



Clayworks

HEALTHY BUILDINGS DATA

Natural Clay Plasters



INTRODUCTION

Clayworks was born from a love of nature and belief in natural, sustainable building practices. It was the result of over a decade of building and restoring with natural materials, travelling the world to learn about the traditions of clay as a building material.

The company has always believed in design being holistic and respectful of the needs of people and planet. We understand that buildings are a leading contributor to greenhouse gas emissions and our mission is to create materials that can do less harm, release less carbon and that are healthier. All of our clay plasters have an Environmental Product Declaration, a Health Product Declaration and Low VOC Emissions Certificates.

From our workshop in Cornwall, Clayworks manufacture readily available, affordable and easy to use natural clay plasters for interiors.



CLAY PLASTERS

Clayworks clay plasters are unique blends of unfired clays mixed with minerals and natural pigments to provide a healthy, breathable finish for interior walls and ceilings. They are a more sustainable alternative to gypsum plaster and paint, supplied ready to mix with water and be applied with conventional plastering tools and skills.

Clay plasters are natural and non-toxic, with extremely low VOC emissions and no synthetic, concrete or lime additives. Made from readily available, naturally abundant materials, they require no processing, only blending. During the manufacturing process very little energy is required, no water is used, and there is zero waste produced.

Amongst the most sustainable wall finishes available, clay plasters are recyclable, repairable and compostable. They allow buildings to breathe, attenuate acoustics and help regulate humidity and temperature.

Clayworks clay plasters offer high-performance with low environmental impact.

Clayworks clay plasters ...

- ... only release trace VOCs and no polymers or oils*
- ... are non-toxic and inert*
- ... are breathable*
- ... are passive regulators of interior humidity*
- ... are compostable for safe disposal*
- ... are beneficial for internal comfort*
- ... are available with an EPD + HPD*
- ... are produced in the UK*

Clayworks

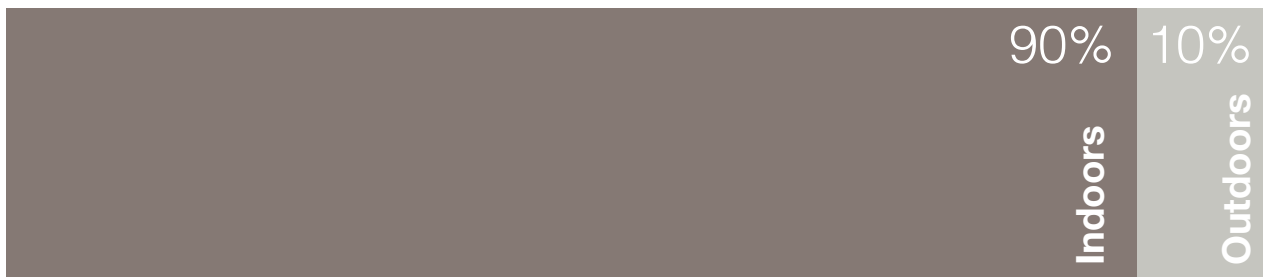


HEALTH & WELLBEING

Clayworks believes that the health and wellness of people and planet should be at the centre of all design and construction activities.

It is well recognised that we are affected by the quality of our environments both in mind and body. Spending as much as 90% of our time indoors¹ it is clear that the design of our interiors has a significant impact on the quality of our lives.

Time spent:



Clayworks clay plasters can play a role in creating healthy and happy spaces.

- They are inert, non-toxic and release only trace VOCs to the air
- They are breathable and moisture buffering reducing the probability of condensation, damp or mould
- They are aids in a comfortable interior environment helping control sound, light, humidity and temperature
- They create a natural and welcoming environment



INDOOR AIR QUALITY (IAQ)

Nothing is more essential to our health than the air we breathe. Unfortunately the air inside many buildings is hazardous to our health. Within our homes the concentration of harmful chemicals is frequently two to five times higher than is found outside². It is estimated by the Royal College of Physicians that in Europe indoor air pollution causes or contributes to the death of 99,000 people every year.³

Less crucially, poor IAQ has a negative impact on our general wellbeing. The World Green Building Council found that productivity can be increased by 8-11% as the result of better quality air in workplaces.⁴

Produced with natural materials, breathable and emitting only low VOCs Clayworks Clay plasters help create good indoor air quality and a healthy environment.



VOLATILE ORGANIC COMPOUNDS (VOCs)

A major cause of poor indoor air quality are the hazardous chemicals that are emitted from many building materials. The main group of chemicals of concern are known as Volatile Organic Compounds (VOCs), these include formaldehyde, benzyne, naphthalene and many other toxic chemicals. Prevalent in adhesives, coatings, composite woods and paints, VOCs are linked to a number of illnesses and are harmful to human health at extremely low concentrations.⁵

Products containing VOCs should be avoided wherever possible, and forward thinking designers are adopting what is known as the precautionary principle⁶. If there is concern over the health of a product, why take the risk when good alternatives are available?

It is a requirement of Building regulations approved document F that the VOC concentrations in a space are kept below safe levels ($300\mu\text{g}/\text{m}^3$). Additionally a number of credits are available within environmental rating systems BREEAM, LEED and WELL for minimising the release of VOCs from materials. VOC emissions specifications in LEED EQ credit "Low -Emitting Materials" for LEED projects globally: The requirements of LEEDv4 and LEED v4.1 BETA (February 2021): CDPH-IAQ (California Department of Public Health (CDPH) Standard Method v1.2 – 2017); and a TVOC below $0.5\text{ mg}/\text{m}^3$ in both office and class room.

VOC content specifications in LEED EQ credit "Low-Emitting Materials" for LEED projects globally:

The requirements of LEED v4 and LEED v4.1 BETA (February 2021): South Coast Air Quality Management District (SCAQMD) Rule 1113 (2016) for Trowel Applied Coatings having a VOC content below 50 g/l.

Environmental rating scheme credits relating to VOCs



Clayworks Clay plasters surpass the requirements for all of these credits.

Reducing VOCs from other sources

Clayworks Clay plasters emit only trace VOCs. They also have the potential to reduce the VOCs present in the air from other sources. It is shown that higher relative humidity within spaces increases the emission of VOCs into the air, particularly formaldehyde⁷. Clay plasters ability to regulate humidity within interiors reduces VOC emissions from other materials within the building. Clay plaster's moisture buffering properties are discussed in greater detail over the page.

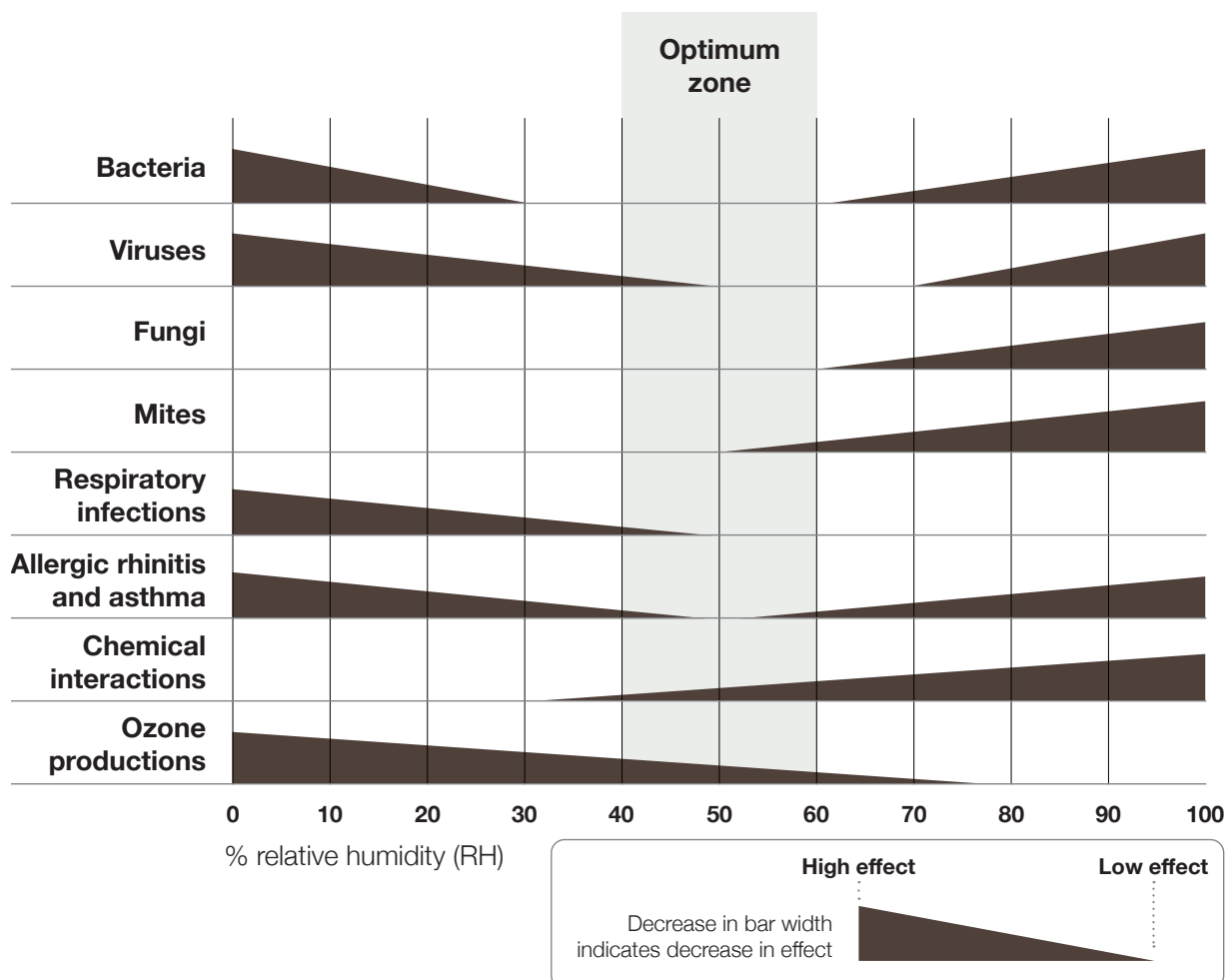
Studies have also demonstrated that clay plasters can remove harmful VOCs from the air, particularly ozone, actively improving indoor air quality and reducing the risk of respiratory illness.⁸

BREATHABILITY – MOISTURE AND HUMIDITY REGULATION

Another cause of poor indoor air quality is hazardous mould, fungi and microbes resulting from condensation and damp. An excess of moisture within buildings creates the conditions for the growth of many harmful biological substances such as mould, fungi, bacteria and viruses. As stated previously, an elevated relative humidity also increases the release of VOCs from other materials.

To achieve good indoor air quality it is important to regulate relative humidity. It has been demonstrated that by maintaining relative humidity between 40 - 60% the majority of adverse health effects are minimised.⁹

The graphic below produced from the research paper 'Arundel, V.A. - Indirect Health Effects of Relative Humidity in Indoor Environments' shows the reduced occurrence of a range of pathogens and illnesses between the 'optimum zone' 40 - 60% relative humidity.



A breathable material, clay plaster is one of the best building materials for maintaining relative humidity within the 'optimum zone' of 40-60%.

BREATHABILITY – VAPOUR PERMEABILITY

There are two main mechanisms of materials that helps regulate internal humidity, 'vapour permeability' and 'hygroscopicity'.

Vapour permeability

Vapour permeability, is a material's ability to allow the passage of water vapour (moisture in the air). Vapour permeable materials prevent the harmful accumulation of moisture within the fabric of a building that leads to the development of damp and mould. This is becoming an increasingly important as the industry pushes for 'air tight' buildings that can cause trapped moisture and the problems associated with this.¹⁰

Using vapour permeable materials allows moisture to travel through the fabric of the building and escape to the outside air. This balances the relative humidity within a space and significantly reduces the risk of condensation, damp and mould.

Clay plasters have excellent vapour permeability and are the most permeable of conventional wall finishes, superior to gypsum, lime and cement plaster, as well as acrylic, alkyd and lime based paints. Using indicative figures from "May, N. (2005) - Breathability: The Key to Building Performance", clay plaster is approximately twice as vapour permeable as lime plaster, and eight times more vapour permeable than lime plaster with a limewashed surface.



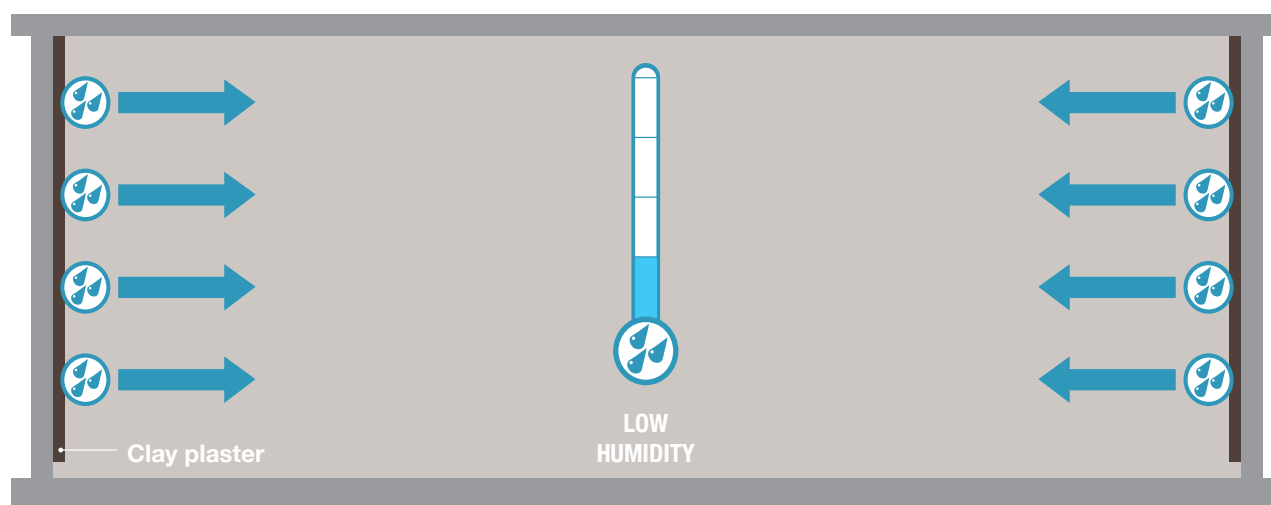
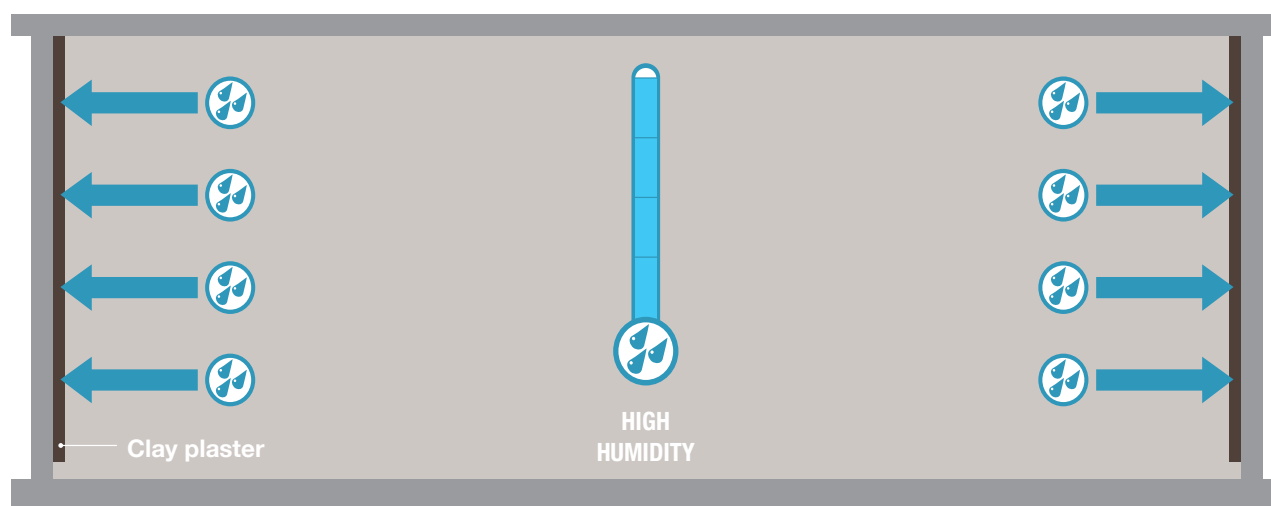
BREATHABILITY – HYGROSCOPICITY

Hygroscopicity

More important than vapour permeability in the regulation of humidity is a materials Hygroscopicity.

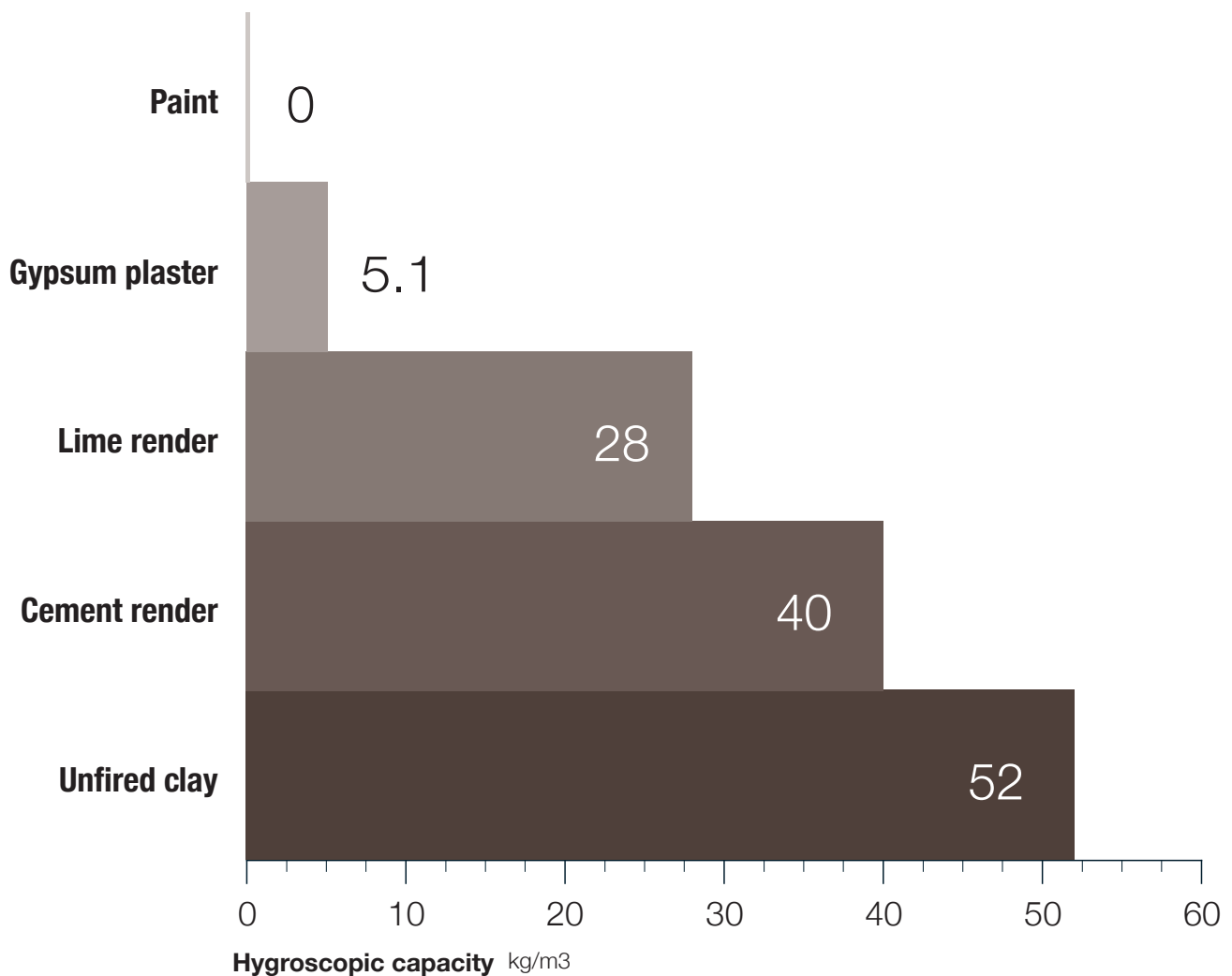
Hygroscopicity is the ability of a material to absorb and release moisture from and to the air. By absorbing and releasing moisture Hygroscopic materials offer a fantastic way of passively regulating the moisture of a space to keep relative humidity within the 'optimum zone' of 40-60%.

Clay has excellent hygroscopic properties, it has a large capacity for absorbing moisture and has an excellent speed of uptake, both important qualities for a material to be able to effectively regulate humidity within an interior space. When relative humidity gets too high clay plaster will absorb the excess moisture and in periods where it becomes too low it will release it.



Unfired clay is one of the best materials available when it comes to moisture buffering. Clay has a hygroscopic capacity that is ten times better than gypsum and almost twice as high as lime plaster. Further the speed at which clay is able to absorb and release moisture is much faster than cement, gypsum or lime.¹¹

Hygroscopic capacity of typical interior wall finishes



Unfired It is important to note that moisture buffering only occurs when hygroscopic materials are in contact with humid air. Therefore gypsum or cement plasters that are subsequently painted have minimal impact on the humidity of a space. In contrast Clayworks clay plaster is a final finish that directly contacts the air allowing it to have maximum impact. "It is evident that by far the most effective buffering for indoor air quality over a 24 hour cycle comes in the first 10mm of the surface of a wall. So this should be the first area to concentrate on" - Neil May

The more clay plaster that is used the more hygroscopic capacity there is, however a build up of 20mm of clay is adequate for the typical daily fluctuations in humidity.¹¹

WELLBEING

Clayworks clay plaster can also contribute to other aspects of well being, ensuring a pleasant space for people to flourish.

Sound - acoustic comfort

Clay plaster helps absorb and dampen sound within a space, and reduces the transfer of sound between spaces to create calm and harmonious interiors.

10mm Clayworks Rustic clay plaster on a clay backing board was found to have a Noise Reduction Coefficient (NRC) of 0.25

Light - visual comfort

Clay plaster's matt surface reflects light in a diffuse manner, softening the light and reduces glare from hard reflective surfaces. Clay plaster can be textured to create a subtle play of light and shadow across the surface, or mica particles can be included to add a little sparkle.

Heat - thermal comfort

Clay has excellent thermal mass properties, with high specific heat capacity and a dynamic rate of change, allowing it to help buffer temperature fluctuations and maintain an even temperature within spaces without the need for additional energy. Thermal comfort is ranked as one of the highest contributing factors influencing overall human satisfaction in buildings, particularly the workplace.

Natural materials - psychological comfort

As well as improving cognitive performance through better indoor air quality, there is a wealth of evidence showing that a connection with nature and natural materials is beneficial for our mental state. The '14 biophilic patterns and the way that they support cognitive performance,' as described in Turner et al. shows that biophilic design the use of the multi-sensory quantities of natural materials such as clay can lower our blood-pressure, improve concentration, memory and make us feel more relaxed.¹²

FUNDAMENTAL MATERIAL SAFETY

Inert and essentially non-toxic, Clayworks clay plasters are fundamentally safe. They release only trace VOCs. They don't contain Perfluorinated Compounds (PFCs), Phthalates (Plasticisers), or Isocyanate based polyurethanes. No lead. No Asbestos. No Polychlorinated Byphenyls (PCBs) and No mercury. They don't require any chemical treatments, flame retardants or preservatives.

Clay plaster requires no special waste disposal. Any waste material may be safely returned to the ground contributing to the Circular Economy.

SOURCES

1. Klepeis NE, Nelson WC, Ott WR, et al. The National Human Activity Pattern Survey (NHAPS): A resource for assessing exposure to environmental pollutants. J Expo Anal Environ Epidemiol. 2001;11(3):231-252. doi:10.1038/sj.jea.7500165
2. U.S. Environmental Protection Agency. 1987. The total exposure assessment methodology (TEAM) study: Summary and analysis. EPA/600/6-87/002a. Washington, DC.
3. Royal College of Physicians (2016) - Every breath we take: The lifelong impact of air pollution
4. World Green Building Council (2015) - Health, Wellbeing and productivity in Offices: The next chapter for green buildings.
5. World Health Organisation (2010) - Guidelines for indoor air quality, selected pollutants.
6. Science and Environmental Health Network: <https://www.sehn.org/sehn/wingspread-conference-on-the-precautionary-principle>
7. Arundel, V.A. - Indirect Health Effects of Relative Humidity in Indoor Environments
8. Darling, E. (2016) Field-to-laboratory analysis of clay wall coatings as passive removal materials for ozone in buildings
9. Arundel, V.A. - Indirect Health Effects of Relative Humidity in Indoor Environments
10. Wooley, T. (2017) Building Materials, Health and Indoor Air Quality. No Breathing Space
11. May, N. (2005) - Breathability: The Key to Building Performance
12. Turner et al. - Creating the Productive Workplace (2018)