Critical **Thinking**

November 2020

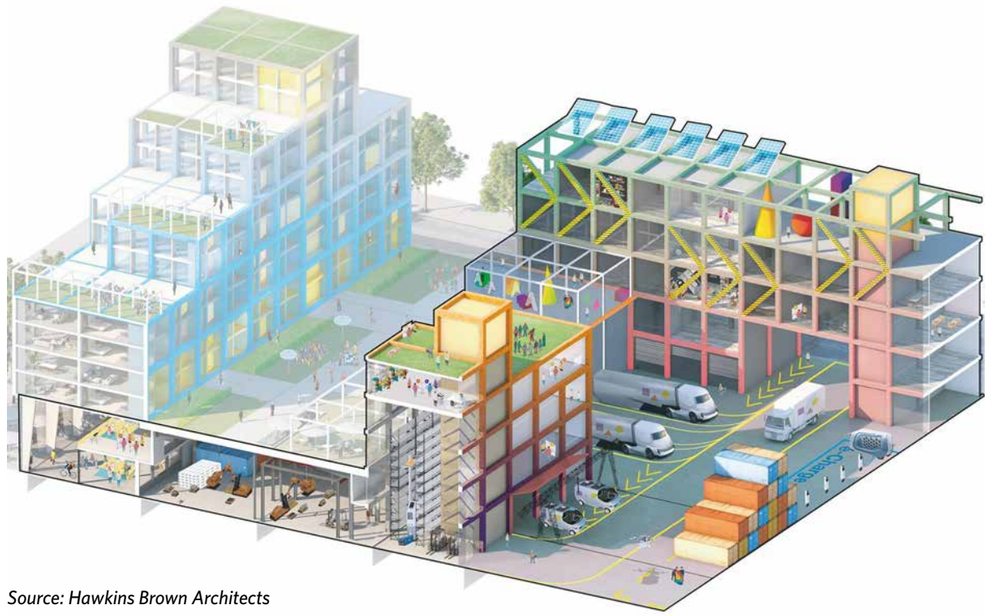
HDR | Hurley Palmer Flatt Group

HDR | Hurley Palmer Flatt Group

Contents

Co-Location, Co-Location, Co-Location

By Peter Watkins, Director, HDR | Bradbook Consulting



Source: Hawkins Brown Architects

Co-Location developments are an emerging trend. Could this be an answer to helping solve the housing crisis, with demand high for both industrial and residential developments? Why not integrate the two uses?

What is a Co-Location Development?

A Co-Location scheme is a mixed development model, where new homes lie in close proximity to other uses, such as light industrial, retail, offices and other classes of use. This paper explores the design and engineering challenges around the integration of industrial and residential developments with a focus on the city of London.

The Demand for Housing & Industrial Space

With limited land availability in London and the emergence of e-commerce over the last 5 years, industrial developers are competing with residential developers for land. As the need for housing and industrial space in cities grows, we're starting to see the two sectors merge to explore opportunities on how Industrial and residential can co-exist and operate harmoniously.

Consolidation, intensification and co-location of uses, to grow and retain industrial space is supported by the new London Plan. Landowners in London are therefore considering the consolidation of assets to maximize land value, exploring the viability of co-location developments with multiple uses, looking to either refurbish to free up lettable area, demolish in part or whole to accommodate other uses.

The population in London has grown 7.5% in the last 5 years to an estimated 9.3m and it was predicted to grow by a further 5% in the next 5 years. A recent report for the British Property Federation by Turley estimated that on average in the UK, 69ft2 of additional storage space is required for every new home built. With the government targeting to build circa 65,000 new homes in London this equates to approximately 4.5 million sqft of new warehouse space needed, an area approximately the size of 330 Olympic swimming pools.

These population predictions were made pre-COVID-19. The impact on how and where we work in the future is likely to change radically as we negotiate our way through this pandemic. This could potentially lead to London's population contracting in the next few years as more people are able to work remotely from outside of Central London.

However, there will undoubtably still be a requirement for additional storage space to augment new housing.

Consumer behaviour is evolving and there is an increasing demand for last mile logistics as retail trade is increasingly being driven by e-commerce. The Office for National Statistics survey findings show that 20% of all retail sales are currently online and this is predicted to continue to grow over the coming years.

The Impact of COVID-19

In addition, the COVID-19 pandemic has accelerated the growth of e-commerce. With shops temporarily closed and the public on lockdown, shoppers have been forced to turn to on-line shopping. This trend is likely to continue in the future as peoples buying habits change.

Many of the elder generation are having to use technology enabled services for the first time, such as online food shopping and communication tools like, Microsoft Teams and Zoom. As this generation becomes more comfortable with technology their behaviours are likely to change permanently and many of them will continue to use these services when the pandemic passes. This will further accentuate the growth in urban logistics hubs.

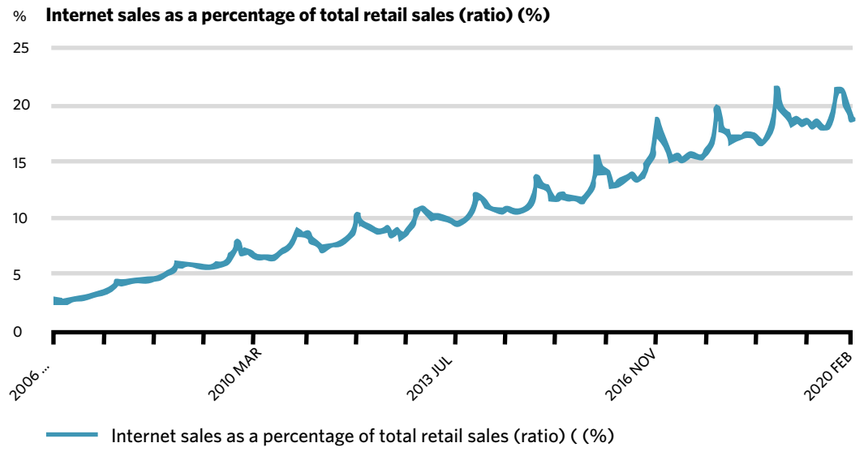
Before the global crisis of COVID-19, CBRE predicted that e-commerce will represent over a third of all retail sales by 2040. This additional growth predicted above will require more and bigger warehouses in cities.

Co-Location Design Challenges

Over the last few years of my career I have been involved with assessing the structural viability of building high-rise residential apartments over a multitude of different uses. From supermarkets and batching plants to bus garages, railways and industrial warehouse units. Each site is different and has its own unique set of design challenges and constraints.

Based on my experience I list below the key technical challenges to be overcome by the design team when designing and assessing the viability of an Industrial/ Residential co-location development;

- How do you blend, integrate/separate the facades between each use?



Source: Office for National Statistics

- How do you maximize the operational efficiency, without compromising other parts of the development?
- How do you incorporate amenity space & landscaping, whilst keeping weights to a minimum?
- How do you provide separation for pedestrian safety without compromising the operational use?
- How do you provide adequate fire protection, ensuring safe evacuation measures are in place for the residents and operators?
- How do you mitigate the noise & potential vibrational effects generated by the industrial use, to limit the impact on residential apartments to within acceptable limits?
- How do you manage the increase in traffic flows and provide separation between the residential and industrial uses?
- How do you achieve the government/local authorities targets for reduced greenhouse gas emissions and net zero carbon?

Co-Location Engineering Challenges

In collaboration with the design team the structural engineer has a fundamental part to play in the resolution of all these key technical factors. The primary role of the engineer is to design the most efficient structure that maximizes flexibility and minimizes complexity, whilst meeting the client's objectives.

The structural engineer must determine what the most economical framing system is? How the structure will resist lateral forces, such as wind and how it will safely transmit the high building loads to the foundations, whilst ensuring that all the site constraints are taken into consideration.

Most Industrial type buildings are typically constructed with a steel frame due to the need for clear internal spaces, resulting in long span structural elements. The lateral stability is usually provided by a combination of cross braced bays and portal frames. However, in contrast to industrial buildings, multi-storey residential buildings are typically constructed with a reinforced concrete frame, with flat slabs and blade columns. The spans between columns are relatively modest and columns can be hidden within party walls. Lateral stability for this type of development is usually provided by reinforced concrete lift/stair core walls. A concrete frame solution offers benefits over other materials in terms of its inherent thermal mass, fire protection, robustness and acoustic performance.

Thus, when these uses are combined, the most efficient structure is not that obvious and the result in theory might be a hybrid steel and concrete framed structure. However, combining materials introduces additional complexity in the design and in particular how the materials connect.

The interface between two materials is likely to occur at a transfer structure over the industrial space. Transfer structural elements supporting multi-storey residential apartments over long span industrial spaces can be significant in terms of size and cost. It is important when assessing the possible solutions to consider all viable forms of construction. Not just the materials cost, but also buildability, material weight, programme and the distribution of services.

Close collaboration with the Architects is essential to co-ordinate the interfaces between the uses to minimize the extent of any transfer structures. The recommendation to avoid unnecessary complexity and cost is to align the structural cores resisting lateral forces up through every floor.

The extent of columns within the industrial floor space must be carefully coordinated with the architects and will be limited to maximize flexibility of use of the floor area, and to allow for HGV circulation and storage.

The magnitude of loading on the vertical elements is also significant, (mega newtons rather than kilo newtons). Consideration should be given to use of high strength materials and lightweight materials, lightweight facades, polystyrene void formers in landscaped areas and lightweight floor build-ups.

Façade structure interaction is another technical factor, it's important to minimize the weight of the façade system, this will assist in reducing deflections on the slab edge, and more importantly it reduces the column loads. This in turn limits the effects of compound deflection on transfer beams supporting these columns.

Vibration Impacts on Co-Location Developments

Other technical challenges include structure borne vibration, generated by the industrial operations. This is a potential risk to the residential occupants and may require mitigation measures. Structure-borne vibration results from an impact on, or a vibration against, a part of a building structure resulting in sound being radiated from an adjacent vibrating surface through the frame.

The main sources of structure borne vibration associated with industrial operations are likely to be:

- Vehicular movements (Vans/HGV's/Forklifts) tracking on the slab.
- Vibration of mechanical plant systems attached to the structure.
- Vehicular/accidental load impacts on structural columns & walls.
- Accidental impacts from dropped objects (pallets/containers) on the structure.
- Gantry Crane movements.

To determine the magnitude of these potential vibration sources a detailed vibration modelling assessment is required during the detailed design phase of the project.

Mitigation measures if deemed necessary would likely entail some form of vibration isolation. The illustration below indicates two typical solutions on how this could be achieved. The relative merits of these options and other potential solutions would clearly depend on the individual constraints of the project.

Co-Location Engineering Impact on Sustainability

Industrial/residential co-location developments by their nature of having complex and heavy structural elements will result in increased levels of embodied energy and carbon, if not efficiently designed.

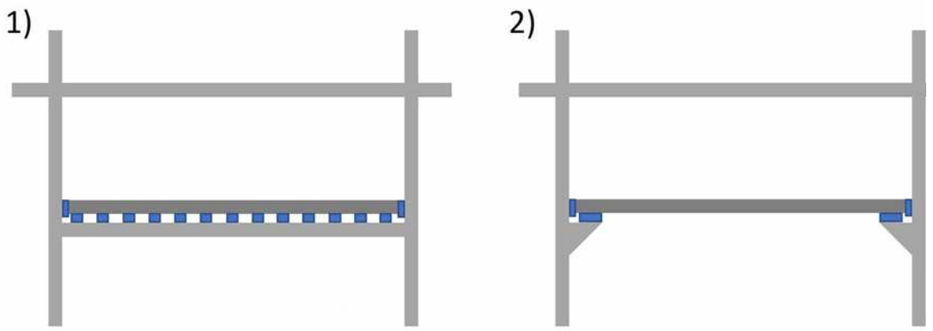
Structural engineers can influence the design to improve the efficiency of a building. The use of light weight forms of construction such as timber or light gauge steel where viable, will minimize the building weight to reduce the extent of concrete foundations or transfer elements. Optimizing structural column grids to achieve thinner slabs, the use of post-tensioned slabs, specifying high-strength materials and recycled aggregates will all result in less concrete being used and a greener, leaner structure.

The future of Co-Location

These are certainly unprecedented times, our industry is currently facing three of the biggest challenges in tackling a global pandemic, driving climate change and BREXIT.

The uncertainty surrounding these unprecedented times has slowed the construction industry. I'm optimistic that as a resilient nation the wheels will keep turning, the future for the mixed development model is bright and this will continue to be driven over the next few years by the demand for housing and the growth of e-commerce.

As technology and e-commerce continue to grow the next big challenge for the Engineer could be multi-storey beds over multi-storey sheds. ◆



Source: Farrat Ltd

Online commissioning service Virtual Cx brings multiple operational benefits

By Stephen Hawkins, Director, HDR | Andrew Reid

COVID-19 has affected all our lives personally and for the majority, professionally. The effect on the construction sector has been dramatic: site numbers are down, and the management of projects and supply chains continues to be a challenge. As a result, we have been required to introduce more rigorous health and safety procedures in the live built environment. This, in turn, means we need to look at how we keep construction work progressing in an efficient and effective way. After all, the sector is a vital part of the economy and we have a responsibility to keep the momentum and maintain jobs. At the same time, we, of course, have to ensure the wellbeing of employees.

The world of building services commissioning has its own set of COVID-19 related challenges. How do we attend Factory Witness Tests (FWT) when there are restrictions on global travel or carry out site duties such as Integrated System Tests (IST) when social distancing is required and there are limited staff allowed on site? For its part, HDR | Andrew Reid has addressed these questions with the development of an online commissioning service, Virtual Cx. This allows for some commissioning activities to be conducted at the supplier's factory or onsite by the construction team, witnessed by HDR | Andrew Reid remotely, online.

While all commissioning activities involve detailed planning, when using the online commissioning service, it brings the pre-planning stage before testing into sharp relief. During the test stage, there should be no need for debate or questioning as any issues should have been resolved beforehand. All test documentation, the test procedure and the online system is in place and agreed prior to any virtual test being witnessed. From a practical point of view, all attendees must be familiar with the video call app or computer-based video and have it downloaded to their electronic device prior to witnessing. And any sign up or registration details should also be completed ahead of time too. Completing a practice run prior to the online witness to make sure the Wi-Fi signal is good and ensuring there is sufficient battery power for the device being used are also key steps, as is having adequate lighting for areas in which witnessing will take place.

Prior to the commencement of the witnessing, it's essential that all relevant documentation is issued and available to attendees, including method statements, test sheets, specifications, and drawings. Just as would be the case in the commissioning process pre-COVID-19, there should be an agreed sequence of events for witnessing the plant equipment/system. Ideally, each different system should have an agreed sequence that gets carried out during the virtual witness. For example, fan coil units may require a

Virtual commissioning has many advantages. It enables projects to progress during COVID-19 travel restrictions and indeed reduces travel costs and the environmental impact from travel.

physical inspection of the filter and outside check of the unit, ensuring dampers are marked and then each terminal/grille is measured and recorded. An initial dry run with on-site contractors (Mechanical, Electrical and BMS) to make sure they are satisfied with the procedures of the witness provides additional reassurance. In this way, any potential areas that should be checked can be added to the testing process.

There should be a clear chain of command in terms of communication. The nominated person setting up the video call should also lead the virtual witness, giving clear narration of what is being demonstrated at each event. The principal lead should mute attendees who can instead ask questions via the chat function. Thus, avoiding the pitfall of talking over one another and creating background noise, which can be problematic in virtual chats. Following the acceptance of the system/equipment, the approved test sheet should be issued to all witnessing attendees for signing.

Virtual commissioning has many advantages. It enables projects to progress during COVID-19 travel restrictions and indeed reduces travel costs and the environmental impact from travel. The virtual nature of the process means it's possible to increase the number of people participating. Because of the preparation required pre-witnessing, communication channels are improved for both the on-site team and those joining virtually, especially with the feedback and chat functions. Physical inspections can be achieved with all participants focussed on the same area at once and tests directed by the commissioning lead means everyone can see the same response instantly.

One of the main factors of an online commissioning service is the fact it is recorded. Everyone attending the witness should be advised of this fact. There are a number of advantages to this. Those not in attendance can view it at a later date. Any subsequent queries can be quickly and easily referred to and photos can be taken for evidence and used as time stamps. This is particularly useful for pressure testing and taking pictures of pressure gauges. Crucially, the recordings can form a useful part of training, both for staff who are newer to the business and equally as a refresher for those with more experience. In short, there are many positives to be taken from virtual commissioning in the time of COVID-19 and beyond. ◆

Ventilation And Transmission: HVAC And Adapting To COVID-19

By Adrian Gray, MEP Lead Director, HDR | Hurley Palmer Flatt

Effective heating, ventilation and air conditioning systems have always been part of maintaining a healthy building environment, and with the impact of COVID-19 and the unique way the virus is spread, it has never been more imperative that HVAC plays a vital role in keeping occupants of buildings safe, especially as people begin to return to the office and other commercial environments.

COVID-19 has three known contamination routes. First of all, there is person-to-person transmission, which could be indirect too, if the virus travels from someone to a surface they have touched, which is then touched by another person. Then there is airborne transmission. The British Council for Offices (BCO)'s Thoughts on Office Design and Operation After COVID-19 document talks of large droplets, greater than 10 micrometres, "expelled by sneezing and coughing and in still air, typically within about 2 metres of the infected person." But Dr Linsey Marr, the Charles P. Lunsford Professor of Civil and Environmental Engineering at Virginia Tech, speaking to the New Scientist says that people emit thousands of times more smaller droplets than larger ones. She thinks that it is these ones that infect people with COVID-19. Then there's the third contamination route: faecal to oral whereby particles from the toilet can enter people's respiratory systems when using WCs.

Counteracting COVID-19 transmission in an office environment

First we should look at the methods of transmission and then evaluate methods to counteract them. The risk of the virus spreading from person-to-person can be lessened where there is a focus on smart technology. This begins upon arrival at a building, with the use of touchless entry systems, for instance harnessing facial recognition technology. Once inside, staff could then be directed to an area of the office that isn't already occupied via digital signage or an app. And instead of manually pressing a button, information from the employee's ID pass about which floor they work on can be read by a card reader, activating the elevator.

The risk of the virus spreading from person-to-person can be lessened where there is a focus on smart technology

To dilute airborne contamination, the Chartered Institute of Building Service Engineers (CIBSE) recommends running ventilation systems at a higher flow rate. "This may require changes to C02 set points for both mechanical ventilation and automated windows ," it states in its COVID-19 Ventilation Guidance. In fact, the recent advice from ASHRAE is that there can never be too much clean air, and they have commenced work on recommendations that will quantify the virus related risk in a space relative to the air change rate, with perhaps 10 air changes being good and 2 poor. Interestingly, most of the fan coil and chilled beam systems recently installed provide between 2 and 3 air changes.

Airborne Particles and the need for ventilation

Chinese and American academics looking at outbreaks in the Chinese province of Zhejiang found that airborne transmission of the virus may have taken place in 48.3% of people in a badly ventilated office. Essentially to stop the spread of COVID-19, ventilation needs to be increased and more fresh air needs to be brought in. The risk of contamination via recirculated air can be mitigated with a higher level of filtration such as F9. This is a very fine system that will catch nanoparticles of 70nm but does involve greater energy use to overcome the resistance.

An alternative is to keep these systems on for much longer – typically two hours before people arrive and then two hours after they leave. CIBSE's COVID-19 report also states that, " Recirculation of air within a single room, where this is complemented by an outdoor air supply, is acceptable."

Getting abundant fresh air in the system is key. This could be as simple as just opening the windows. The BCO's report goes so far as to say, "Actively use operable windows and openings to boost ventilation to occupied spaces as much as possible, even if this is at the expense of thermal comfort."

Fan coils and Chilled beams

Getting abundant fresh air in the system is key

The BCO also recommends that fan coils, which recirculate air locally in the occupied space, " should be frequently and thoroughly cleaned and where condensation occurs, drain pans and traps should be maintained frequently to prevent growth of bacteria and mold." It is also a recommendation that HepVo traps are installed on condensate systems that drain into waste pipework. I have seen some research that questions the safety of fan coils due to the air movement that they generate having the potential to distribute virus particles widely throughout an office environment. Occupiers should consider a CFD study as part of their back to work safely plan. As far as chilled beams are concerned, CIBSE says that active chilled beams can be operated as normal, while with passive chilled beams there should be a good supply of air.

I would be interested to see some further research on the performance of underfloor and low level air distribution. The lower velocities and laminar air flow associated with these systems causes less air turbulence, particularly in the zone where air is breathed. This would seem to have an obvious advantage in reducing the risk of virus spread in an office environment.

It is also interesting to consider VAV which has not been used widely in offices since the 90's, primarily because of the space it requires. But this type of 'all air' system can provide a much higher air change rate than fan coil and chilled beam systems. If we can find a way of cleaning the return air, with filtration and other technologies, then a VAV a system would typically provide 8-10 air changes of 'clean air'.

Based on what we currently know and only in relation to the risk associated with COVID-19 I would rate the safety of currently most popular base building ventilation systems as follows

1. Displacement (full fresh air or F9 filters filter providing clean recirculated air)
2. VAV (with cleaned return air using a minimum F9 filters)
3. Passive chilled beams with under floor fresh air supply.
4. Underfloor distribution (ie fan tiles)
5. Active chilled beams
6. Fan coils

Whilst the supply air helps with the dilution of any potential virus particles in a particular space, actually removing them from a space requires a good extract system and it may be that ducted extract systems will become more prevalent. Transmission risk could be substantially reduced by using CFD to position extract points with precision in places where most particles are likely to accumulate.

There are some very encouraging emerging technologies, that might help combat the spread of COVID-19, things to keep a track of include UV-C lighting which can be used to clean spaces or inside ductwork to clean the air, and if used in conjunction with filtration could be extremely effective. You need to take care though as UV-C light is very dangerous if you come in direct contact, quickly burning skin and destroying light sensitive retinas. Japanese scientists have discovered that UV light at a certain frequency can destroy virus particles whilst being safe for humans, whist this is in the early stages of development, it an encouraging example of where technology is being developed to help the fight against Coronavirus.

Something else I see an interest developing in is bipolar ionisation, alternately referred to as cold plasma. Historically this has been used to clean the air in medical and food production applications. Laboratory tests have shown that when ionised air is supplied to a space will eliminate COVID-19 from air and surfaces in a short space of time so has the potential to be used in a wider range of applications. Care should be taken before installing this technology in an office environment as some of the equipment is not designed for this purpose.

While ionisation manufacturers have been concerned about reducing the risk of ozone, some products have been developed in Denmark, and used in occupied spaces for some time, that use minute amounts of ozone to disinfect food processing facilities. These products have been shown to be effective against the SARS and other viruses and this would indicate a potential to eradicate COVID-19 with ozone levels similar to those that occur naturally on a sunny day.

Limits on the amount of ozone that is safe in an occupied space are a new area of research, but a recent standard has been set by the American underwriter's laboratory (UL) with UL2998 setting a limit of 5 parts per billion for certifying air purification products. But this is not yet a standard that has been officially adopted internationally. This is clearly an area that has great potential in the fight against COVID-19 and I would expect that UK research organisations such as BSRIA and BRE will be taking an interest and setting standards for using these new technologies.

Mixed Mode Ventilation

The 'mixed mode' of ventilation will become more commonplace. When it is not high summer, the cooling can be turned off so windows can be opened. This could even eventually replace the familiar sealed building model. This system can happen automatically with sensors, after all, fresh air is good for people: There are several recent examples of this being done successfully, other buildings, such as London Wall Place, have been designed future proofed for 'mixed mode' use to be adopted if this is preferred by a tenant.

Meanwhile, to combat faecal-oral transmission, bathroom extraction fans need to be kept on high and again perhaps running the systems for 24 hours a day. Toilets that automatically shut and touchless flushes can also help to stop the spread of the virus. The same goes for anti-bacterial coatings on bathroom doors. Some of clients are considering motorized doors that are effectively 'touch free'.

Post-COVID-19 Ventilation Strategies

Toilets that automatically shut and touchless flushes can also help to stop the spread of the virus

There is definitely set to be more access to outside air moving forward and there is a strong sustainability argument to be made for this method. However, some of the changes to ventilation strategies being deployed for a post-COVID-19 world will inevitably have some compromises for carbon emissions. If systems are run at a higher rate and for longer, if not continuously, throughout the day then that has implications for a larger carbon footprint, as the buildings become less energy efficient. However, in the middle of a global pandemic, it's a price worth paying. As energy saving methods (thermal wheels and plate heat exchangers) also present a risk, CIBSE recommends that these are bypassed and not used in the current environment. Products are now being developed that could utilise in duct UV C lighting systems to disinfect thermal wheels, this will help to diminish the environmental cost of keeping us safe in out workplaces.

Of course, some of these solutions are temporary but other, smart office elements like touchless versions of door handles, room/desk booking systems (wayfinding) and reception sign-in procedures look set to be with us for the longer term. These all affect the M&E, as well as the architecture and design of buildings. We will overcome COVID-19 but we need to listen to the lessons that we are learning, and some will most certainly become permanent before the next virus that hits the human race comes along! ◆

HDR | Hurley Palmer Flatt Group

HDR | Andrew Reid

HDR | Bradbrook Consulting

HDR | Concentre Consulting

HDR | Hurley Palmer Flatt Group Companies

hurleypalmerflattgroup.com

© 2020 HDR | Hurley Palmer Flatt Group, all rights reserved.