1. Sound Insulation

The ordinary VHG standard wall (ICF element E01 with Styrofoam / Neopor webs) has a sound insulation value of 43 dB. ICF Element E02 with hard webs (plastic webs) has a value of approx. 53 dB.
Practically there are two types of sound transmission:

- footfall noise
- airborne noise

Styrofoam is well suited for footfall noise. For the insulation against airborne noise, mass is required. This is only provided by solid concrete, less by styrofoam, or aerated /porous concrete. The necessary mass is achieved with a concrete core of minimum 15cm as in all ICF elements. If the concrete core is increased to 20cm, higher sound insulation and fire proof values are achieved. These elements are however usually only used for multi-storey buildings of 6 to 8 storeys.

Looking at a finished VHG wall with hard webs, there is an uninterrupted layer of solid concrete. The finished ICF wall with styofoam webs looks like a mesh or a grid of concrete and/or styrofoam.

Sounds always travels along the path of least resistance. And therefore, sound (approx. 37dB) will usually enter a building through the windows and not through the walls.

2. Fire Safety (excerpt from the ETA)

2.2.3 Essential requirement 2 Safety in case of fire

2.2.3.1 Reaction to fire
Euroclass F, No Performance Determined (NPD).
2.2.3.2 Resistance to fire
With the minimum thickness of the continuous concrete core of 150 mm and minimum concrete strength C16/20 according to Table 1 of Annex C of ETAG 009, the fire-resistance class of walls with polypropylene spacers (continuous type walls) is for:

- load bearing walls **REI 120; (elements E02 and N 21 with hard webs) 120 minutes fire resistance)**
- non load bearing wall **EI 120. (120 minutes fire resistance)**

With the minimum thickness of the grid concrete core of 150 mm and minimum concrete strength C16/20 according to Table 2 of Annex C of ETAG 009, the fire-resistance class of walls with EPS spacers (grid type walls) is for:
- load bearing walls R 30. (Element E01 with Neopor webs) 30 minutes fire resistance

3. Static Engineering

How high can one build with ICF?

This depends on the architectural, static, and geographic conditions of the area. One must always bear in mind that ICF elements act just as formwork for concrete. Therefore all the construction requirements applying to concrete apply here too. Styrofoam has a static / structural value of 0.

Does ICF construction require steel reinforcement?

The structural product of an ICF construction is a concrete construction. Concrete has a high compressive strength but a low tensile strength. Thus, in all places where high tensile forces are expected, steel reinforcement is necessary. This is typically the case in the basement walls and lintels. However, the decision in every particular case is the responsibility of the static engineer.

The reinforcing with steel is facilitated with the grooves in the webbing of all VHG ICFs. In the lintels, it is also very easy to make a reinforcing cage with stirrups and rebars.

Is there a standard ICF static engineering?

No. This is not possible as ICF structurally is only formwork. The structure itself is the concrete core; the static equilibrium of a concrete structure needs to be calculated by a static engineer.

EURO Norm / Eurocode

In all european countries, the Euro Norm / Euro Code is used. Every country also has its own particular norms for the calculation of statics. Attached you can see the table for the calculation of an unreinforced ICF wall (max. height unreinforced = 3,50 m) with our Standardelement (E02, 25 cm fire wall block) and a concrete core of 15 cm. With higher walls or heavier loads on the running meter of walling, appropriate rebarring / steel reinforcement, as with any other concrete construction, is applied. (Attachment PDF: ICF walls_static)

4. weight of ICF VHG blocks

type	elements	measurement	volume in liter	value weight in g/liter	weight in gram	includ-ing plastic web
		in cm				in gram
E01	ICF primary block E 01	125 x 25 x 25	32.02	30	**961**	**1.650**
E02	ICF block with plastic webs E 02	125 x 25 x 25	29.18	30	**875**	
E03	ICF lintel block E 03	125 x 25 x 25	38.99	30	**1.170**	
E04	ICF ceiling element E 04	125 x 25 x 25	26,53	30	**796**	
E05	ICF height compensation element E 05	125 x 25 x 3,5	5.75	30	**173**	
N12	ICF locking piece N 12	16 x 5 x 25	1.86	30	**56**	
N20	ICF primary block N 20	125 x 35 x 25	66.24	30	**1.987**	
N21	ICF block with plastic webs N 21	125 x 35 x 25	60.40	30	**1.812**	**2.520**
N22	ICF ceiling element N 22	125 x 35 x 25	52.59	30	**1.578**	
N23	ICF lintel block N 23	125 x 35 x 25	70.24	30	**2.107**	

5. Diffusion / Condensation / Drying

As a result of the difference in pressure between the air inside and outside, moisture diffuses through the wall construction. Low temperatures in a wall can cause the humidity to reach 100% (condensation point) and the water vapour in the air condenses. Example: Air with a temperature of 20°C and a relative humidity of 50 % condenses at 9.3°C.

It must now be calculated if the condensation water that occurs only in winter can dry up again in summer. According to conventional construction science, the amount of water that evaporates in summer needs to be double the amount that condenses in winter. With the VARIANT-HAUS-System evaporation is 6 times the amount of condensation, even in the coldest of climates, with extremely low winter temperatures. In warmer climates, there is less condensation in winter and as a result, there is less moisture that needs to evaporate in summer.

Cross section of an ICF Wall in the Diffusion Model When respiratory air is passed through the plastic tube, gas bubbles permeate the whole wall. The bubbles also appear in the upper water segment. This is an original cross-section of a 30cm outer wall, with an inner-insulation layer of 5cm, a 15cm concrete core, and a10cm outer-insulation styrofoam layer.

Do outer walls need to be breathable?

If a wall is constructed properly, crack-free etc. there is no exchange between the air inside and outside. In this regard, there is no difference between walls made of conventional materials such as wood or brick, and walls of concrete or steel. The necessary exchange of air, occurs via windows or vents.

It is also advantageous and desired that the inner wall surface can absorb water / moisture. This allows for an long term equilibrium in humidity. This is sufficiently provided by wallpapering, untreated wood, textile surfaces. Thus, water vapour absorption is not normally an issue in ICF buildings.

The drying of the concrete

The physical properties of Neopor (being waterproof, and yet breathable) often lead to some confusion and misunderstandings. The crucial factor when it comes to the drying of concrete is the breathability. The diffusion resistance of Neopor® (µ 40/100) is much lower than that of normal concrete (µ 70/150). Moisture dies through Neopor® Material similarly as it does through a normal concrete wall.