CONSTRUCTING SCIENCE

SETTING GUIDANCE FOR
LIFE SCIENCES LABORATORIES

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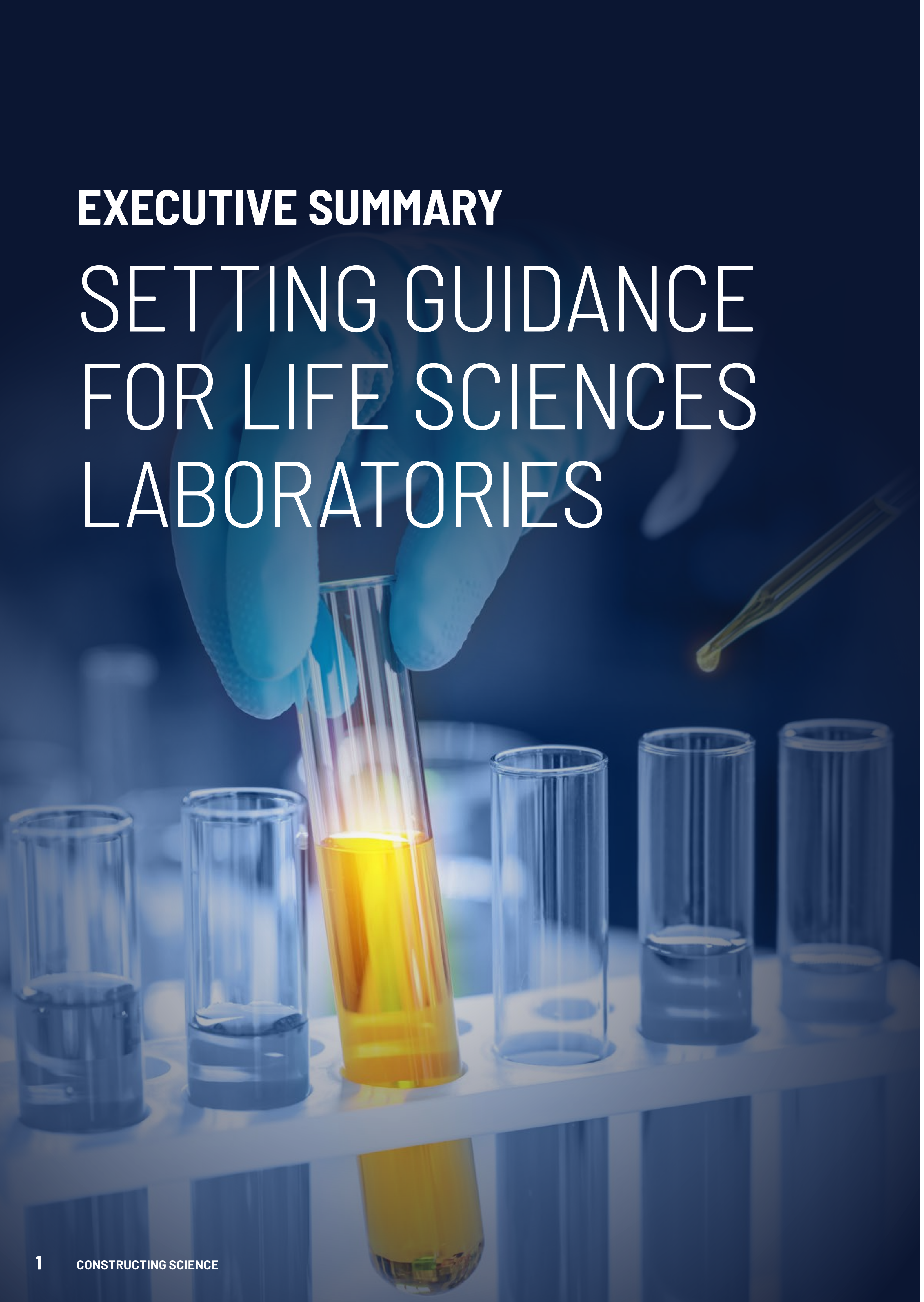
SETTING GUIDANCE FOR LIFE SCIENCES LABORATORIES



The UK has the potential to become the leading global hub for Life Sciences – but a lack of suitable premises threatens to hold the sector back despite the ambitions of corporations, academic institutions and the Government.

There have been several recent major developments aimed at alleviating this pent-up demand – such as the Francis Crick Institute in London's Kings Cross, the White City development in the west of the capital, and a more recent modular development at Canada Water to the east of the city – but demand for lab space continues to grow fast.

As of June 2023, Cushman & Wakefield are tracking over 2 million square feet of active demand for laboratory demises within the Golden Triangle. While edge-of-town science campuses continue to expand, city-centre sites are becoming increasingly sought after by commercial biopharma occupiers, especially when co-located with universities, hospitals and other institutions.

While the UK Government's intention is to establish the country as a Life Sciences superpower, this lack of premises threatens to undermine its plans. Speed is of the essence – but how can organisations be sure that they are designing premises that are suited to the specific needs of life science companies?

The experts behind this report were brought together to address this issue. The founding consortium members – Buro Happold, CPC Project Services, Cushman & Wakefield, EEDN, Gensler, Gleeds, Hoare Lea, MedCity, Mission St and Ramboll – recognised the need for a common language and approach to assist in the Government's vision and enable all the industry players to communicate.

This report provides a guidance to the infrastructure required of lab-capable buildings, and gives decision-makers including investors, developers, planners and real estate companies a common understanding of good practice. It comprises technical design and performance criteria, while combining regulatory requirements with technical recommendations.

It also provides links to a new dynamic model, CONSTRUCTING SCIENCE™, which has been developed and built around a simple and intuitive interface. It is designed to guide the user through a "pathway" of their prospective development options, site/asset credentials and building performance specifications, depending on basic parameters including the required floor space and the type of laboratory required.

While this report is not, and cannot be, a full directory of necessary specifications for the construction of Life Sciences spaces, it is based on a powerful collective experience of designing, developing, operating and working in laboratory facilities.

We hope to see widespread industry adoption of the common language and standards described within this paper, which can only help to alleviate shortage of suitable laboratory space across the UK.

As a consortium we will also aim to periodically update this report and the online model with all relevant and new information.

The Constructing Science Members

"CONSTRUCTING SCIENCE" is a trade mark of the Consortium of Companies – Buro Happold, CPC Project Services, Cushman & Wakefield, EEDN, Hoare Lea, Gensler, Gleeds, Med City, Mission Street, and Ramboll .

FOREWORD

In 2021, the UK Government outlined its ambition for the country to become "the leading global hub for Life Sciences".

More recently, the Government pledged £650m for the sector, bringing together a strategy to increase capacity and incentivise funding.

This ambition is rooted in the existing strengths and potential of the UK's Life Sciences ecosystem – globally leading universities, a highly skilled Life Sciences workforce and the huge potential of the NHS for research. Academic research in the UK leads the way in terms of the proportion of medical sciences publications, which are among the most highly cited in the world, and the UK remains an attractive destination for foreign direct investment in Life Sciences.

This investment is driving growth – exemplified by the expansion of physical space devoted to Life Sciences, often forming organic or planned clusters. When AstraZeneca moved to its new UK headquarters to King's Cross in central London, they joined organisations such as the Francis Crick Institute, Wellcome Trust and University College Hospital.

Elsewhere in London, the White City Innovation District hosts Imperial College London's innovation campus as well as the UK headquarters of Novartis, while providing high-specification laboratory space and incubators for a range of smaller innovative Life Sciences companies, start-ups and spin-outs.

Jo Pisani
Chair
MedCity Advisory Board

Similar clusters of strength in health, Life Sciences and MedTech are developing across the UK.

However, if Life Sciences are to continue to thrive in the UK, companies must have the space to grow and expand. Research by MedCity in 2021 found that, in London alone, more than 20 life science companies were looking to secure at least 345,000 square feet of new highly specialised wet lab space, alongside requirements for over 114,000 square feet of manufacturing space, 22,000 square feet of other lab space, and 63,000 square feet of office space.

Post-pandemic, there has been a rise in the number of Life Sciences dedicated real estate investors and developers entering the UK market. Additionally, asset holders seeking to diversify their portfolios away from workspace and retail asset classes have also entered the sector. To date, many investors, developers, venture capitalists and REIT's have targeted the "golden triangle", with a particular focus on the Ox-Cam arc.

By providing standards that detail the requirements of different forms of health and Life Sciences real estate, this report will play a key role in meeting demand and enabling the continued growth of UK Life Sciences.

1 INTRODUCTION

The Life Sciences sector has been maturing at an accelerating pace in recent years.

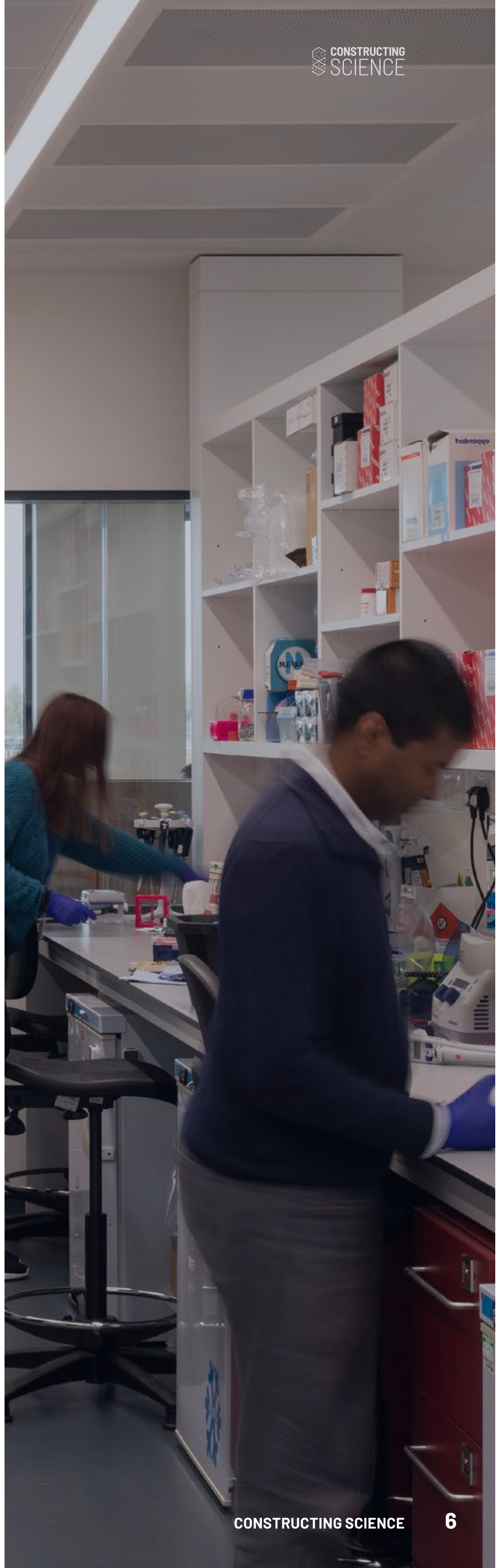
Despite this, however, construction of lab-capable buildings is not standardised and does not benefit from a guidance document to give decision-makers a common understanding of good practice.

This is what we aim to provide with this report and the online Constructing Science dynamic model.

The report does not seek to be a panacea of specifications, or an alternative to seeking professional consultancy from the early stages for the development of a Life Sciences project. The consortium of firms assembled under the Constructing Science banner are some of the most prominent in the Life Sciences sector – including financiers, developers, facility operators, professional design teams and Government think-tanks.

There are many opinions and trends, but we have strived to provide a useful, valuable and convenient baseline tool to enable the industry to have an agreed point of reference. We have written this report in an attempt to start defining the market standard baseline for the construction of science spaces beyond the higher education healthcare and commercial real estate environments.

We believe that creating a shorthand reference point for all parties involved in the development of Life Sciences and sci-tech facilities can only be beneficial to the industry and will allow teams to start conversations with a common nomenclature and understanding of specifications.



WHO IS THIS FOR?

We aimed to make this report less technical and more informational, with highly technical elements kept in reserve for the appendices.

We have also launched an online dynamic model, which can be accessed on **constructingscience.com** with the ability to easily filter relevant data according to a variety of needs. As such, this is an endeavour to help all players in the Life Sciences industry:

OCCUPIERS/END-USERS

To aid in aligning and translating user requirements around design and construction components, and help create an outline user requirement specification (URS) to assist in their search for suitable space. The model should further enable them to understand the market baseline offer better, and allow them more transparency in the selection process;

DEVELOPERS, VENTURE CAPITALISTS AND OTHER INVESTORS/REITS

By providing a point of reference for development specification and a model to quickly assess properties and spaces under consideration, whether for new development or conversion; and

DESIGN TEAMS

By providing a model to define the market baseline, demonstrate the current standards to clients, and to provide an easily accessible 'first point' tool;

LOCAL AUTHORITIES

To assist in defining the market baseline and provide a consistent nomenclature and specification reference, helping in planning determination processes.

KEEPING IT RELEVANT

The success of this endeavour can only be measured by the level of industry adoption.

Our first target is the adoption of a common nomenclature and guidance. It is important to make it as accessible as possible and to ensure that the online model is launched at the same time as the report, aiding in the widespread adoption of the standards.

The Constructing Science team is also committed to a periodic update of the model and the report when necessary, with new versions seeking to incorporate sustainability targets and cost parameters, while also expanding beyond Life Sciences to include adjacent science spheres such as manufacturing.

THE UK SCIENCE SECTOR

The Life Sciences sector is a key part of the UK's knowledge economy, recognised as strategically important by Government and policy makers for its impact on the country's health, wealth, and resilience.

In 2019 the Biopharma and MedTech sectors together employed more than 256,000 people, boasting a combined turnover of more than £80bn, with industry distributed across the whole UK.

This strength is underpinned by key structural factors, notably including a world-class academic science base that feeds a rich and diverse research and start-up environment – as well as the NHS, which supports high-quality, large-scale clinical trials. The UK has three of Europe's ***advanced*** life science clusters, as well as five out of 18 ***established*** clusters. The UK Government is committed to building on this foundation to make the UK a leading global hub for Life Sciences.

Despite these strong foundations, the UK Life Sciences sector still has areas of relative weakness. The most recent ***Office for Life Sciences Competitiveness Indicators*** assessed the UK's performance against 24 key competitor countries across 29 indicators, covering the themes of research environment, domestic market, production environment, international collaboration, investment environment and access to skilled labour.

The UK was ranked first in only one metric (the proportion of each country's medical sciences publications which are among the most highly cited (top 1%) globally), and performance on many metrics was average or poor. In addition, while Life Sciences employment rose 9% between 2010 and 2019, industry turnover fell by £1.6bn in real terms over the same period.

To deliver on the potential of the UK Life Sciences sector, active steps are needed to address these areas of weakness. The Government has identified four priorities to deliver the world-leading Life Sciences sector to which it is committed: **building on learnings from Covid-19; developing clinical research infrastructure; improving the adoption of innovative medicines; and fostering a supportive business environment**.

Similar priorities have been identified by the sector itself, with a recent report by Bistol Myers Squibb and PWC focusing on making better use of data, expanding clinical research in the NHS, developing advanced therapies manufacturing capacity and boosting medicines uptake.

What is clear from these approaches is that there is a significant appetite to continue to grow the sector. These approaches will necessitate an expansion of real-estate, as much as financial, workforce, and institutional capacity.

Meeting the demand is an essential first step to delivering on the ambitions of Government and the sector for the UK to be a world leader in Life Sciences.

The demand for high-quality scientific spaces has increased dramatically over the past few years and significantly accelerated during the Covid-19 pandemic. Our report builds on the work done by several other publications during this period.

DEFINING THE GUIDANCE

The guidance comprises technical design and performance criteria for laboratories, alongside guidance for property and project evaluation where laboratory use is being considered.

It combines regulatory requirements with technical recommendations and best practice and is based on extensive collective experience of designing, developing, operating and working within laboratory facilities.

The guidance is skewed towards Life Sciences in a post-pandemic world, as this is where the UK commercial developer-led science market is currently focused. Future guidance will encompass other notable UK science sectors such as advanced manufacturing and technology, materials science, and the like. The guidance has been authored by the Constructing Science Consortium with content prepared during 2022, following launch of this cross-industry initiative in April 2023.

SECTOR GROUPS

"Life Sciences" is an umbrella term for the branches of science that involve the study of life, including animals (not least, human beings), plants and micro-organisms. This report focuses on the biopharma sector.

In terms of the constituent companies that make up the commercial biopharma sector, three broad categories can be distinguished:

Pharmaceutical companies develop and manufacture medicines derived from chemicals and synthetic processes

Biotechnology (biotech) companies develop and manufacture medicines (via extraction from or manipulation of living organisms).

The category of biotechnology includes Advanced Therapy Medicinal Products (ATMPs), medicines based on genes, tissues or cells. These companies are generally smaller in size and typically focused on R&D

Medical technology (MedTech) includes every product, service or solution used in healthcare to save and improve lives. Subsectors include devices, In-vitro diagnostics (IVDs) and digital health.

The **devices** subsector encompasses any instrument, apparatus, appliance, software, implant, reagent, material or other articles used for a healthcare purpose.

In-vitro diagnostics (IVDs) are tests conducted on samples of blood or tissue taken from the human body in order to detect disease, conditions and infections. These tests are typically conducted in equipment ranging from test tubes to sophisticated genetic sequencing devices (in vivo tests, by contrast, are conducted in the body itself).

Digital health encompasses computing platforms, connectivity, software, and sensors used for healthcare.

MATURITY LEVELS

There are distinct differences in the requirement of companies, but in general they follow a pattern based on their maturity.

For this report, we have identified four distinct levels of maturity among Life Science companies; to allow us to define needs:

MICRO
1 TO 6 PEOPLE

Typically grant- and/or founder-funded, pre-seed. Early stage, potentially spinning out from a university and/or academic co-founders. Staff may not all be working full-time on the project. A start-up is likely to need to achieve major milestones prior to further expansion, which may include seed and 'Series A' finance raising, or collaborating on a licensing deal with a large pharma. Unlikely to be revenue-generating;

SMALL SME
6 TO 30 PEOPLE

Likely to have raised or raising some equity funding alongside grant funding, although likely to still be reliant on grants for further R&D. Typically raised or raising seed to Series A, averaging £500K up to £2M and have reached some critical scientific milestones showing commercial potential. May not yet be revenue-generating but likely to be in discussions with larger partners, with many team members working full-time;

SME
30 TO 250 PEOPLE

Likely to have reached some commercial milestones and depending on technology, be generating revenues or have licensed assets. May still be raising equity from series A, B+ and although may still apply for specific targeted grants for pipeline technologies; the team will now be expanding; and

LARGE
250+ PEOPLE

Likely to be generating significant revenues and either looking at IPO/listing or, depending how it is funded, may have trade sales in the pipeline. May be a UK entity of larger pharma.

VARIABLES

We aimed to make this report less technical and more informational, with highly technical elements kept in reserve for the appendices.

The UK Green Building Council is, at the time of writing, producing standards for decarbonising Science & Technology buildings. Readers are advised to utilise their standards when looking at the following variables. These are likely to include energy use, upfront embodied carbon, lifecycle embodied carbon, with other metrics such as space heating/cooling demand and peak load also to be considered.

Gross External Area (GEA)
The area measured from outside faces of external walls, including external projections. The base area of an atrium is included if incorporated within the property. Excluded are external open-sided balconies, covered walk-ways, fire escapes, canopies, and voids over or under structural, raked or stepped floors.

Gross Internal Area (GIA)
The total floor area of building to the internal face of the external walls (or atrium wall) including internal structures (columns etc) and core. Excluded are roof plant areas and totally unlit areas.

Net Internal Area (NIA)
The total floor area of building to the internal face of external walls (or atrium wall) but excluding core (that is, GIA minus core including non-main-core service risers).

Core Area (CA)
The area containing lifts, stairs, common lobbies, internal plant and service areas, risers/ducts, WCs and the footprint of internal structures (e.g. columns).

Primary Circulation (PC)
Major routes within the NIA, typically 1.5m wide and which link to fire egress routes or exits. PC does not include working space between laboratory benches or aisles between desking. Ground level reception area is included.

Net Usable Area (NUA)
The usable area remaining after CA and PC have been subtracted from the GIA.

Occupancy (On Floor)
The usage ratio derived by NIA divided by the maximum number of people designed to work in this floor space (typically one person per 10sqm of NIA floor of office space).

Floor-To-Floor Height
Calculated as the dimension between the top of slab of a floor to the top of slab of the floor above (typically 4m or more).

Floor-To-Ceiling Height
The distance between the finished floor level to the underside of a suspended ceiling. If no ceiling system is installed, then the height is taken to the lowest level of overhead utilities, for example, a typical FFL to underside of ceiling is between 2.7 - 3.0m.

Ceiling Zone
The clear service void within the ceiling.

Floor Void Depth
The clear service void within a raised access floor system (typically lab buildings do not have raised floors).

Planning Grid
The planning grid is the smallest working unit for organising the space. Standard lab planning grids are 3.2 - 3.4m. these are derivatives of the typical lab modules, and will inform anything from the structural grid to the internal space arrangement. Note that in repurposing projects the planning grid will be 1.5m.

Lab Module
Derived from a laboratory bench and circulation aisle spacing and is typically within the range of 3.2-3.6m.

Goods Lift
Lift with loading capacity, car and doors sized for typical laboratory furniture (such as FC, MBSC), robust finishes (typically stainless-steel) and controls that can allow for unoccupied usage (such as when transporting cryogens or bottled gases).

Internal Storage Within Tenant Demise
For laboratory consumables, equipment, fittings and separately for materials subject to regulatory requirements.

Secondary Storage
Usually secondary space that can be allocated to tenant requiring less frequent use and will typically house biobanks, freezer storage, archiving etc.

Shared Segregated Waste Hold
Dedicated and secure enclosure that includes zones for laboratory waste-streams, such as clinical and biological waste.

Centralised Waste Treatment Facilities may be required.

Shared Chemical Store And Waste Hold
Dedicated and secure enclosure to accommodate waste solvents, acids, bases and chemicals. Typically, the area will be bunded to contain any spillages.

Shared Gas Bottle Store
Dedicated and secure enclosure to accommodate gas bottles and manifold controls and distribution, and empty bottles for collection.

Shared Loading/Delivery Area/ Technical Yard
A dedicated and secure area for off-loading of goods and collection of waste, as well as packing, unpacking, post rooms.

CIVIL & STRUCTURAL VIBRATION

Laboratory spaces often house processes or equipment that are sensitive to vibration.

New-build commercial lab spaces are typically specified with a vibration performance of response factor 1 (also known as ISO-1) or vibration criterion (VC) A. ISO-1 is the level of human perception and the design criterion for a surgical operating theatre. In contrast, office spaces are designed to response factor 4 or 8; that is, 8 to 16 times higher than typical lab requirements.

A vibration performance of ISO-1 or VC-A usually allows good flexibility for positioning most items of lab equipment anywhere on the floor plate to suit the preferred layout. For refurbishment and zones of new build labs, a relaxation of these criteria to ISO-2 (Response factor 2) can be considered as some tenants requirements are less demanding.

Lower vibration levels will naturally be achieved close to supporting columns and walls, providing zones where more sensitive equipment – such as microscopes – can be positioned if needed, without upgrading the performance of the whole floor plate.

If additional enhancement is needed, it may be possible to provide local vibration isolation to improve performance for individual items of equipment, although there are some limitations to this approach.

Some very sensitive items of equipment, such as high-resolution imaging systems, require very low levels of vibration that are not practical to achieve on a suspended floor slab.

If this type of equipment is to be accommodated in the building, it is preferable to locate it in a dedicated 'low vibration zone' such as on the ground floor or at basement level where the floor slab sits directly onto the ground. Here, it is more likely that a low vibration environment can be achieved without significant additional structural measures being needed.

The actual level of performance that can be achieved will depend on project-specific factors such as proximity of external sources of vibration (such as roads or railways), the type of ground the building is founded on, and the extent to which the building structure itself attenuates vibration levels.

FLOOR LOADING

New-build lab spaces on upper floors are typically designed for an occupancy load of 4kN/m^2 plus an allowance for internal partitions. This is not codified in UK design standards, but has developed as a typical requirement based on assessment of lab layouts and equipment weights across a range of lab types.

The 4kN/m^2 is sufficient for most common lab uses including:

- lab benching with significant storage above and below
- typical free-standing equipment such as analytical systems
- and heavy benching for desktop equipment requiring low vibration levels, which tend to be at the higher end of the lab loading range.

For some lab uses, a reduced loading allowance of 3kN/m^2 plus internal partitions would be sufficient, but this may place limitations on the layout – for example, clustering of heavy items of equipment may not be possible. It also requires a higher degree of management by the tenant to ensure that the load capacity is not exceeded.

In many lab buildings, the upper floor slab design is governed by vibration requirements rather than loading, meaning that a higher load capacity can be provided with minimum additional capital cost. For example, with a common lab grid of 6.6m x 7.2m, designing for a vibration performance of ISO-1 would mean that vibration governs the design unless the occupancy loading allowance exceeds approximately 7kN/m^2.

Where the lowest floor of the building is ground-bearing, it will typically have a higher load capacity than 4kN/m^2 and can often provide a location for very heavy items of equipment at no (or minimal) additional capital cost.

The density of MEP engineering services required to serve a lab building means that a higher loading allowance should be included for ceiling, services and floor finishes than in, say, an office building. Typically, 1.5kN/m^2 is a reasonable allowance.

STRUCTURAL GRID

The structural grid in a new-build laboratory building is typically chosen to co-ordinate with an efficient lab benching layout.

This facilitates connections between lab sinks and drainage drops, which are usually located on the face of a column, and tends to result in a grid dimension of between 6.2m and 7.2m parallel to the building façade.

Grid dimensions perpendicular to the façade are more strongly influenced by factors such as the arrangement of primary lab and office space, the width of the building and suitable spans to achieve the vibration criteria.

The choice of structural grid also plays a critical role on the efficiency of the structural design for achieving the vibration criteria, and by extension, the embodied carbon impact of the building.

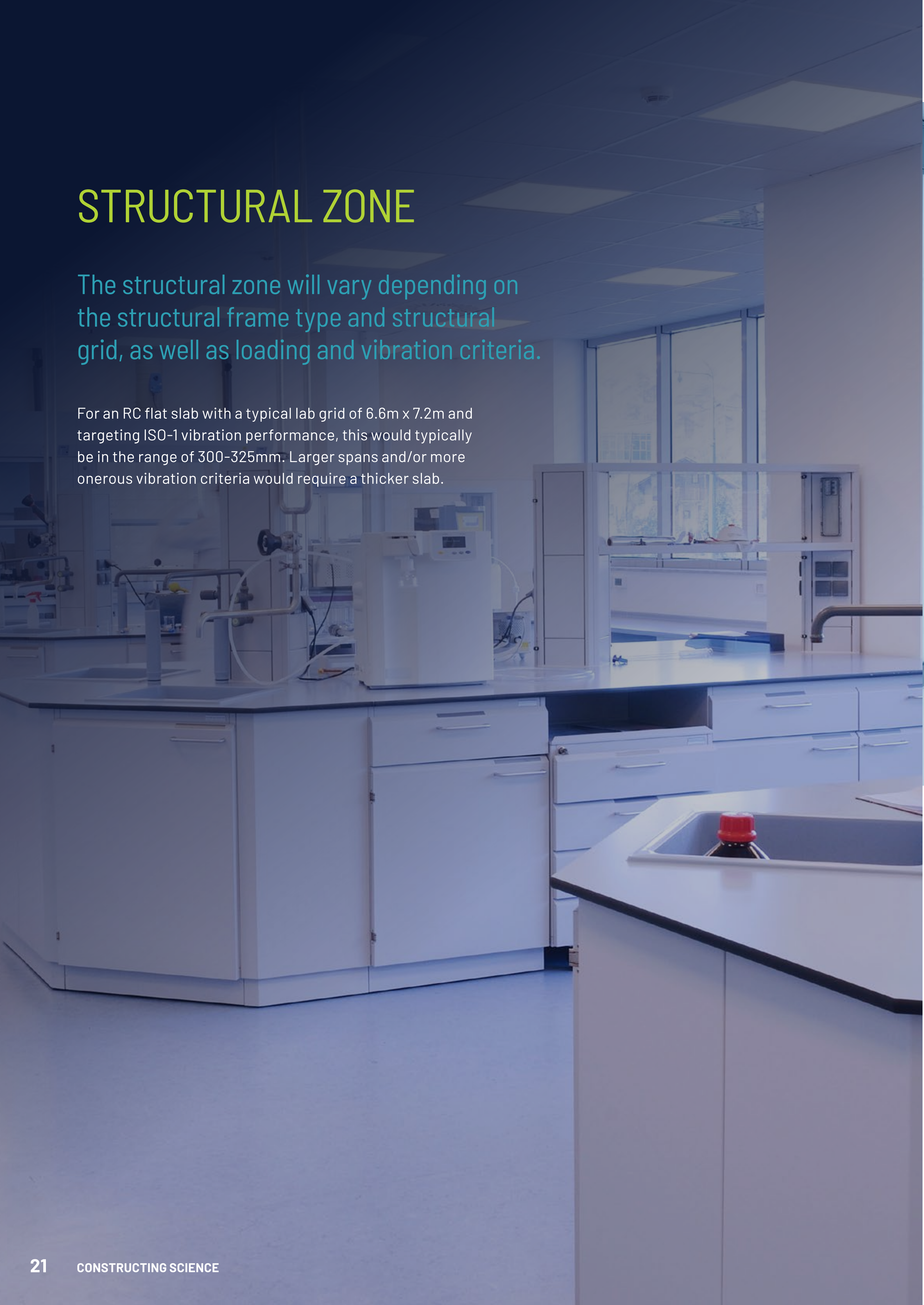
The upper floor slabs account for approximately 80-90% of the embodied carbon in a typical in a typical building superstructure and this can be even higher for labs.

Reducing the slab thickness through sensible choice of grid can, therefore, have a significant benefit in reducing embodied carbon as well as reducing capital cost.

FLOOR-TO-FLOOR HEIGHT

The floor-to-floor height can be divided into four different zones:

- Structural zone
- Service/ceiling zone
- Floor-ceiling clear height
- Floor build-up.



STRUCTURAL ZONE

The structural zone will vary depending on the structural frame type and structural grid, as well as loading and vibration criteria.

For an RC flat slab with a typical lab grid of 6.6m x 7.2m and targeting ISO-1 vibration performance, this would typically be in the range of 300-325mm. Larger spans and/or more onerous vibration criteria would require a thicker slab.

SERVICE / CEILING ZONE

The clear depth required for MEP services will depend on the core/riser arrangement and floorplate size, but would generally be in the range of 800-1,000mm with a nominal 100mm ceiling zone below.

Heavy chemistry areas may require a deeper ceiling void to accommodate large ventilation ductwork. Some developers are moving towards exposed services and omitting the ceiling zone, but this may not be suitable for all lab types due to cleanliness requirements.

FLOOR-CEILING CLEAR HEIGHT

Clear height requirements will vary according to use, and may need to increase in some spaces to accommodate specific items of equipment that are very tall or require access from the top.

For general wet lab space, the following clear heights are typically appropriate to accomodate the majority of uses:

- Support labs and refurbishment projects: 2,700mm
- Primary new-build labs: 2,900mm
- "Premium" lab space: 3,000mm

FLOOR BUILD-UP

Lab spaces should generally be designed with a solid floor to maintain vibration performance and remove any floor void that would hinder clean-up of liquid spillages.

Typically, this would comprise a minimal levelling screed zone with a vinyl floor finish, within a nominal 15 to 20mm finishes zone. Taking these three elements together, overall floor-to-floor heights in the range of 4,100 to 4,350mm are fairly typical for new-build laboratory buildings. This may not be achievable for a refurbishment project where a reduced floor-to-floor height of around 3,800 to 4,100mm may be acceptable; reducing below this is not recommended and will typically result in compromised space or higher energy consumption due to complex services routing.

LABORATORY DRAINAGE

Dedicated drainage stacks should be provided for lab areas, segregated from domestic foul drainage serving kitchens, WCs, showers etc.

Drain point connections to the below-ground drainage lab system should be provided in a new-build base-build scheme as a minimum, whereas drainage stacks above ground could form part of the internal fit-out, depending on the arrangement of tenant demises within the building.

Chemical-resistant pipework such as co-polymer polypropylene should be provided as a minimum, For some buildings other types of specialist drainage will be required (e.g. stainless steel pipework for high-temperature discharge from autoclaves).

Outside the building, the lab drainage passes through a sampling manhole before being combined with the domestic foul drainage and discharging to the public sewer. For some types of laboratory, a Trade Effluent licence may be required (a legal agreement with the sewerage undertaker allowing discharge of lab drainage effluent to the public sewer system within certain parameters volume, temperature and pH), the sampling manhole enables compliance to be monitored. Trade Effluent licence arrangements may be on a building-wide or a per-occupier basis.

RE-PURPOSING EXISTING BUILDINGS

The sections above describe the design criteria that would typically be adopted for a new-build commercial laboratory building.

Where an existing building is being re-purposed for lab use, it is not usually possible to meet all criteria as some aspects – such as the structural grid and floor-to-floor height – are fixed and cannot be changed.

This does not preclude a change of use to laboratory space but may result in less efficient lab layouts and/or restrictions on the type of lab use that can be accommodated.

For other aspects such as loading, vibration and drainage it is often possible to adapt or upgrade the existing arrangements to improve performance, albeit not always economically.

RE-PURPOSING EXISTING BUILDINGS

LOADING

Where the existing occupancy loading allowance is less than 4kN/m^2, options for improving suitability for lab use include:

- Considering whether existing floor/ceiling finishes can be stripped back to free up capacity for lab loading
- Accepting a reduced loading allowance and tailoring the use of the space accordingly (with appropriate management procedures to ensure capacity is not exceeded)
- Strengthening the existing structure to increase capacity (part or all of a floorplate)

Deciding which options are suitable and how they are implemented will depend on the existing capacity, structural frame type and the building's proposed use.

VIBRATION

A building that was originally designed for a use other than labs will usually have much less onerous vibration performance requirements.

For example, the typical new-build vibration performance of ISO-1/VC-A is 8 to 16 times lower than a typical office vibration criterion. This may limit the types of laboratory use that can be accommodated on the upper floors of the building.

However, if the lowest floor of the building is ground-bearing this will naturally have a much better vibration performance and would commonly achieve ISO-1/VC-A without any intervention.

Options for upgrading the vibration performance of upper floor slabs are limited but could include:

- Adding columns to reduce spans (best suited to improving performance in specific areas)
- Providing vibration isolation for individual pieces of equipment using a proprietary product or system
- Adding mass in the form of a screed, if the load capacity of the floor is sufficient

DRAINAGE

An existing building can be retrofitted with a lab drainage system, typically by coring holes through the slabs for new drainage stacks and breaking-out sections of the ground floor slab to install the below-ground network.

This is more straightforward for a ground-bearing floor slab than a suspended one. Alternatively, it may be possible to install new drainage stacks within existing risers or even external to the building.

Local pumped drainage systems can also be used to route lab effluent to a smaller number of drainage stacks, reducing the work required to retrofit the below-ground elements.

The new lab drainage system would connect to the existing foul drainage system outside the building via a new sampling manhole. The capacity of the existing system would need to be checked for new flow from the labs, in addition to existing domestic foul flows.

REPURPOSING CONSIDERATIONS

Further considerations in relation to repurposing include:

- Basebuild structure;
- Basebuild services capacity; and
- Existing infrastructure and operational requirements.

Further commentary on each element is included below.

BASEBUILD STRUCTURE

There are three critical elements that can influence costs:

BASEBUILD FRAME CONSTRUCTION

The most suitable frame construction for a lab is a concrete frame, as this provides good vibration control and robust slab loadings. More lightweight structural solutions such as steel or timber are possible, but could require additional interventions, increasing costs and programme. In addition, they may limit the flexibility of the space by rendering it unsuitable for certain types of research.

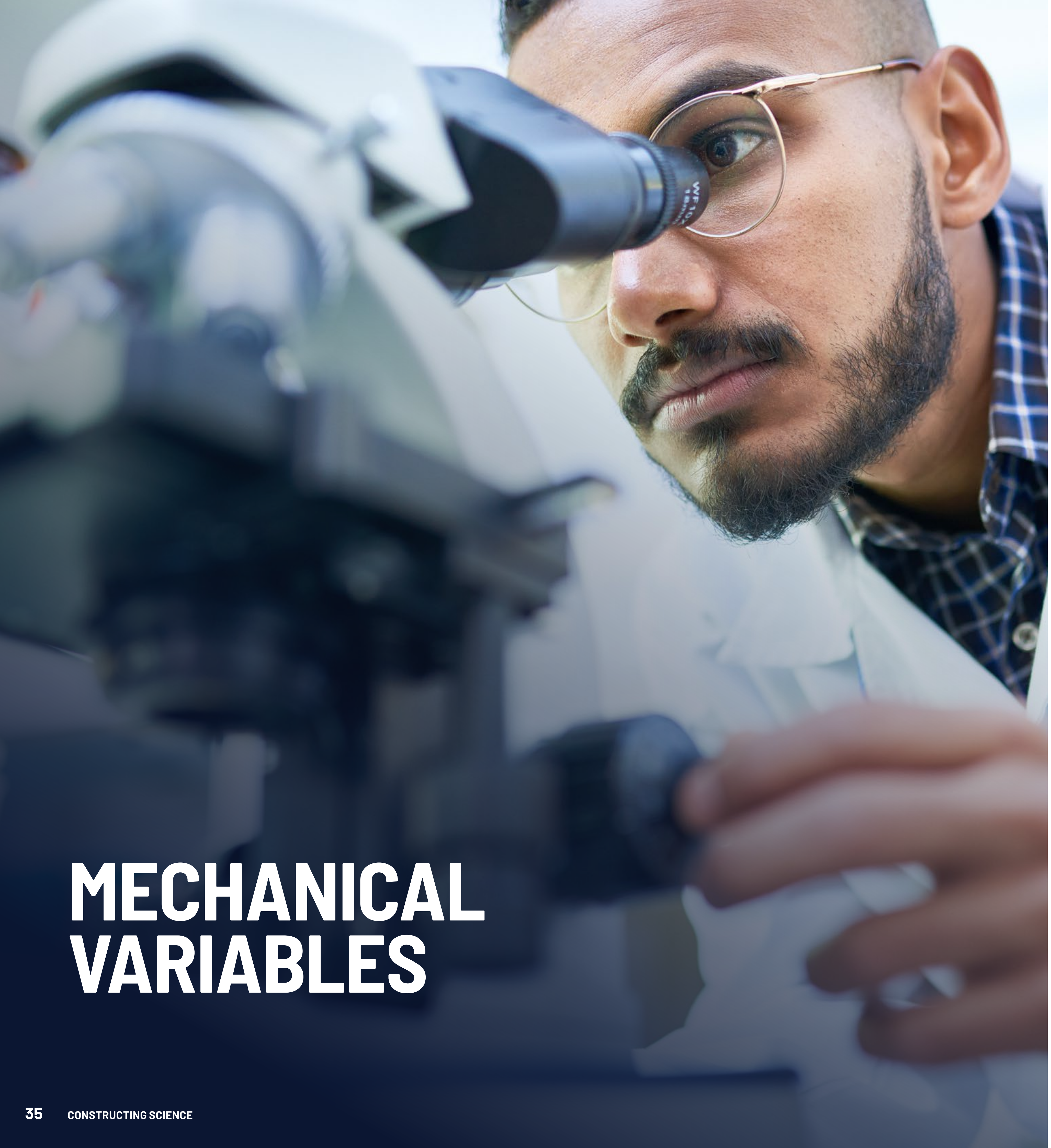
BASEBUILD SLAB-TO-SLAB HEIGHTS

Optimum slab-to-slab heights are 4.5m, however it is possible to deliver wet lab space with lower heights, via the use of on-floor plant. However, this costs more, and can impact viability/spatial efficiencies and reduce the flexibility of the space for research.

FIRE COMPARTMENTATION

In existing buildings fire compartmentation between research and non-research spaces may require enhancement.

4 NEW BUILD CONSIDERATIONS



MECHANICAL VARIABLES

INTERNAL TEMPERATURE

This is typically defined within a range allowed by the building design and controls (e.g. ± 2°C).

Two figures are normally provided to enable the saving of energy: one for summer, where the temperature can drift up to save on cooling loads and the other for winter, where the temperature can drift down to save on heating loads.

In laboratories, there can be a need for a certain temperature or precision of temperature control that comes out of a specific experiment or equipment demand.

Early decisions about equipment are therefore crucial to establish the demand and need for control.

RELATIVE HUMIDITY

Relative humidity is the measure of moisture in the air, expressed as a percentage of the absolute (actual current) humidity relative to a maximum humidity given the same temperature.

This is normally defined with a range that the building design and controls can keep the relative humidity within, typically ±5%.

Relative humidity control is only required in laboratories for specific functions, assays or runs. As humidity control can be a high-energy demand, it should not be installed as a base provision, but the space should allow for humidity controls to be retrofitted as needed and when the laboratory space is fitted- out.

AIR CHANGE RATE PER HOUR

Air change rate per hour (ACH) is the number of times that the total air volume in a room or space is completely removed and replaced in an hour by external fresh air.

As the ACH rate of laboratories is continuous when in operation, it is often the highest energy use for the laboratory. However, importantly, it is also typically providing a safe working environment for occupants by removing contaminated air.

There are several factors that place demands on the ACH, including: the dilution of contaminated air within the laboratory; ventilated equipment extracting air from the laboratory; and pressure or airflow regimes transferring air into or out of laboratories.

This has resulted in a common level of ventilation/ACH specification, with laboratories typically forming significant energy consumers, although this is now being challenged by wider imperatives to reduce energy usage and carbon footprints across all building types.

Reducing the ACH while maintaining safe operation means the ACH approach should become risk-based and respond to the specific operations and activities intended for the laboratory. Without knowing these in advance (e.g. when designing for speculative provision) it is typical to provide a generic ACH and provide a 'demand-led' ventilation system that can vary the ACH as needed.

Reducing the ACH when the building is unoccupied via a 'night setback' mode, can significantly reduce overall energy consumption.

PRESSURE AND AIRFLOW REGIMES

A pressure regime relates to a differential air pressure between the laboratory and adjoining spaces, measured in Pascals (Pa).

An airflow regime relates to air transfer between the laboratory and adjoining spaces which is directional but not controlled to a set pressure. The principles of controlling air pressures and flows are fundamental to bio-containment and the design of safe laboratories.

Introducing an airflow regime is more common for Containment Level 2 laboratories and features less onerous controls than the pressure regime which are typically seen in Clean laboratories and Containment Level 3 laboratories.

Air pressure or airflow in a room under positive regime (higher pressure than outside, or with net outflow) ensures that contaminants (particles, viruses, bacteria etc.) are kept out of the room. Conversely, the air pressure or airflow in a room under negative regime (lower pressure than outside, or with net inflow) ensures that contamination from the room does not flow out into surrounding spaces.

SENSIBLE COOLING

Sensible cooling refers to reducing the air temperature (or dry bulb temperature) without changing the moisture content of the air.

In laboratories, the sensible cooling load is mostly used to cool internal heat gains from laboratory equipment, electrical equipment, lighting, and solar heat from external windows.

The need for sensible cooling is much more prominent in laboratories than other workplaces.

PROCESS COOLING

Process cooling is a water-cooling system that removes unwanted heat from specialist equipment or processes.

Process cooling is typically independent of the building general cooling system because it is designed to meet the needs of equipment or processes with different performance requirements, such as different operating times, temperatures, stability or water quality.

ELECTRICAL VARIABLES

SMALL POWER

Small power refers to the 'plugged-in' devices within a building.

Small power electrical equipment typically includes all unfixed devices, products and appliances including PCs, laptops, monitors, printers and so on. Laboratories typically house more equipment than an office workspace due to the extent of dedicated scientific equipment, meaning laboratories have greater small power loads than offices.

LIGHTING

Laboratory lighting design is becoming more challenging.

Meeting sustainability standards, wellness requirements, low-glare and shadow-free safety demands, and colour-rendering needs, must all be achieved in addition to appropriate coordination with flexible laboratory benching and equipment layouts.

Most laboratory lighting designs now require a layered lighting approach with a sophisticated lighting control system to deliver on all these demands.

STANDBY POWER

Certain processes or equipment in laboratory environments may require provision for standby power to ensure continued operation in the event of mains power loss.

Extended loss of power to equipment (such as ultra-low temperature freezers or sensitive imaging equipment) can cause extensive loss of research material. It is critical to establish whether this is an issue for building users or potential tenants when designing the facility.

UNINTERRUPTIBLE POWER SUPPLY (UPS)

In addition to a need for standby power, other equipment items are sensitive to even very short-term interruptions to power supply.

This can result in damage to the equipment, loss of research, or extended equipment re-start periods. It is relatively common for equipment to be provided with a UPS to mitigate such scenarios. UPS can either be provided by users and located adjacent to equipment, or as a central building facility with dedicated power circuits on the floor.

PUBLIC HEALTH VARIABLES

PURIFIED WATER

Purified water is water that has been filtered or processed to remove impurities.

Water can be purified by de-ionization, reverse osmosis (RO), carbon filtering, mechanical filtration, or ultraviolet oxidation. These processes are used in different combinations to produce pure water used in laboratories.

Pure water can be produced locally (for small quantities) or centrally in a building. Central pure water systems often circulate the water in a loop to maintain water quality but are expensive to install, energy intensive and costly to run and therefore most appropriate when usage is known to warrant it.

SPECIALIST DRAINAGE

Laboratories can have demands on drainage that are not seen in other buildings.

These demands can include chemical-resistant drainage systems, radioactive drainage systems, high-temperature drainage systems and validated treatment processes. The most common of these is to have a drainage system serving the laboratory that is made from chemical-resistant materials.

Where high temperature drainage is necessary (for example, autoclave discharge) materials such as copper, assist with heat dissipation prior to connection to the main lab drainage system.

WASTE TREATMENT

Treatment of laboratory drainage is uncommon for speculative laboratories in the UK, however, it is not unusual to provide a sampling chamber at the drainage outfall prior to connection to the main sewer for sampling in conjunction with a Trade Effluent Licence.

Only very specialist users require dedicated waste effluent treatment systems and this typically requires user input around the specific processes being undertaken to determine the necessary course of treatment. CL3 laboratories generally require self-contained capture systems with a dosing system prior to discharge to the main drainage system which is undertaken as a controlled process.

In the US, pH neutralisation plant is typically installed in laboratory buildings due to the permissible discharge parameters into the sewer network, but for most laboratory users this is not necessary to meet UK discharge standards, subject to statutory utility provider approval.

LABORATORY GASES AND COMPRESSED AIR

Laboratory gases are gases supplied to the laboratory for experimental and process needs.

Each gas is typically provided in a pressurised cylinder and piped to the point of use although larger scale systems may use bulk liquid stores with a vaporiser and compressed air is typically generated via a compressor.

There are significant safety implications with the design and installation of gases in and around a building that require careful consideration, as does the storage and movement of the cylinders. The most commonly used gases in Life Sciences facilities are nitrogen, carbon dioxide and compressed air.

CRYOGENS

Cyrogens are very low-temperature fluids used in some laboratories for bulk storage of gases, low-temperature freezing of samples, cooling superconductors (such as in imaging equipment).

The safety concerns are greater with cryogens than gases as the very low temperature can cause freeze burns. When the cryogen comes into contact with atmosphere, it vaporises and rapidly expands in volume which can cause depletion of oxygen levels or damage to room fabric. Specialist ventilation (for example, a purge vent system) is typically provided to areas housing cryogens.

OTHER

DUCTED FUME CUPBOARDS

Ducted Fume Cupboards (FCs) provide operator safety when handling hazardous chemicals or processes.

Ducted FCs house the hazardous chemical or process within the cupboard, pulling the air away from the operator and discharging it out to the atmosphere via a fan-powered flue or stack at roof level. Ducted FCs use a lot of air to provide a safe environment for the operator, so 'low-airflow' units should be specified to reduce energy and running costs, where these meet the safety demands of the chemical or processes to be undertaken.

The discharge to atmosphere needs to be considered for safety, so that the chemical is not causing harm to others or the environment once it has left the flue. This is particularly important for laboratories in an urban setting where residences (low and high-rise) may be nearby. In this circumstance, it is likely that the generic solutions given in BS EN 14175 will need validation by computer fluid dynamics (CFD) modelling.

MICROBIOLOGICAL SAFETY CABINETS (MBSCS)

MBSCs are used for handling pathogens and are designed to protect the product from contamination, the user from the product, or both.

MBSCs include integral HEPA filtration to ensure air cleanliness and may be ducted (like a FC) or fully recirculating. Ducted MBSCs can typically be discharged to general exhaust systems as the air has been filtered prior to discharge.

Some laboratory tenants will require the building's engineering systems to operate without interruption while undertaking certain processes, to prevent safety issues or the loss of vital research or product.

This risk is typically managed by having resilient electrical supply and ventilation systems with multiple items of plant and diverse servicing routes appropriate to the needs of the tenant.

PROJECT PARAMETERS

COST DRIVERS AND PARAMETERS

The cost ranges included within this report represent the construction costs only for the purposes of any cost appraisal the reader may wish to make.

These are expressed as a £/m² of GIA. included Costs are also expressed as current day, meaning that inflation to start on site is not included in the rates. The rates will contain an allowance for inflation during the construction period, but it should be noted that this is a nominal amount, and programme and sequencing could potentially have an impact on the fixed price allowance within the rates.

For the avoidance of doubt, the matrix below confirms exclusions from the total £/m² cost provided, and an indication of where this should be included in overall project budgets and appraisals. Also indicated are the budget holder – whether tenant or developer (though note that this is not necessarily applicable to end users).

Where the reader is using the rates provided for desk top appraisal, these should be uplifted for inflation to the expected midpoint of construction using BCIS or other reputable published construction tender price index

However, there are some general parameters that apply to both in terms of life science laboratories, which are summarised in the proceeding section. Generally, the key cost driver for a laboratory is related to the technical complexity of the space.

COMPLEXITY

For the purposes of this paper, we will focus on CL2 with recirc and CL2 with process extract in the range.

OVERALL BUILDING AREA

The overall building size will be a key driver of its overall cost and at the early stages of design and project appraisal this will be a function of the NUA (the brief areas required) plus an allowance for internal circulation multiplied by a percentage factor to give the overall size of the building.

This is shown below:

Net Useable Area x X = Net Internal Area, where X is a percentage uplift to account for the internal circulation

Net Internal Area x Y = Gross Internal Area, where Y is a predetermined percentage to account for the following:

- Areas used in common (receptions, lift lobbies, core areas)
- Areas used for plant and lifts
- Areas of a head height of less than 1.5m
- Areas where the distance between opposing faces is less than 0.25m.

Therefore, the more efficient factors X and Y are the smaller the building size required to deliver the spatial requirements. From the developer's perspective the inverse of this process applies – that is the construction of the largest possible building on the land available, maximising the internal area available for leasing (generally measured as the NIA) by making the building as efficient as possible.

Key drivers for building efficiency include:

- Provision of basement space;
- Area required for plant;
- Common areas and spaces;
- Building shape and massing;
- Internal core layout; and
- Provision of internal voids (atria and lightwells).

Of these, for laboratory buildings the most challenging to building efficiency are:

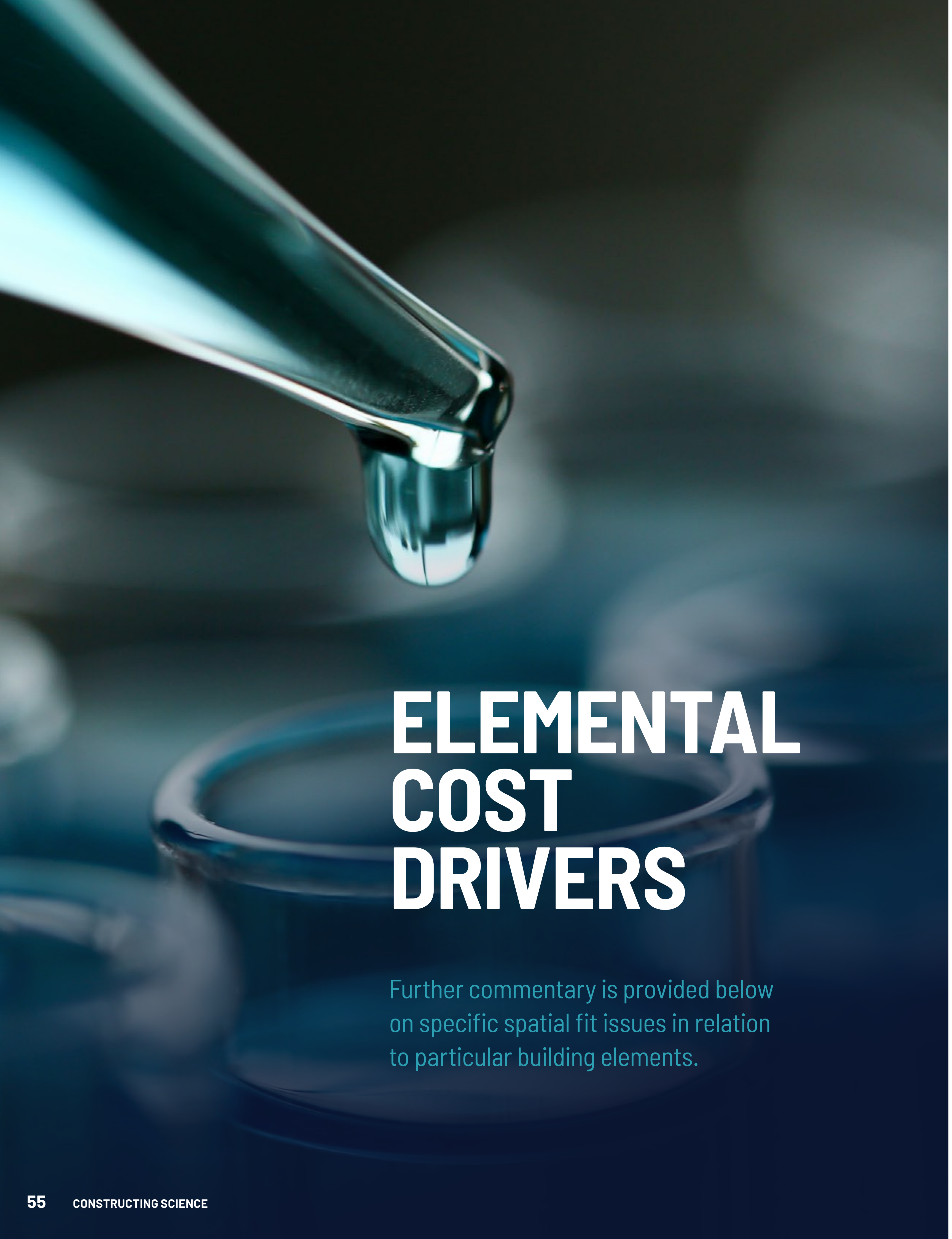
1. Plant area required: more extensive plant areas are required when compared to an office building
2. The core layout (as a result of more extensive servicing of the spaces and operational requirements)
3. The provision of internal voids – good daylighting is often desirable in primary wet lab space, but also more generally for wellbeing (though the reverse can be the case, depending on the research).

Building shape and massing also influences the internal layout of cores, facades costs and structural solutions, as well as impacting on fit-out costs, so this is a key early variable when considering laboratory design and costs.

SPATIAL COMPOSITION

A crucial driver of any laboratory building in terms of cost, spatial efficiency and speed of build is the proportions of wet lab, dry lab and write-up space.

It is almost too obvious to state that the greater the amount of wet lab, dry lab and specialist research space a building contains, the more expensive it will be. The proportions of space allocation are therefore important when considering our cost model.



ELEMENTAL COST DRIVERS

Further commentary is provided below on specific spatial fit issues in relation to particular building elements.

SUBSTRUCTURE

A key consideration will be whether a basement is necessary. These can be required for central plant provision, logistics and back of house functions, but these are costly to construct and will push £/m^2 towards the upper end of the cost ranges.

SUPERSTRUCTURE (FRAME AND FACADES)

Frame costs will be determined by the structural grid selected (impacting on spans and therefore slab thickness and columns), and the more honsourous vibration criteria required will result in a more expensive frame. Slab-to-slab heights are also a consideration, but will have a lower impact on structural costs unless intersitial plant floors are required. Frames are typically reinforced concrete (see comments below on sustainability). Facade costs are driven by performance requirements, building shape, material selection and production efficiency (repetition, and so on). More specifically for a laboratory building, the slab-to-slab heights selected will impact on the quantum of façade and also the lab planning and resulting structural grid will impact on the façade module sizing, which can impact on costs.

BUILDING SERVICES AND FIT OUT

Key cost drivers on the building services include the quantum of primary wet lab space, which will drive air requirements, in turn impacting on the amount of central air handling plant required, primary and secondary ductwork and VAV boxes and fan coil units. Also important is the inclusion of fume extract, which will increase the cost per square metre depending on provision and density. Note that this, in turn, can impact on slab-to-slab height and riser provision within the core areas (a further consideration for building efficiency).

Small power requirements will typically be greater than those required for offices. Often, individual laboratory zones also have their own distribution boards and circuitry to account for further flexibility and ease of reconfiguration. Where dry laboratory space is included, these spaces can be even more power-hungry. Overall, this again means greater space taken up by electrical plant and greater space in the risers, again impacting on efficiency.

BASEBUILD STRUCTURE

The capacity of the basebuild services to provide the quantum of air changes required to laboratory space often needs to be augmented when repurposing buildings, which results in an obvious cost premium in existing buildings as a result of the intervention required into the basebuild, with associated risks. This often also impacts on the spatial efficiency of the building.

BASEBUILD SERVICES CAPACITY

The capacity of the existing infrastructure of the building needs to be reviewed in relation to repurposing, to ascertain whether any additional power is needed. This cost/viability driver is compounded by sustainability requirements, which often require the adoption of an all-electric solution to building services increasing the power requirements of the basebuild.

In addition, the suitability of the building for laboratory operations can result in further basebuild interventions being needed – for instance, loading bay reconfiguration, goods lift provision, and gas bottle storage. All these have the capacity to impact on costs if they are complex to implement.

SUSTAINABILITY

A note that currently the more ambitious the project is in relation to sustainability, the greater its capital cost is likely to be and therefore would trend towards the upper end of the cost ranges presented.

Reduction in embodied carbon will also have a cost impact – though this could be mixed. For instance, earth-friendly concrete is generally 20-30% more expensive to procure than standard mix, but this could be compensated for by using recycled steel for rebar or steel elements.

Strong sustainability credentials are becoming more common with both local authorities and with tenants, and are often a key component in a business's talent acquisition. Finally, reduced energy consumption also means lower lifecycle costs.

The question of cost impact therefore needs more holistic consideration than typical investment/payback assessments.

SUSTAINABILITY PARAMETERS

At present the scope of this report and accompanying dynamic model does not extend to the incorporation of sustainability initiatives within either its guidance or output reports.

In response to the wider life science community demands and aspirations for the preservation of both life and our planet, within the construction industry, the Life Sciences sector is at the forefront of promoting and delivering sustainable development that in many instances surpass what is currently being delivered by the industry in other sectors.

In addition to corporate Environmental Social Governance (ESG) policies and net zero carbon targets, industry governing bodies including the UK Green Building Council (UKGBC), British Council for Offices (BCO) and Building Research Council (BRE) promote sustainable development.

Typically, new build commercial laboratory developments within a science cluster setting are currently targeting:

- ESG credentials encompassing holistic sustainability, carbon neutrality, health and wellbeing, social value and placemaking, biodiversity, low carbon mobility, circular economy and waste, climate resilience and water
- Accreditations including: BREEAM, WELL, LEED, Wired Score, Active Score, Smart Score

Development endeavours include:

- A minimum of 20% biodiversity net gain
- 50% of car parking to be provided with electric vehicle charging points
- Achieving a minimum BREEAM "Excellent" accreditation with opportunities and cost benefit to reach an "Outstanding" accreditation
- Achieving Net Zero Carbon in "Construction" aligned to UKGBC Framework definition
- Achieving "New Zero Ready" by avoiding fossil fuels
- Undertaking operational energy modelling to identify a landlord target and offset operation for the first five years
- Developing a Circular Economy Strategy at time of gaining a planning consent
- Undertaking dynamic thermal modelling studies and tests against future 2050 to 2080 weather files.

USING THE CONSTRUCTING SCIENCE DYNAMIC MODEL

PREREQUISITES TO USE

The dynamic model has been developed and built around a simple and intuitive interactive user interface.

It has been designed to guide the user through a "pathway" of their prospective development options, site/asset credentials and building performance specifications.

The output reports are designed to provide the user with both a graphical and textual guide and the suitability of successful and viable development for a Life Sciences occupier together with the types of scientific research and development activities the development could host plus an indication on the type, size and scale of occupier organisation it may appeal to.

It must be acknowledged that the output report is indicative and is for guidance purposes only. It is intended to serve as an "informed" starting point for both business case and design development by the user's professional advisors.

FUTURE ITERATIONS

We understand that this guidance is by no means complete, but it should serve as a first step to defining the construction of science.

We are aiming for iterations on a regular basis for which the team are working on some of the parameters to be included:

COST
A review of the cost position including benchmarking

LOCATION
Exploring the locality axis of the equation

PROGRAMME AND SCHEDULE
A review of the cost position including benchmarking

NET ZERO AND SUSTAINABILITY
Reviewing the approach to a net zero science building from a construction and operational perspective

EQUIPMENT
Equipment selection and procurement

INTERNATIONAL MARKET
Reviewing the transferability of the report and the approach to a wider international audience

ALIGNMENT
Alignment with operational readiness and CQV process

CONSTRUCTABILITY AND METHODS OF CONSTRUCTION
Constructability and methods of construction including shell and core, and fit-out

APPENDIX A. CASE STUDIES

In this section we have only included three examples.

These are not blueprints for development, instead we believe these are representative of the current standard of developer led facilities aimed at the science research & development market. The samples cover repurposed and new-built over a decade of development. It is best to review these buildings as adaptive development platforms. The case studies include a summary table which coincides with the basic building parameters table earlier in this report.

Special attention should be given to the differing slab to slab dimensions, the electrical capacity and the logistic features. Noticeable is the emphasis on sustainability and wellness features.

The quality of laboratory spaces is critical for the success of the building, but tenants expect a modern office fit-out and associated amenities typical to the technologies.

Overall, these developments create multi-tenanted facilities, which can cover a wide range of disciplines. These spaces are designed for a quick adaptation to tenants' needs and could react to a high turnover. These facilities have to account for the pace of technological upgrades and automation.

Mission St/

1 Temple Way in central Bristol was constructed in the mid 1970's as the home of the Bristol Evening Post.

As an "office building with an industrial function" the building lends itself well to laboratory conversion. It contains many of the "must-haves" of purpose-built lab buildings including a robust concrete frame, generous floor-to-ceiling heights, good vertical risers, back of house loading areas and goods lifts.

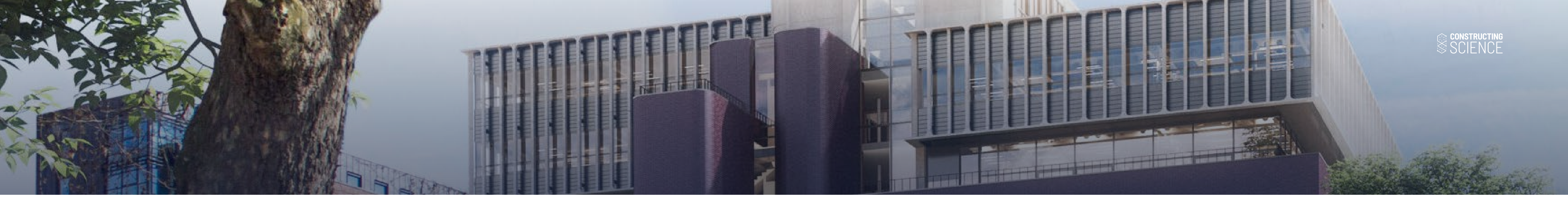
As the first significant speculative R&D facility in the south west, 1 Temple Way is positioned as potential "grow-on space" from the extremely high volume of research spin-outs from the successful universities and incubators in the region. Most of the 10 proposed floors can be split into 3 or 4 separate tenancies and can accommodate wet lab, dry lab and office users depending on the location in the building.

A new central core and atrium will provide improved natural light into each floor of the building and three additional floors will mirror the brutalist architecture on the floors below.

Central air-handling plant will provide 6-8 air changes to lab spaces while the building will be connected to the Bristol district heating network to provide sustainable heating and hot water. Extract-to-air for specialist lab equipment will be provided via roof mounted strobic fans, reducing the impact on the city centre skyline.

With 10 potentially occupiable floors, 1 Temple Way will be one of the tallest lab buildings in the UK. As such, the provision of good quality back-of-house areas including delivery areas, waste removal, gas storage, goods lifts and tenant service risers are critically important.

Particular attention has been given to public realm, contemporary design and shared spaces. High quality public areas include a bookable events venue, roof terraces to 4 floors and a rooftop "club-room" and terrace accessible to all occupiers.



SUMMARY TABLE

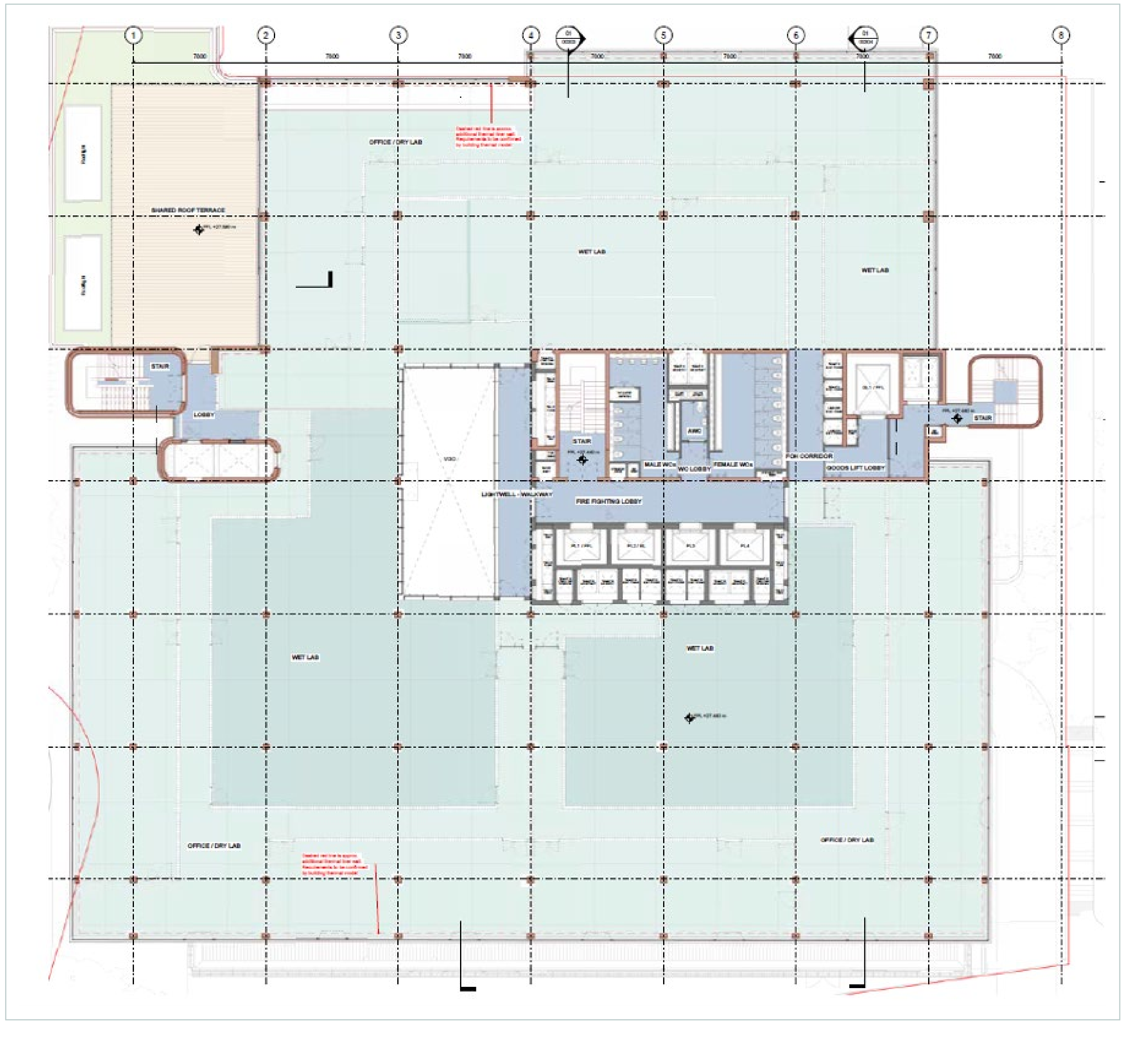
YEAR	COST	SPLIT	GROSS AREA	NET AREA	CONSTRUCTION	STRUCTURE	SLAB - SLAB
2023	TBC £ / m²	LAB : OFFICE 60:40	18,860 m²	12,609 m²	REFURBISHED	CONCRETE WAFFLE SLAB	3,600 - 4,200 mm

RAISE FLOOR	TENANCY	ACCREDITATION	LOGISTIC AREA	GASES	CRYOGEN	ATRIUM	CAFE
NO	UP TO 20	BREEAM EXCELLENT	500 m²	15 m²	30 m²	YES	F&B INC PUBLIC

SHOP	CAR PARKING	CYCLE FACILITIES	WELLNESS	GAS	ELECTRICITY	WATER
NO	YES	YES	NO		2.4 MVA	DOMESTIC HOT AND COLD, LABORATORY COLD

LOCAL EXTRACT VENTILATION	WET LABORATORY	DRY LABORATORY	CONTAINMENT LEVEL	LABORATORY VENTILATION	OFFICE VENTILATION
SHARED TENANT RISERS	DRAINAGE PROVISION	COOLING PROVISION	UP TO CL2	6-8 ACH	14 L/S/P

TYPICAL FLOORPLATE – 3 POTENTIAL TENANCIES PLUS TERRACE GARDEN



HOARE LEA

Abcam at Discovery Drive, Cambridge, is new build with space including an office, writeup/ administration block, a laboratory block, logistics, storage, and staff support functions.

Two blocks are separated by an "acrive" atrium which is designed as a shared collaborative work space that has break out functions and cafe, located on the ground floor.

The building enables flexibility in occupation and although single tenant occupied the design allows for up to six different organisations to be located within, with up to two tenancies per floor.

The servicing strategy allowed for a nominal tenancy split of 50% laboratory, 50% office and write-up space. The office space designed to Building Council of Offices specification.

Central plant space is allocated to serve the Landlord areas, and the tenant Category A and B fit-out. Dedicated tenant plant space is provided to allow for local extract requirements, additional cooling condenser units and similar. Local extract space provision for tenant fit-out ductwork per riser.

Logistics space is provided to handle tenant deliveries, office waste management, and specialist waste management from laboratories. Space allocation for compressed bottled gases and cryogenic liquid storage.

A development by PROLOGIS

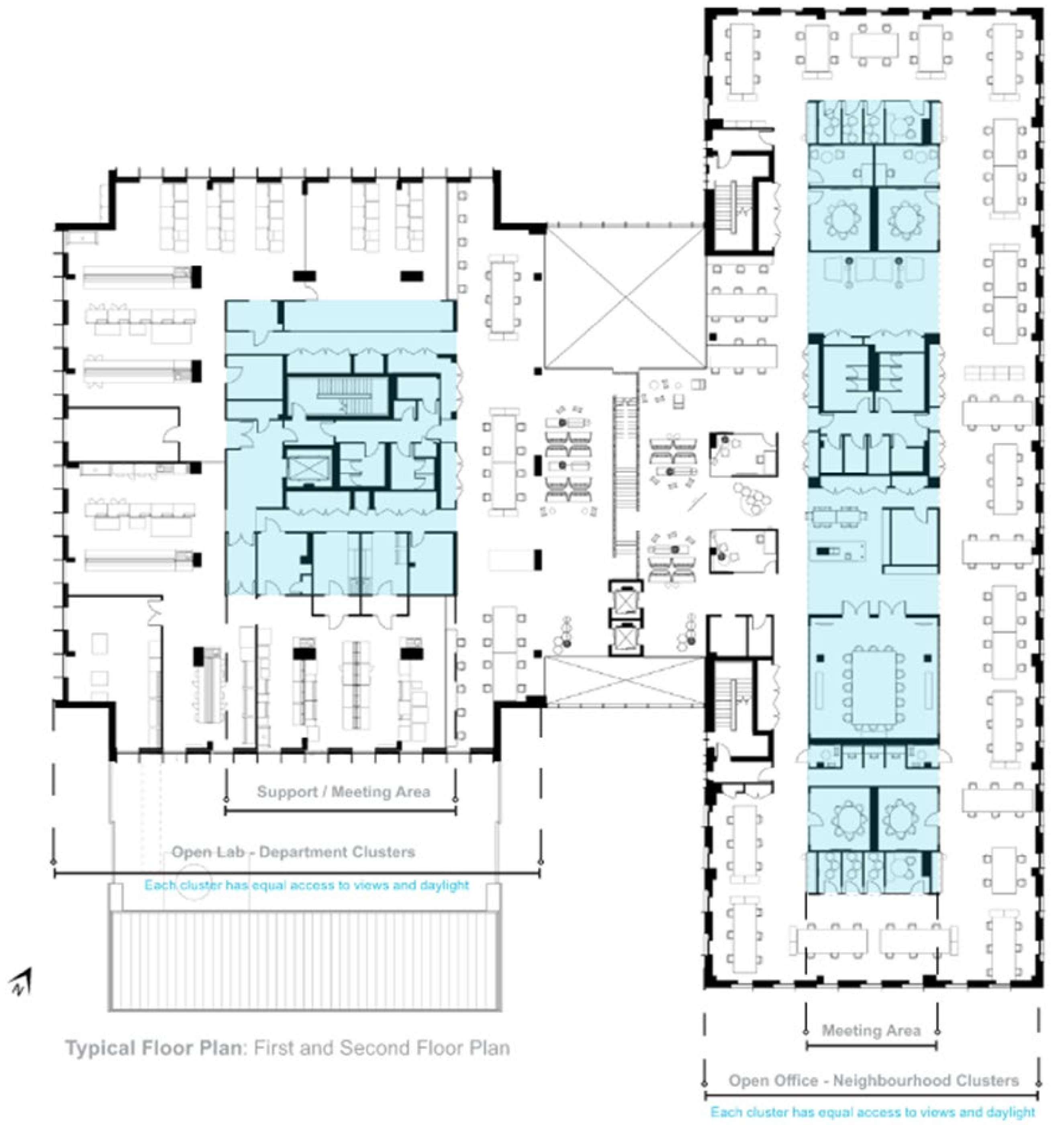
SUMMARY TABLE

YEAR	COST	SPLIT	GROSS AREA	NET AREA	CONSTRUCTION	STRUCTURE	SLAB - SLAB
2016	£4,900 £ / m²	LAB : OFFICE 50:50	11,860 m²	9,275 m²	NEW	CONCRETE FLAT SLAB	4,200 mm

RAISE FLOOR	TENANCY	ACCREDITATION	LOGISTIC AREA	GASES	CRYOGEN	ATRIUM	CAFE
NO	UP TO 6	BREEAM VERY GOOD	65 m²	6 m²	12 m²	YES	SPACE PROVISION

SHOP	CAR PARKING	CYCLE FACILITIES	WELLNESS	GAS	ELECTRICITY	WATER
NO	YES	YES	NO		1.6MVA 134W/m²	DOMESTIC HOT AND COLD, LABORATORY COLD

LOCAL EXTRACT VENTILATION	WET LABORATORY	DRY LABORATORY	CONTAINMENT LEVEL	LABORATORY VENTILATION	OFFICE VENTILATION
RISER SPACE PER TENANCY	DRAINAGE PROVISION	COOLING PROVISION	UP TO CL2	6 ACH	14 L/S/P



Typical Floor Plan: First and Second Floor Plan

HOARE LEA

1000 Discovery Drive, Cambridge Biomedical Campus.

A new build space designed as a flexible speculative laboratory/office development, with potential tenants likely to be a combination of businesses undertaking biomedical R&D and relevant research organisations comprising of offices, wet or dry laboratories for biological and potentially some chemistry uses.

The building includes a reception area, flexible café space, plant rooms, communal meeting rooms, delivery area and landscaped areas with visitor and disabled parking, cycle storage and associated facilities.

The building enables a flexible approach to leasing, allowing multiple organisations to be accommodated, with up to four tenancies per floor. The servicing strategy allowed for a nominal use split of 50% laboratory, 50% as office/write-up space.

Central plant space is allocated to serve the Landlord areas, and the potential tenant fit-out. Dedicated tenant plant space is provided to allow for local extract requirements, additional cooling condenser units, and similar. Local extract space provision for tenant fit-out ductwork per riser.

Logistics space is provided to handle tenant deliveries, office waste management, and specialist waste management from laboratories. Space allocation for compressed bottled gases.

A development by PROLOGIS

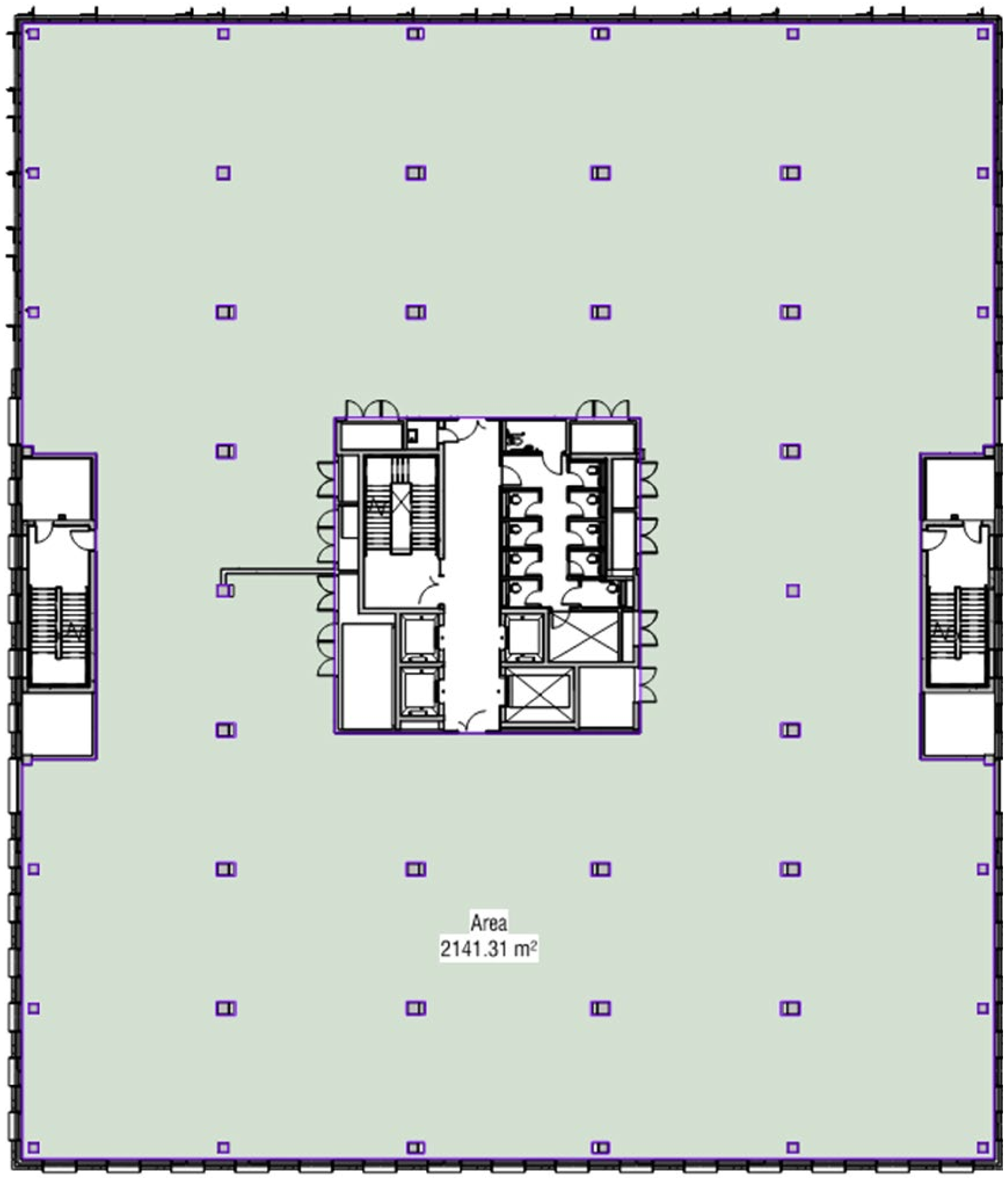
SUMMARY TABLE

YEAR	COST	SPLIT	GROSS AREA	NET AREA	CONSTRUCTION	STRUCTURE	SLAB - SLAB
2023	£3,500 £ / m²	LAB : OFFICE 50:50	12,295m²	9,815 m²	NEW	CONCRETE FLAT SLAB	4,200 mm

RAISE FLOOR	TENANCY	ACCREDITATION	LOGISTIC AREA	GASES	CRYOGEN	ATRIUM	CAFE
NO	UP TO 18	BREEAM EXCELLENT	30 m²	10 m²	NONE	YES	SPACE PROVISION

SHOP	CAR PARKING	CYCLE FACILITIES	WELLNESS	GAS	ELECTRICITY	WATER
NO	YES	YES	NO		1.7MVA 138W/m²	DOMESTIC HOT AND COLD, LABORATORY COLD

LOCAL EXTRACT VENTILATION	WET LABORATORY	DRY LABORATORY	CONTAINMENT LEVEL	LABORATORY VENTILATION	OFFICE VENTILATION
RISER SPACE PER TENANCY	DRAINAGE PROVI SION	COOLING PROVISION	UP TO CL2	6 ACH	14 L/S/P



Gensler

Gensler worked closely with GenMab on the adaptive reuse of the existing facility to transform it into one that supports labs and research and development activities.

GenMab, a Denmark-based company specialises in the creation and development of differentiated antibody therapeutics for the treatment of cancer.

The labs are strategically adjacent to the Hygge (a nod to its Danish roots), an informal gathering space defined by cosiness and conviviality. Filled with natural light from the window wall, the labs put science on display to create a shared sense of purpose for employees. An interconnecting stair links colleagues between different floors of the workplace with cozy nooks and booths for focusing and collaborating.

SUMMARY TABLE

YEAR	COST	SPLIT	GROSS AREA	NET AREA	CONSTRUCTION	STRUCTURE	SLAB - SLAB
2021	CONFIDENTIAL	LAB : OFFICE 30:70	10,219 m²	N/A	REPOSITIONED	CONCRETE FLAT SLAB	4,200 mm

RAISE FLOOR	TENANCY	ACCREDITATION	LOGISTIC AREA	GASES	CRYOGEN	ATRIUM	CAFE
NO	MULTI 320 PEOPLE	LEED GOLD	APPROX 170 m²	CO2 N2	12 m²	YES	SPACE PROVISION

SHOP	CAR PARKING	CYCLE FACILITIES	WELLNESS	GAS	ELECTRICITY	WATER
NO	YES	YES	YES	YES	1.18 WATT / SF	DOMESTIC HOT AND COLD, LABORATORY COLD DI DISTRIBUTION

LOCAL EXTRACT VENTILATION	WET LABORATORY	DRY LABORATORY	CONTAINMENT LEVEL	LABORATORY VENTILATION	OFFICE VENTILATION
RISER SPACE PER TENANCY	DRAINAGE PROVISION	COOLING PROVISION	UP TO CL2	6 ACH	14 L/S/P

APPENDIX B. LABORATORY FIT-OUT GUIDE

INTRODUCTION

This is a guidance document that has been drafted to inform what specific elements items are included within each level of fit-out to aid clients and client teams to be aligned on projects.

Each description for the level of fit out is intended to be read as stand-alone section.

Project teams and clients can make changes and adjust these definitions to suit their own requirements, but we recommend a clear schedule of inclusions and exclusions is maintained.

KEY DEFINITIONS AND ABBREVIATIONS

S&C	LE	LR	LA
SHELL AND CORE	LABORATORY ENABLED	LABORATORY READY	LANDLORD AREAS

TD	WL	DL/O
TENANT DEMISES	WET LABS	DRY LABS/ OFFICE

NRM REF	ELEMENT	SHELL AND CORE	LABORATORY ENABLED	LABORATORY READY
0	**Facilitating works**	All works required	All works required	All works required
1	**Substructure**	All works required	All works required	All works required
2	**Superstructure**			
2.1	**Frame**	All works required	All works required	All works required
2.2	**Upper floors**	All works required	All works required	All works required
2.3	**Roof**	All works required	All works required	All works required
2.4	**Stairs and ramps**	All works required	All works required	All works required
2.5	**External walls**	All works required	All works required	All works required
2.6	**Windows and external doors**	All works required	All works required	All works required
2.7	**Internal walls and partitions**	• Cellularisation into TD(if required)and circulation spaces • LA formed, toilet cores, plant, reception, formation of risers ect • Any fire walls and compartmentation as required	• Cellularisation into TD(if required)and circulation spaces • LA formed, toilet cores, plant, reception, formation of risers etc • Any fire walls and compartmentation as required • Further subdivision of spaces into smaller TD if required	• Cellularisation into TD(if required)and circulation spaces. • LA formed, toilet cores, plant, reception, formation of risers etc • Any fire walls and compartmentation as required • Further subdivision of spaces into smaller TD if required
2.8	**Internal doors**	Internal doors as required by definition included in section 2.7	Internal doors as required by definition included in section 2.7	Internal doors as required by definition included in section 2.7
3	**Internal finishes**			

NRM REF	ELEMENT	SHELL AND CORE	LABORATORY ENABLED	LABORATORY READY
3.1	**Wall finishes**	• Finishes to LA only • Standard paint finish to LA side of walls that form TD • Standard paint finishes to LA • Reception feature finishes enhanced. • Acoustic treatment to atrium areas	• Finishes to LA and TD • Standard paint finish to LA side of walls that form TD • Standard paint finishes to LA • Reception feature finishes enhanced • Standard paint finish to internal face of external walls • Standard paint finish to TD side of dividing walls • O/DL typically finished with emulsion paint. • WL typically finishes with sterisheen paint • Acoustic treatment to atrium areas • Acoustic treatment as appropriate to fit-out areas	• Finishes to LA and TD • Standard paint finish to LA side of walls that form TD • Standard paint finishes to LA • Reception feature finishes enhanced. • Standard paint finish to internal face of external walls • Standard paint finish to TD side of dividing walls • O/DL typically finished with emulsion paint. • WL typically finishes with sterisheen paint • Clean room wall coverings to WL or DL as required • Any other specific end user requirements • Acoustic treatment to atrium areas • Acoustic treatment as appropriate fit-out areas
3.2	**Floor finishes**	• Finishes to LA only	• Cellularisation into TD(if required)and circulation spaces • LA formed, toilet cores, plant, reception, formation of risers ect • Any fire walls and compartmentation as required	• Finishes to LA and TD • Circulation spaces are typically carpet • Plant spaces are typically floor plaint • Toilets are typically vinyl • Reception typically has a feature finish • Raised access floor (if required)to DL/O with carpet finish • Void former and screed chemical resistant vinyl to Wet Labs • Any other specific end user requirements • Access panels where required

NRM REF	ELEMENT	SHELL AND CORE	LABORATORY ENABLED	LABORATORY READY
3.3	**Ceiling finishes**	• Finishes to LA only • Circulation spaces are typically MF (metal framing) Ceiling System with plasterboard • Plant typically has an open ceiling • Toilets typically have a suspended mineral fibre finish • Reception typically has a feature ceiling	• Finishes to LA and TD • Circulation spaces are typically MF (metal framing) Ceiling System with plasterboard • Plant typically has an open ceiling • Toilets typically have a moisture resistant suspended mineral fibre finish • Reception typically has a feature ceiling • WL typically has gasketed corrosion resistant metal grid ceiling • DL/O typically has mineral fibre grid ceiling	• Finishes to LA and TD • Circulation spaces are typically MF (metal framing) Ceiling System with plasterboard • Plant typically has an open ceiling • Toilets typically have a moisture resistant suspended mineral fibre finish • Reception typically has a feature ceiling • WL typically has gasketed corrosion resistant metal grid ceiling • DL/O typically has mineral fibre grid ceiling • Any other specific end user requirements
4	**Fittings, furnishings, and equipment**	• LA areas fitted out generally • Toilets fully fitted out • Reception area fitted out • Wayfinding and statutory signage	• LA and TD areas fitted out generally • Toilets fully fitted out • Reception area fitted out • Wayfinding and statutory signage	• LA and TD areas fitted out generally • Toilets fully fitted out • Reception area fitted out • Wayfinding and statutory signage • Laboratory benching to WL • Fume cupboards, autoclaves, and the like to WL • Fixed furniture to WL • Fixed storage to DL/O • Any other specific end user requirements
5	**M&E services**			
5.1	**Sanitary installations**	• Sanitary installations to toilet cores within LA	• Sanitary installations to toilet cores within LA	• Sanitary installations to toilet cores within LA • Eye wash stations to WL • Wash hand basins to WL • Any other specific end user requirements to WL

NRM REF	ELEMENT	SHELL AND CORE	LABORATORY ENABLED	LABORATORY READY
5.2	**Services equipment**			
5.3	**Disposal installations**	• Internal rainwater pipes • Soil and waste from sanitary installations • Condensate disposal from cooling plant • Provision for laboratory drainage, including floor gullies	• Internal rainwater pipes • Soil and waste from sanitary installations • Condensate disposal from cooling plant • Laboratory drainage floor gullies	• Internal rainwater pipes • Soil and waste from sanitary installations • Condensate disposal from cooling plant • Laboratory drainage floor gullies • Lab drainage from fitted furniture • Chemical waste disposal • Any other specific end user requirements
5.4	**Water installations**	• Cold water storage tanks, pump sets and plantroom installations • Hot water generation plant, pumps, and plantroom installations • Domestic cold and hot water vertical distribution to risers	• Cold water storage tanks, pump sets and plantroom installations • Hot water generation plant, pumps, and plantroom installations • Domestic cold and hot water vertical distribution to risers • Category 5 cold and hot water installations	• Cold water storage tanks, pump sets and plantroom installations • Hot water generation plant, pumps, and plantroom installations • Domestic cold and hot water vertical distribution to risers • Category 5 cold and hot water installations • Horizontal distribution of all services and terminated in ceiling void in indicative locations. • Any other specific end user requirements
5.5	**Heat source**	• LTHW plant room installation with vertical distribution to risers	• LTHW plant room installation with vertical distribution to risers and horizontal distribution to locations	• LTHW plant room installation with vertical distribution to risers • Any other specific end user requirements

NRM REF	ELEMENT	SHELL AND CORE	LABORATORY ENABLED	LABORATORY READY
5.6	**Space heating and air conditioning**	• LTHW emitters to LA • Air handing plant • Ductwork distribution vertically to risers • Chiller water plant and plantroom installations • CHW vertical distribution to risers • CHW emitters to LA • Local cooling to main equipment rooms	• LTHW emitters to LA & TD • Air handing plant • Ductwork distribution vertically to risers and horizontally in ceiling void • Chiller water plant and plantroom installations • CHW vertical distribution to risers and horizontal distribution to emitters. • CHW emitters to LA and TD • Local cooling to main equipment rooms	• LTHW emitters to LA & TD • Air handing plant • Ductwork distribution vertically to risers and horizontally in ceiling void • Chiller water plant and plantroom installations • CHW vertical distribution to risers and horizontal distribution to emitters. • CHW emitters to LA and TD • Local cooling to main equipment rooms • Any other specific end user requirements
5.7	**Ventilation**	• Local extract provided to toilets • LA air change level provided, as required • Smoke extract provided, as required • Vertical distribution to risers for ductwork	• Local extract provided to toilets • LA air change level provided, as required • Smoke extract provided, as required • Vertical distribution to risers for ductwork • Provision for fume and local extract distributed to risers	• Local extract provided to toilets • LA air change level provided, as required • Smoke extract provided, as required • Vertical distribution to risers for ductwork • Horizontal distribution to provide fume and local extract for equipment • Any other specific end user requirements

NRM REF	ELEMENT	SHELL AND CORE	LABORATORY ENABLED	LABORATORY READY
5.8	**Electrical installations**	• Main HV incoming power to transformer • Main LV switch panel • Distribution boards provided in electrical risers • Standby generator, as required • Power supplies for all plant provided as part of the S&C • Lighting and small power provided to LA	• Main HV incoming power to transformer • Main LV switch panel • Local distribution boards to TD • Standby generator. As required • Power supplies for all plant provided as part of the S&C and LE • Small power and data provided to LA and perimeter power to TD, including floor boxes, as required • Lighting provided to TD	• Main HV incoming power to transformer • Main LV switch panel • Local distribution boards to TD • Standby generator, as required • Power supplies for all plant provided as part of the S&C and LE • Small power and data provided to LA and perimeter power to TD, including floor boxes, as required • Wi-Fi installations, as required • Lighting provided to TD • Any other specific end user requirements
5.9	**Fuel installations if required**	• Natural gas main installed and distribution to plant rooms	• Natural gas main installed and distribution to plant rooms	• Natural gas main installed and distribution to plant rooms • Any other specific end user requirements

NRM REF	ELEMENT	SHELL AND CORE	LABORATORY ENABLED	LABORATORY READY
5.10	**Lift and conveyor installations**	• Goods and passenger lift installations	• Goods and passenger lift installations	• Goods and passenger lift installations
5.11	**Fire and lightning protection**	• Lightning protection system installed • Dry riser installation • Sprinkler tank, pumps and riser installation, if required • Distribution provided vertically to risers and sprinkler heads to LA	• Installed lightning protection system installed • Dry riser installation • Sprinkler tank, pumps and riser installation, if required • Distribution provided vertically to risers • Horizontal distribution and sprinkler heads installed to TD	• Lightning protection system installed • Dry riser installation • Sprinkler tank, pumps and riser installation, if required • Distribution provided vertically to risers • Horizontal distribution and sprinkler heads installed to TD • Any other specific end user requirements
5.12	**Communication, security and control systems**	• Fire alarm panel and sensors to LA • Data outlets to LA • CCTV installation externally if required with LA interface • Access control to LA • BMS system head end and control to LA • Disabled alarm to toilets, as required • Building security alarm	• Fire alarm panel and sensors to LA and TD • Data outlets to LA and perimeter of TD • CCTV installation externally, if required with LA interface • Access control to LA and TD • BMS system head end and control to LA and TD • Disabled alarm to toilets, as required • Building security alarm	• Fire alarm panel and sensors to LA and TD • Data outlets to LA and perimeter of TD and to fitted furniture • CCTV installation externally, if required with LA interface • Access control to LA and TD • BMS system head end and control to LA and TD • Disabled alarm to toilets, if required • Any other specific end user requirements • Building security alarm
5.13	**Specialist installations**	• No works required • Provision for centralised gasses could be installed/ on floor bottle storage designed	• No works required • Provision for centralised gasses could be installed/ on floor bottle storage designed • CO2 detection	• Centralised gasses and bottle storage area provided; pipework terminated in ceiling void ready for connection • Gas detection system installation • CO2 detection
5.14	**Builders work in connection**	• All works required for the above works	• All works required for the above works	• All works required for the above works

APPENDIX C. CONSTRUCTING SCIENCE MEMBERS

BURO HAPPOLD

Buro Happold is an international, integrated consultancy of engineers, designers and advisers. For over 45 years Buro Happold has built an unrivalled reputation by delivering creative, value-led solutions for the benefit of people, places and planet.

Described by clients as 'passionate', 'innovative' and 'collaborative', Buro Happold is synonymous with the delivery of exceptionally complex projects on every continent, working with the world's leading architectural practices and organisations, such as the United Nations, UNESCO and C40 Cities. Through a global community of driven, world-leading engineering, advisory and design professionals, Buro Happold is acting to address major challenges in an ever-evolving world.

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CPC

CPC Project Services (CPC) is an independent Cost and Project Management Consultancy, operating across the UK. CPC is delivering some of the science sector's most well-known and award-winning Life Science projects with commercial developers, universities, Government agencies and end-users.

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CUSHMAN & WAKEFIELD

Cushman & Wakefield (NYSE: CWK) is a leading global real estate services firm that delivers exceptional value for real estate occupiers and owners. Cushman & Wakefield is among the largest real estate services firms with approximately 52,000 employees in over 400 offices and approximately 60 countries.

In 2022, the firm had revenue of $10.1 billion across core services of property, facilities and project management, leasing, capital markets, and valuation and other services.

Cushman & Wakefield's Life Sciences team provides real estate advice to the sector, including site selection and design, lease and portfolio management, operational advice, financing and capital markets.

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EEDN

EEDN is a dynamic and innovative construction project, programme and design management consultancy with focus on technically advanced projects.

We have delivered a multitude of projects in the SciTech sphere, from academic research to commercial science and cGMP manufacturing. Our team provides focussed advice to the build environment from pre-feasability to completion and operational readiness.

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GENSLER

Gensler is a global architecture, design, and planning firm with 53 locations and more than 7,000 professionals networked across the Americas, Europe, Greater China, Asia Pacific, and the Middle East. Founded in 1965, the firm works globally with more than 4,000 clients across more than 29 practice areas spanning the work, lifestyle, community, and health sectors. We are guided by our mission to create a better world through the power of design, and the source of our strength is our people.

By leveraging our diversity of ideas, our research and innovation, our shared values, and our One-Firm Firm culture, we are working seamlessly as a borderless firm in 140 countries and making the greatest impact on our communities as we continue to tackle the world's challenges.

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APPENDIX C. CONSTRUCTING SCIENCE MEMBERS

GLEEDS

Gleeds is an international property and instruction consultancy with more than 135 years' experience in the property and construction industry. With 2,350 dedicated staff across six continents and 80 offices, Gleeds prides itself on being a global business that is structured to act and think locally. Working with clients in almost every sector, Gleeds services the entire project lifecycle and categorises its offering into the following core areas: programme and project management, commercial and contract management, property and asset management and advisory.

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HOARE LEA

Hoare Lea is an award-winning engineering consultancy with a creative team of engineers, designers, and technical specialists. We provide innovative solutions to complex engineering and design challenges for buildings.

We're engineers of human experiences, problem solvers who care how a pace makes you feel when you step inside – who bring buildings to life. We overcome every challenge with ingenuity, determination, and pride.

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MEDCITY

MedCity is the Life Sciences cluster organisation for London. MedCity fosters collaborations between biotech, medtech and pharma companies and the capital's Life Sciences ecosystem to supercharge innovation, drive inward investment and build skills and talent across the sector in the UK.

Working in close partnership with London's world-leading universities and national ecosystem stakeholders, MedCity creates powerful networks and partnerships to fast-track R&D, with a specialist focus on diagnostics, digital health and cell and gene therapy. As life science experts, MedCity also facilitates the development of life science space in London to support the growth of research intensive businesses.

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MISSION STREET

Mission Street is a specialist investor, operator and developer focused on the delivery of creative solutions for the evolving Science and Innovation sector. We have a rapidly growing development portfolio, with more than 1,200,000 sq ft of committed projects in strategic locations within Oxford, Cambridge and Bristol.

The company is led by a specialist management team with extensive experience developing and operating Science and Innovation buildings and campuses and integrating these into their ecosystem. We believe that sustained economic prosperity will be underpinned by growth and investment in scientific and emergent 'knowledge economy' industries. Our Mission is to become the partner of choice for the UK's research and innovation sector, supporting the entire lifecycle from discovery to R&D and manufacturing

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RAMBOLL

Founded in Denmark in 1945, Ramboll is a global engineering, architecture and consultancy company that operates across 35 countries with over 16,000 employees.

We combine deep local insight and experience with a global knowledge base to create sustainable societies and drive positive change for our clients, as we transition to a more sustainable future. Ramboll UK has a dedicated science design team and an impressive track-record of delivering leading-edge science facilities for academic, institutional and commercial clients across the UK.

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