3]	**230**	**> 150**
Water vapour resistance factor Mu μ [-]	**3**	**10**
Reaction to fire [class]	**A2-s1-d0**	**D-s1-d0**
Thickness for U=0.5 W/(m²·K) [mm]	**31**	**29**
Price for U=0.5 W/(m²·K) [€/m2]	**187**	**271**
Recommended application	**• Interior insulation • ETICS**	**• Interior insulation • ETICS**
Processing	**dust relase**	**dust relase**

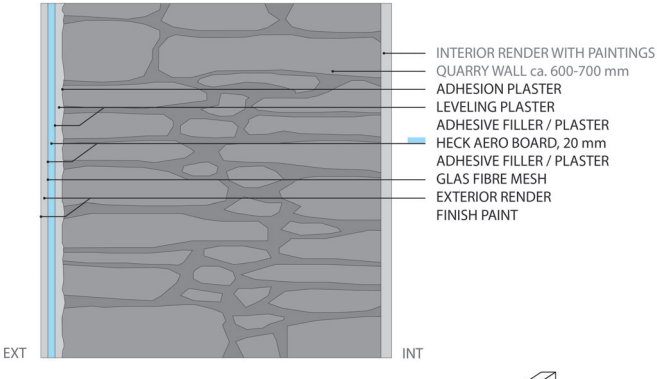
Aerogel Boards

Aerogel boards are more rigid and can be obtained in greater thicknesses than blan-kets. They are produced by either gluing several layers of aerogel blankets together or by binding aerogel granulate into boards, usually with a lamination. In both cases, due to the addition of glue, the thermal conductivity of the boards is higher than that of the blankets. Boards are used as interior insulation or as ETICS. Commercially available products which are used in Switzerland are the AERO board by Heck and the Aevero by Sto. The latter can be attached without the usage of dowels but is only intended for in-terior application and smaller areas on the exterior.

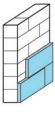
MANOIR DE COR-MONDRÈCHE, CH

DETAILS

GRAND HOUSE IN CORMONDRÈCHE
MANOIR DE CORMONDRÈCHE, CH



WALL SECTION DETAIL



AEROGEL BOARDS

AEROGEL BLANKET

PROPERTIES

Product type	**blanket Spaceloft**
Thermal conductivity λ [mW/(m·K)]	**15**
Density [kg/m3]	**150**
Water vapour resistance factor Mu μ [-]	**5**
Reaction to fire [class]	**C-s1-d0**
Thickness for U=0.5 W/(m²·K) [mm]	**28**
Price for U=0.5 W/(m²·K) [€/m2]	**165**
Recommended application	**Interior/exterior insulation ETICS**
Processing	**dust release**

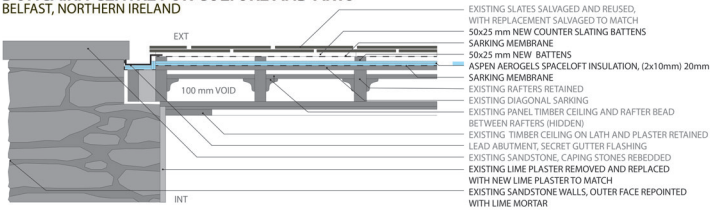
Aerogel Blankets

The most widespread aerogel product type in Switzerland, aerogel blankets, consists of a fibre fleece made from organic and inorganic fibres into which the aerogel is embed-ded. The blankets are mechanically flexible and have a very low thermal conductivity. They are typically used as insulation material in architectural details such as roller shut-ter housings or window reveals, as interior insulation or as external thermal insulation for façades. Aerogel blankets are available as the product Spaceloft from Aspen Aero-gels, with maximal thicknesses of 10 mm.

DUNCAIRN CHURCH
DUBLIN, IR

DETAILS

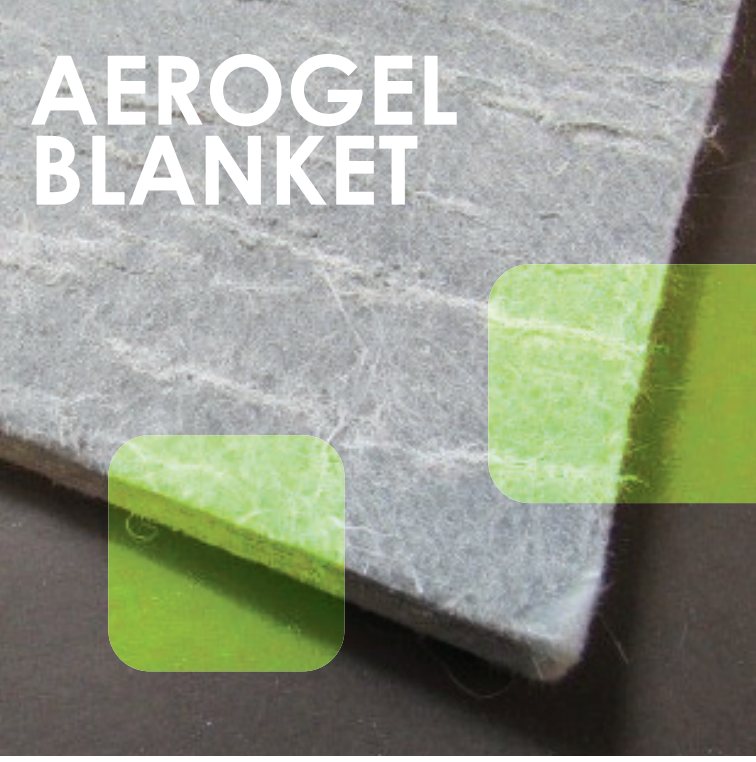
DUNCAIRN CENTRE FOR CULTURE AND ARTS
BELFAST, NORTHERN IRELAND



ROOF COUNTER SECTION DETAIL

AEROGEL BLANKET

AEROGEL BLANKET

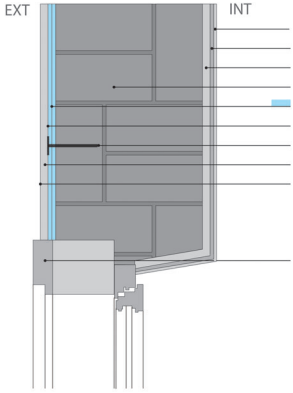


PROPERTIES

FICHTENSTRASSE ZÜRRICH, CH

DETAILS

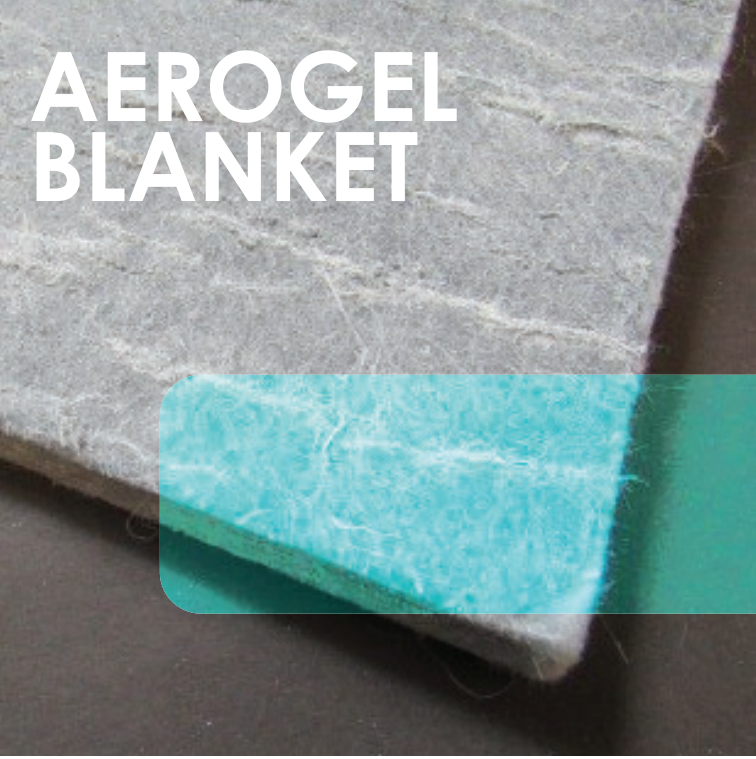
SEMIDETACHED HOUSE FICHTENSTRASSE
ZÜRICH, CH



DETAIL IN FLOORPLAN

AEROGEL BLANKET

AEROGEL BLANKET

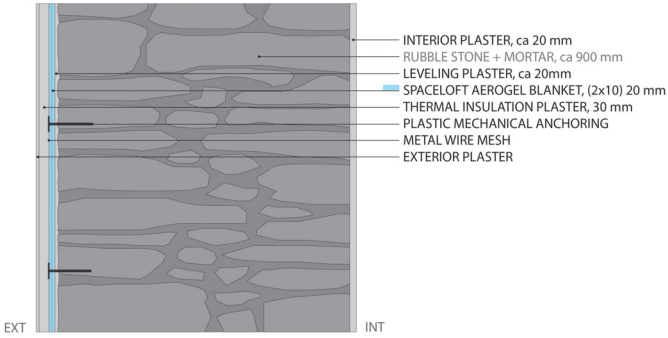


PROPERTIES

MÜLLI HALLAU, CH

DETAILS

FORMER MILL IN HALLAU
MÜLI OBERHALLAU, CH



WALL SECTION DETAIL

AEROGEL
BLANKET

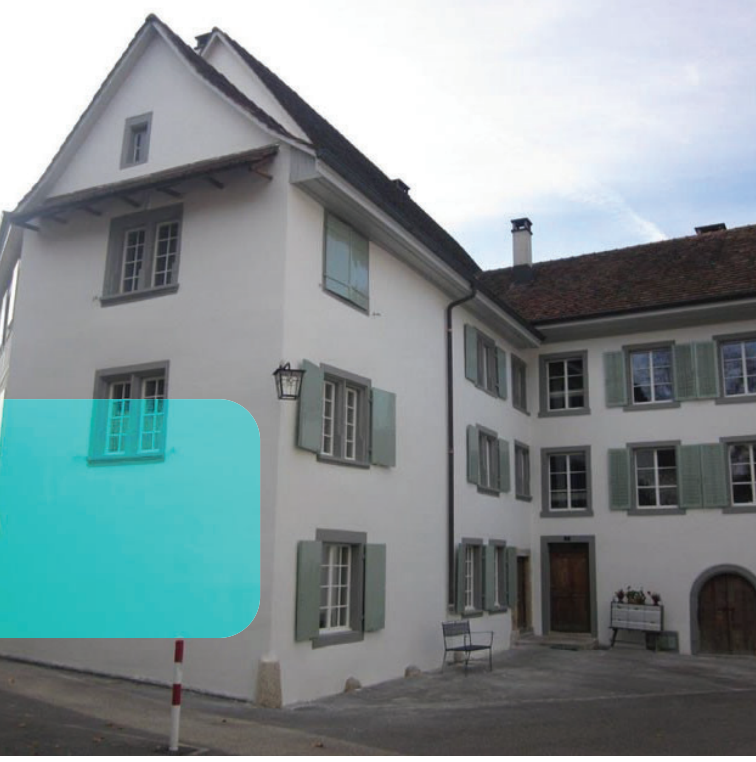
AEROGEL RENDER

PROPERTIES

Product type	**render Fixit 222**
Thermal conductivity λ [mW/(m·K)]	**28**
Density [kg/m3]	**220 (dry)**
Water vapour resistance factor Mu μ [-]	**4-5**
Reaction to fire [class]	**A2-s1-d0**
Thickness for U=0.5 W/(m²·K) [mm]	**51**
Price for U=0.5 W/(m²·K) [€/m2]	**100-195**
Recommended application	**exterior insulation machine dust**
Processing	

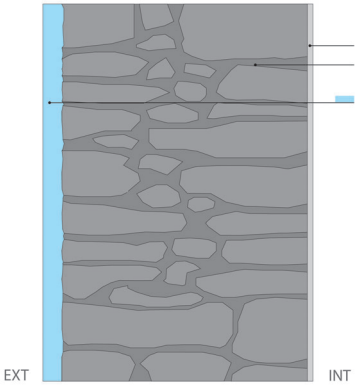
Aerogel Renders

By binding aerogel granulate inorganically, several render systems with thermal con-ductivities of around 28 mW/(m·K) have been developed, which is slightly below the thermal conductivity of conventional insulation blankets or boards and at less than half the thermal conductivity of conventional insulating renders. Different approaches have been presented by several authors [24–27]. The aerogel renders are an interesting ma-terial especially for historic uneven surfaces – interior and exterior – and for applica-tions where varying insulation thicknesses are advantageous, as in the vicinity of win-dow jambs or of beams in timber framing constructions (e.g. quarry stone masonry). Commercially available aerogel renders in Switzerland are Fixit 222 from FIXIT and HAGATHERM Typ Aerogel from HAGA.

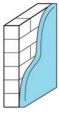


DETAILS

FORMER MILL IN SISSACH
MÜHLE SISSACH, CH



WALL SECTION DETAIL



AEROGEL
RENDER