

Credentials that leave conventional construction behind

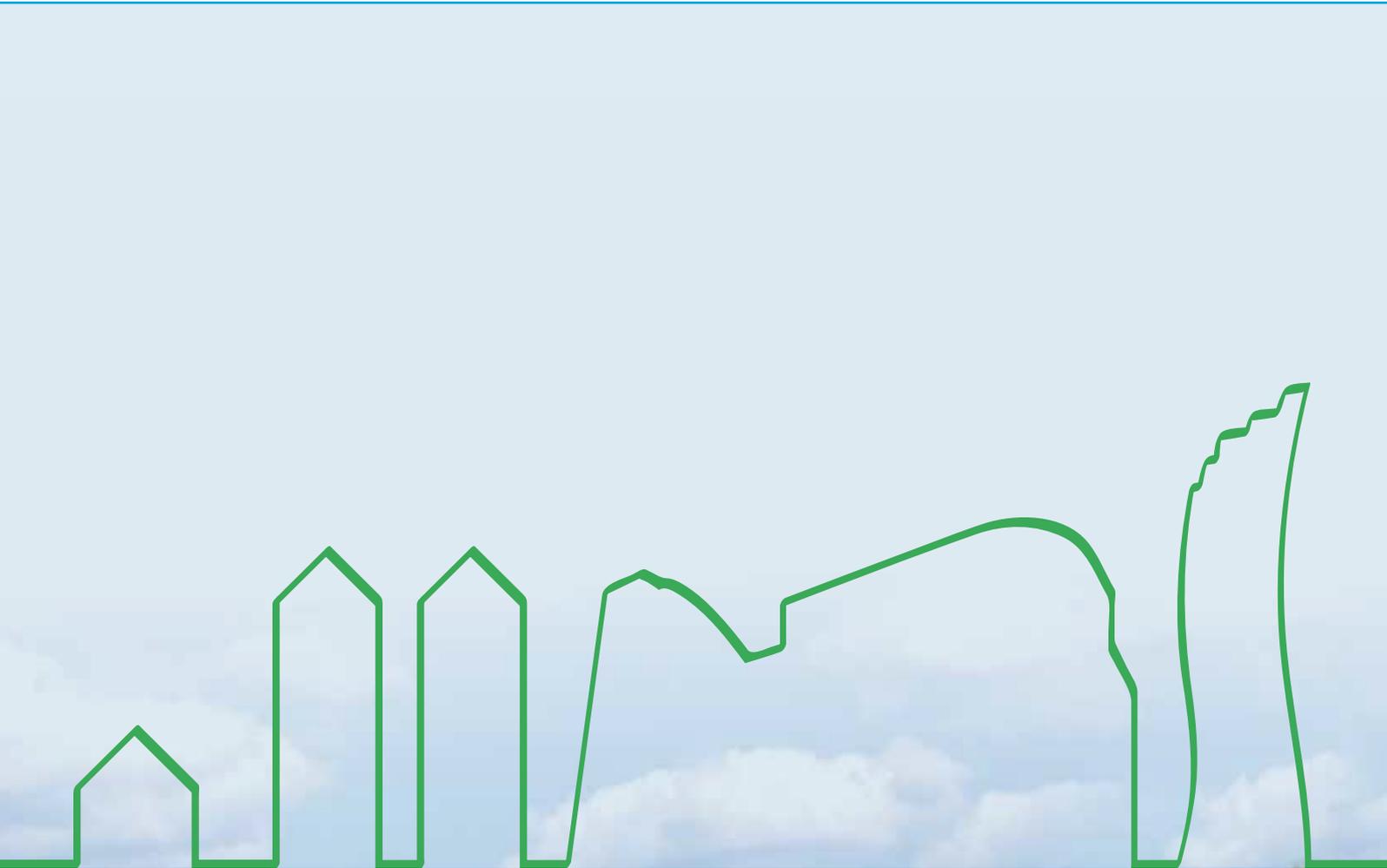
Knauf AQUAPANEL® Exterior Wall



Be certain,
choose **AQUAPANEL®**

AQUAPANEL®





Performance that leaves brick and block behind

The Knauf AQUAPANEL® Exterior Wall is an advanced drylining system with a unique combination of economic, sustainability and performance advantages that are quite simply beyond the reach of brick and block.

A new exterior drywall concept from Knauf



Meeting tomorrow's demands today

Traditionally, exterior walls have been built largely of brick and block – tried and tested materials that have been with us for 5000 years. But today's demands for highly energy efficient buildings are making it more and more difficult for brick and block to deliver, with walls sometimes needing to be almost 50 cm thick to meet stringent regulatory requirements.

But now Knauf has created a new exterior drywall concept specifically to address today's demands and anticipate tomorrow's – a system that delivers performance conventional materials can't match.



Knauf has now developed a totally new concept in building – a versatile, high performance exterior drywall system, complemented by expert service and technical back-up.

A complete wall from a single source

The Knauf AQUAPANEL® Exterior Wall is a complete system. All components are designed for compatibility with each other and manufactured to the highest standards under strict quality control.

Knauf can provide everything you need to create an exterior drywall construction which will precisely meet technical and aesthetic requirements.

The system includes AQUAPANEL® Cement Board Outdoor and accessories for exterior finishing, Knauf profiles, Knauf Insulation materials, and Knauf Gypsum Boards, joint compounds and interior finishing options.

Knauf AQUAPANEL® Exterior Wall benefits

The Knauf AQUAPANEL® Exterior Wall is an advanced drylining system with a unique combination of economic, sustainability and performance advantages that are quite simply beyond the reach of brick and block.

For example, it can achieve an energy performance of 0.20 W/m²K at a thickness of only 22 cm, compared with a minimum of 34 cm for blocks plus 16 cm insulation, as well as offering better acoustic insulation and superior seismic performance.

And that's only the beginning. Turn to the Knauf AQUAPANEL® Exterior Wall for your next building project and you'll also benefit from:



Better economy

- Faster construction times – up to 27% time savings to the end of surface finishing stage compared with brick and block means the building can be completed earlier for rent or sale*
- Faster closing of the building envelope gives protection against weather – enabling interior finishing stages to start earlier
- Up to 8% gains in practical usable interior space compared with brick and block allow investors to generate more return on investment (ROI)*
- Longer-term renovation and/or change of functionality of building is possible, giving investors and lenders greater credit security
- Investment costs/share of total building cost are lower than with masonry

* Figures based on comparisons pages 12, 13.



Sustainability

- Better energy performance due to slimmer wall construction: on average 25% more space than with brick and block (based on the same U-Value) which allows for better thermal insulation outside*
- Up to 50% lower primary energy requirements and up to 30% lower CO₂ emissions in manufacturing, thanks to slim construction and less building material mass*
- Better environmental performance through reduced use of natural resources

* Figures based on comparison page 8 and pages 14,15.

Performance

- Comparable fire, sound and thermal performance to brick and block but with more wall space and lighter construction
- Easy access to building infrastructure and building services, HVAC etc.
- Ideal as façade refurbishment material because reinforcement of primary building structure is not required
- Greater design freedom and pliancy for creating monolithic jointless surfaces and for curves (to 1 m radius)
- Superior seismic performance

In short, choose the Knauf AQUAPANEL® Exterior Wall for your next project and you will profit from performance tailored to deliver a superior return on investment at every stage – from initial planning, through construction, to building occupation and use.

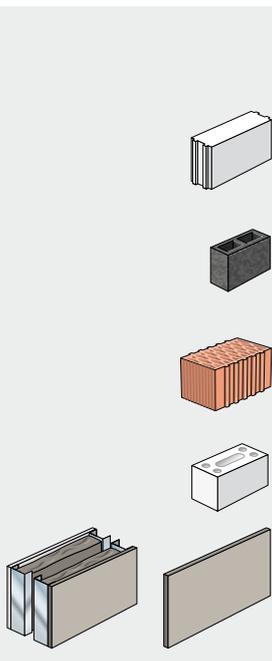
Better economy

The Knauf AQUAPANEL® Exterior Wall offers a range of economic advantages to investors and architects when compared with conventional building techniques.

As well as the specific economic advantages shown in the next pages, the Knauf AQUAPANEL® Exterior Wall also offers specific drylining benefits which result from shorter construction times, including:

- Faster closing of the building envelope, enabling interior finishing, laying screed etc. to begin as early as possible whilst the exterior is still being completed
- Shorter drying time means less energy is consumed during the construction phase
- Faster construction reduces the time scaffolding is required on-site
- Easier site management due to fewer interfaces between different trade skills - the Knauf AQUAPANEL® Exterior Wall requires only one type of expertise: drylining
- Easier site logistics as there is less building material mass to transport and less need for heavy equipment
- Just-in-time complete system solution from one source
- Flexibility for renovation/change of functionality provides greater security to investors and creditors
- The façade can be demounted selectively at the end of its life cycle for more effective recycling as there are no composite systems bonded with adhesive

The Knauf AQUAPANEL® Exterior Wall offers better U-Values with a wall construction which is, on average, 25% slimmer than conventional construction



U-Value d = thickness of construction (in mm)	0.26 W/m ² K d	0.24 W/m ² K d	0.22 W/m ² K d	0.20 W/m ² K d
Cellular concrete	365 mm	/	/	/
Lightweight concrete stone	365 mm	365 mm	490 mm	490 mm
Lightweight brick	425 mm	490 mm	/	/
Sand-lime brick + ETICS*	295 mm + ETICS 120 mm	315 mm + ETICS 140 mm	315 mm + ETICS 140 mm	335 mm + ETICS 160 mm
Knauf AQUAPANEL® Exterior Wall Double stud	190 mm (insulation 120 mm included)	195 mm (insulation 150 mm included)	215 mm (insulation 160 mm included)	220 mm (insulation 160 mm included)

* Exterior Thermal Insulation Composite System.

Higher return on investment

The Knauf AQUAPANEL® Exterior Wall offers gains in practical usable interior space compared with brick and block thanks to thinner wall constructions. As a consequence, room net gains of up to 8% can be achieved.* Rental and selling potential is increased enabling a higher return on investment (ROI).

Potential savings/lower investment costs can also be achieved based on material and labour costs. The share of these costs with regard to the total cost of the building is lower related to the Knauf AQUAPANEL® Exterior Wall than for its equivalent in traditional masonry.

Lower weight (up to 75% less) means a cheaper load bearing structure is possible than can be achieved using brick and block.*

Faster return on investment

As an innovative system based on drywall technology, the Knauf AQUAPANEL® Exterior Wall enables faster construction – time savings of up to 27% can be achieved to the end of surface finishing stage* compared to brick and block. So the building can be sold or rented sooner, bringing faster return on investment (ROI).

* Figures based on comparisons pages 12-14.

Actual values depend on the type of construction.



Better economy

Comparative calculation for an average office building



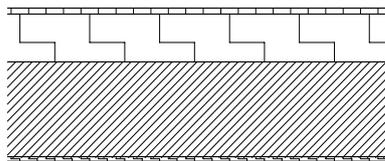
Here the construction of a three storey office building is analysed and comparisons are made between traditional masonry construction and drylining using the Knauf AQUAPANEL® Exterior Wall system.

These comparative calculations, prepared by Prof. Dr.- Ing. Architect Bert Bielefeld of the University of Siegen, Germany, reflect issues in the real estate industry such as investment, costs, construction period, building site logistics and building maintenance over the life cycle and profitability of the building.

The case study shows how the Knauf AQUAPANEL® Exterior Wall is delivering tangible benefits to investors and architects.

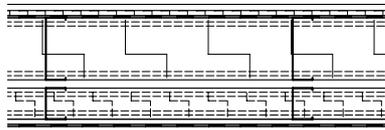
The three systems compared

Note: all systems have a U-Value of 0.23 W/m²K.



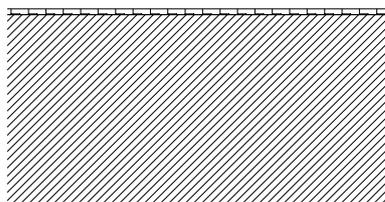
System 1

Honeycomb masonry and ETICS + render



System 2

Knauf AQUAPANEL® Exterior Wall + render



System 3

Insulated honeycomb masonry + render

Space gains plus increased rental potential

Basis of calculation

	Floor surface m ²
Gross closed floor surface	3,441.00 m ²
Lost space due to corridors, lifts etc. which cannot be rented	206.37 m ²
Interior/separating walls in building	134.97 m ²
Net floor surface excluding exterior wall (1)	3,099.66 m²

Space gain

	Wall thickness (m)	Length of exterior wall (m)	Floor surface area of exterior wall (m ²) (2)	Surface for rent (m ²) (1-2)	Floor space lost (m ²)	Loss of space (in %)
System 1 Honeycomb masonry and ETICS + render	0.39 m	446.22 m	171.79 m ²	2,927.87 m ²	37.92 m ²	1.30%
System 2 Knauf AQUAPANEL® Exterior Wall + render	0.30 m	446.22 m	133.87 m ²	2,965.79 m ²	0.00 m ²	0.00%
System 3 Insulated honeycomb masonry + render	0.52 m	446.22 m	232.03 m ²	2,867.63 m ²	98.17 m ²	3.42%

The calculation shows that this office building built with a Knauf AQUAPANEL® Exterior Wall system offers space gains when compared with traditional building systems.

Potential rent increase

	Rentable area (m ²)	Rental income per year (based on 10 €/m ² /annum)	Loss of potential rental income (€)	Loss of potential rental income (in %)
System 1 Honeycomb masonry and ETICS + render	2,927.87 m ²	351,343.84 €/m ²	4,551.44 €	1.30%
System 2 Knauf AQUAPANEL® Exterior Wall + render	2,965.79 m ²	355,895.28 €/m ²	0.00 €	0.00%
System 3 Insulated honeycomb masonry + render	2,867.63 m ²	344,382.80 €/m ²	11,779.68 €	3.40%

The calculation shows that this office building type with a Knauf AQUAPANEL® Exterior Wall system generates up to 3.4% more rent when compared with traditional building systems, due to the space gained inside the building.

Case study:

**Project: Residential housing - WHA
Attemgasse 5, in Vienna, Austria**



The total gain effective area here is: 70 - 80 m², approx. 2.4%, calculated by Peter Raab of Baumschlager Eberle, who commented:

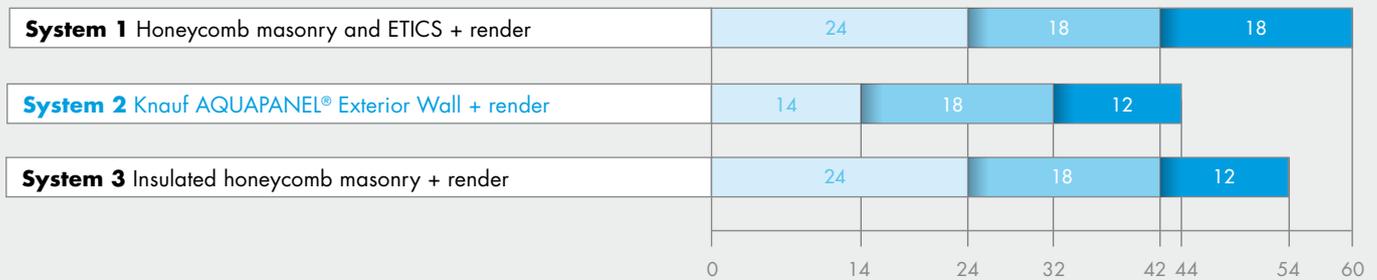
**“That’s an extra apartment.
I am convinced that this is the
future of residential housing!”**

Source: Baumschlager Eberle, architectural office.

Better economy

Faster construction times

Construction time in days



The calculation shows that the Knauf AQUAPANEL® Exterior Wall can be built 10 days faster, which equates to an 18.5% time saving up to the building envelope stage. In total, up to 26.7% time saving can be achieved up to the end of the render stage.

- Construction of steel/concrete substructure and exterior wall
- Installation of windows
- Rendering – and installation of ETICS for System 1



Case study:

**Project: DELTA Stahl
administrative building –
Barsinghausen, Germany**



Lower investment costs

Exterior wall material plus labour costs*

Façade	Percentage of total cost of building (in %)
System 1 Honeycomb masonry and ETICS + render	3.32%
System 2 Knauf AQUAPANEL® Exterior Wall + render	2.50%
System 3 Insulated honeycomb masonry + render	3.00%

In this example, conventional exterior walls account for up to 3.32% of the construction materials plus labour cost of the building (values differ depending on type of construction). The Knauf AQUAPANEL® Exterior Wall system material and labour costs represent only 2.5% of total costs which equates to up to 25% savings when compared directly with conventional construction.

* Calculations are based on BKI construction costs part 2 (Building Cost Information Centre German Chamber of Architects) and use actual market prices.

Thanks to the Knauf AQUAPANEL® Exterior Wall, the building was completed within 6 months.

The final construction was calculated as having between 4 and 10 times less wall weight (calculated on assumption of constant U-Value for the Knauf AQUAPANEL® Exterior Wall and different traditional building methods).*

Calculating the effective area shows that a gain of 3 – 8.4% could be achieved.

*Note: The example and comparison from the office building in Barsinghausen, Germany refers to the following defined traditional building methods: lime sand brick, honeycomb brick, aerated concrete, site-mixed concrete and precast concrete.

Study by Klaus-Michael Hessler, intago GmbH, commissioned by Knauf Aquapanel GmbH & Co. KG.

Sustainability



The Knauf AQUAPANEL® Exterior Wall offers better environmental performance and lower CO₂ emissions compared with conventional building techniques.

Primary energy reduction

- On average, a Knauf AQUAPANEL® Exterior Wall system is 25% thinner than brick and block construction with the same U-Value. The space can be used for additional thermal insulation, decreasing the demand for primary energy for heating and cooling*
- A Knauf AQUAPANEL® Exterior Wall system has approximately 30% of the material mass per m² of wall area compared to conventional brickwork construction. (It has approximately 25% compared to concrete construction.) This results in a primary energy requirement in the material manufacturing process up to 50% lower than for traditional building methods

Lower CO₂ emissions

The comparative calculation shows that CO₂ output in material production for a Knauf AQUAPANEL® Exterior Wall is reduced by approximately 30% per m² of wall area compared with a similar brick and block wall.

	CO ₂ / m ²
System 1 Masonry and ETICS + render	30.40 kg
System 2 Knauf AQUAPANEL® Exterior Wall + render	21.33 kg
System 3 Lightweight clay bricks + render	40.20 kg

* Figure based on comparison on page 8.

Reduced use of natural resources/less pollution

- The reduced building mass of the Knauf AQUAPANEL® Exterior Wall saves on natural resources during the manufacturing process and contributes significantly to sustainable construction
- Lower transport and energy costs due to lighter weight
- Water savings due to drywall construction on job site
- Dismantling/recycling is easier at the end of the life cycle: waste can be separated by type of material so the volume of waste is reduced and the degree of recycling is higher

1. Environmental System Certificate

The Knauf AQUAPANEL® Exterior Wall is certified for sustainable building by the WESSLING engineering company. The Environmental System Certificate describes the energy performance with regard to primary energy demand and CO₂ emissions. It is set up to improve the development of environmental and healthy

 building. The Environmental System Certificate is based on data and



calculations for the Life Cycle Assessment (GaBi); equivalent to the Life Cycle Assessment procedure for Environmental Product Declarations (EPD) according to ISO 14025, Type III.

2. Environmental Product Declaration (EPD)

AQUAPANEL® Cement Board Outdoor and AQUAPANEL® Cement Board Indoor are registered for sustainable building at the Institute of Construction and Environment (IBU) under the declaration number



EPD-KNA-2010111-D. The Environmental Product Declaration is developed according to ISO 14025, Type III.



3. Certificate for Building Biology

AQUAPANEL® Cement Board Outdoor and AQUAPANEL® Cement Board Indoor are 100% waterproof and completely inorganic, so there is no risk of mould or mildew. They meet the highest requirements for a safe and hygienic environment inside the building – as



certified by the German Building Biological Institute Rosenheim (IBR) in report number 3006-214. Knauf Gypsum Boards are also certified by the German Building Biological Institute.

4. Blauer Engel for Knauf Insulation materials

Products from Knauf Insulation are certified for environmental friendliness and are free from hazardous substances. Many glass mineral wool insulation materials based on the formaldehyde free bonding technology ECOSE® are registered at the Blauer Engel.



Building physics advantages

Case study:

**Project: Municipal building
Supreme Administrative Court of
the Republic of Bulgaria, Sofia**



An additional floor was added at the top of the building without the need for reinforcement of the primary building structure due to the lightweight construction. It was possible to retain the style of the original façade.

The construction timeframe from planning to building completion was only 7 months and there was no disruption of normal business.

A Knauf AQUAPANEL® Exterior Wall offers performance advantages when compared with conventional building techniques.

Physical characteristics

- Fire resistance 30-120 minutes; non-combustible components (Building material class according to EN 13501: A1 non-combustible); the Knauf AQUAPANEL® Exterior Wall fulfils legal requirements in all areas
- Sound insulation: 61 dB is easily achievable with a weight of 69 kg/m². And because it's an integrated system, only one component needs to be changed to achieve better acoustic insulation
- Thermal insulation: 0.20 W/m²K at a thickness of only 22 cm, compared with a minimum of 34 cm for blocks plus 16 cm insulation

Fast and simple refurbishment

- Existing façades can be replaced with a Knauf AQUAPANEL® Exterior Wall without the need for reinforcement of the primary building structure due to the light weight
- Curtain wall construction offers the possibility to include additional thermal insulation or to improve aesthetics with a fresh new appearance
- Easy retrofitting is possible when the functionality of the building needs to be changed. Dismantling and installation are fast. Changes to the floor plan or the fire and sound protection concept, as well as additional storeys, can be quickly and easily carried out

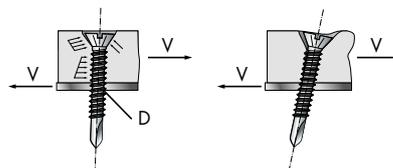
Superior seismic performance

The Knauf AQUAPANEL® Exterior Wall system is ideal for earthquake zones because of its low dead weight. Lightweight structures have a lower risk of failure and less potential for damage in the case of failure. In the event of an earthquake, redevelopment and repair can easily be carried out.

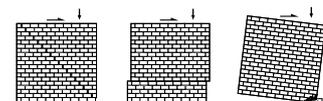
Because steel supporting structures display ductile load-bearing behaviour, they are the first alternative for the loads occurring during an earthquake. In the case of dynamic loads, the energy that is present is dissipated. In addition, there is reduced intrinsic stress perpendicular to the plane of the component and a lower risk of damage/injury.

	Masonry infill	Drylining infill
Dead weight (kN)	8107	6160
Behaviour factor q	2.0	4.0
Earthquake load on base point (kN)	2919	1109

The Knauf AQUAPANEL® Exterior Wall is stable both “in-plane” and “out-of-plane”. The contribution of the screw connection to the ductility of the lightweight construction system can be seen here.



Result: Trials have shown that, due to the positive deformation behaviour and the ductility of the lightweight construction, the force on the conventional wall is 3 times higher in comparison. This is due to the higher weight and stiffness of brick and block wall.



Case study:

Project: Seismic trial –
Athens, Greece



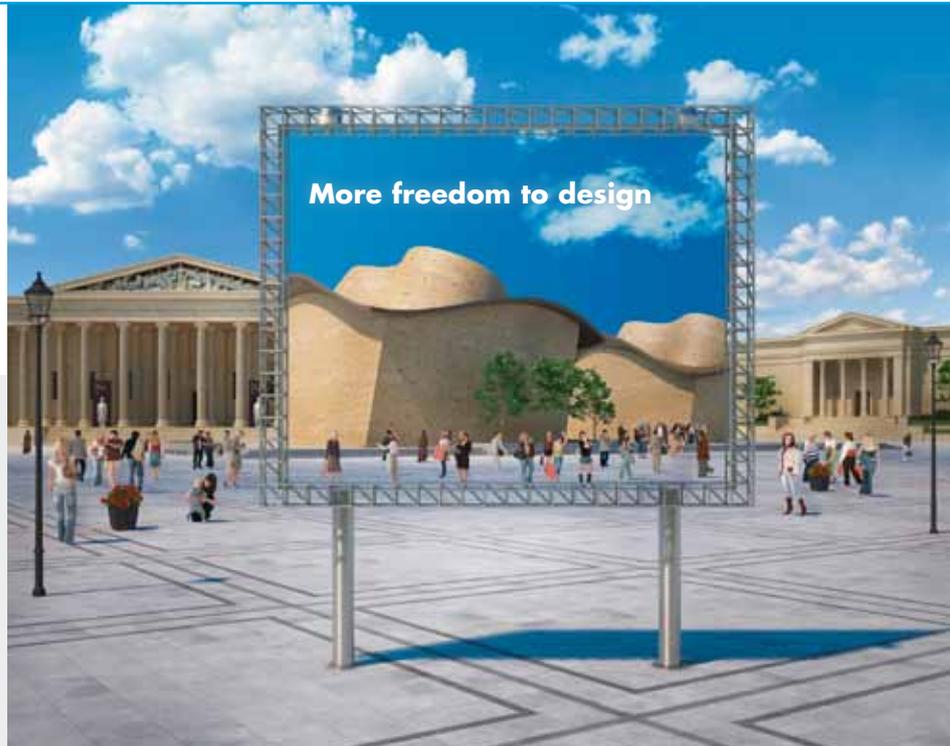
A complete two-storey lightweight house was created on a steel structure using a Knauf AQUAPANEL® Exterior Wall.

The house was subjected to rigorous tests:

- Low amplitude sine-sweeps in X-, Y- and Z- directions
- Bi-axial earthquake loading: 100% in horizontal and 70% in vertical direction
- Tri-axial earthquake loading: 100% in both horizontal and 70% in vertical direction
- Peak ground acceleration trial with force of 1 g

With no damage to the structure or façade at even 1 g acceleration, the Knauf AQUAPANEL® Exterior Wall was proven as the alternative to masonry in seismic zones due to its light weight, its high ductility, and its high resistance to out of plane motion.

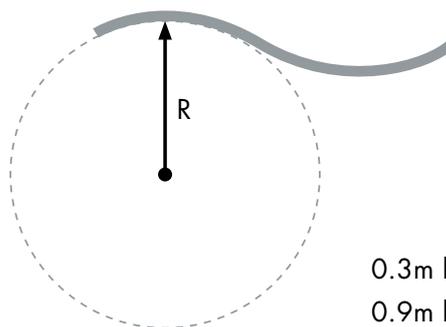
More freedom to design



The Knauf AQUAPANEL® Exterior Wall system enables exciting new designs for all types of exterior applications.

Curves possible

The Knauf AQUAPANEL® Exterior Wall can be easily bent dry on site to create convex or concave wall shapes. Dome constructions and arches can also be created.



0.3m board width  $r \geq 1 \text{ m}$
0.9m board width  $r \geq 3 \text{ m}$

Range of finishing options

A perfectly smooth design option without visible joints can be created for large areas.

What's more, almost any finishing is possible to add colour, style and character to your building project.

Case study:

**Project: Boom shopping mall,
Athens, Greece**



Knauf AQUAPANEL® Exterior Wall offers alternative solutions, for example, blind façades. The Boom shopping mall in Athens, Greece is a memorable landmark with an eye-catching appearance that makes a powerful corporate statement, thanks in part to its blind façade.



Knauf AQUAPANEL® Exterior Wall

Innovation without risk

The Knauf AQUAPANEL® Exterior Wall system offers a choice of design options, finishes and effects.

Monolithic façades with render



Residential housing, Senigalia, Italy



Art Museum, Kerteminde, Denmark

Building envelope behind decorative covering



Klimahaus 8° Ost, Bremerhaven, Germany



Construction company premises, Hoewelaken, The Netherlands



Altes Theater, Dessau, Germany



Adam & Eve Hotel, Antalya, Turkey



Acropolis Museum, Athens, Greece



John Deere Showroom, Madrid, Spain

Knauf AQUAPANEL® Exterior Wall

Innovation without risk

Curves



Cornelia Diamond Resort, Antalya, Turkey



Elounda Beach Hotel, Crete, Greece

Top up/additional floor



Supreme Administrative Court of the Republic of Bulgaria,
Sofia, Bulgaria



Sheraton Hotel, Sofia, Bulgaria

Support from start to finish

Knauf is committed to supplying superior, innovative technical solutions and delivering high levels of service.

Our consultants will work with you to make sure your project gets off to the best possible start.

We can help you to develop individual system recommendations which save costs and reduce risk. These may include system demonstrations, on-site product prototype testing and consultations.

Thanks to our state-of-the-art factories and local stocking in regions, you can get just-in-time delivery and ready access to building materials at short notice – an important consideration when the construction schedule is tight.



The Knauf AQUAPANEL® Exterior Wall is a unique system with many proven advantages.

When you specify it, you get more than a high performance wall ... you get the expertise of an organisation dedicated to helping you realise your ideas.



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AQUAPANEL®

AQUAPANEL® is a technologically advanced building system. Because it's a system, it involves clear step-by-step process from design idea to project completion. AQUAPANEL® cement board panels, accessories and services work in unison – you can be certain that your project will all come together as planned.

 www.AQUAPANEL.com

Knauf AQUAPANEL® Exterior Wall

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