NIAZI RODEN

Knight Frank

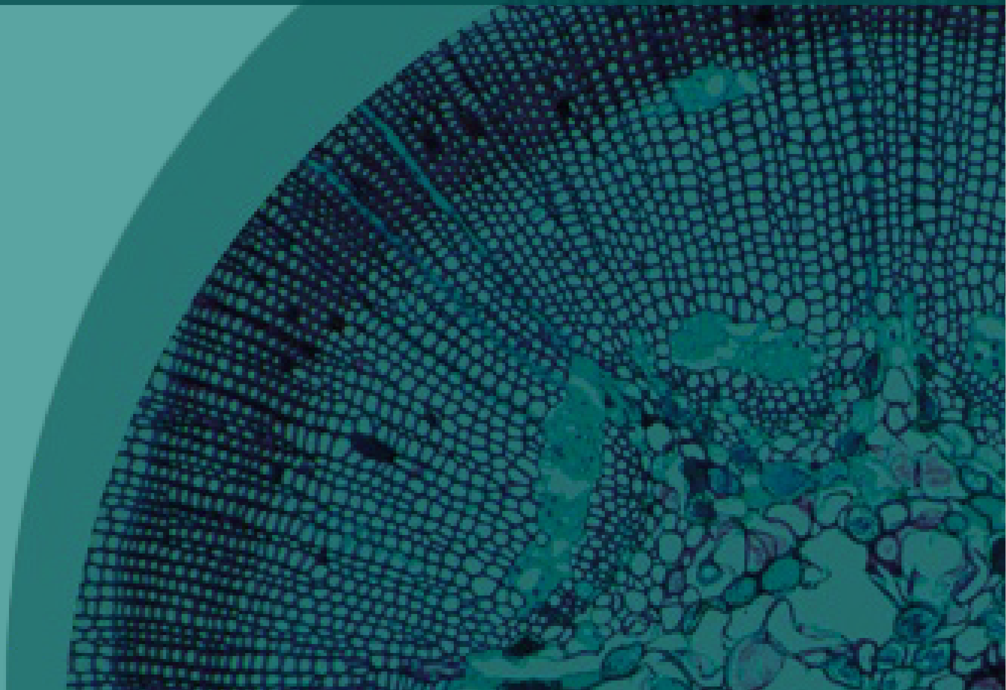
UK Life Sciences and Innovation

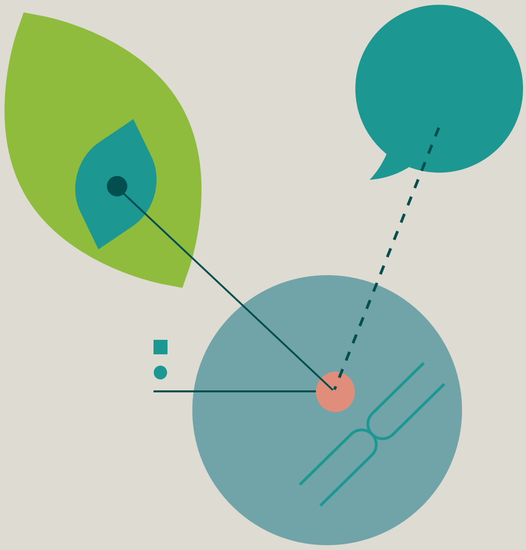
Labs Explained

Introduction

The Life Sciences real estate market is expanding, with an increased number of investors and developers exploring opportunities. Ageing populations, people's increased focus on health, and rapid advancements in biological processes are powering the Life Sciences industry globally and driving demand for laboratory space.

The growth of the Life Sciences market in the UK has created a different type of property use with many unique features and idiosyncrasies. Here we set out to explain the different laboratory typologies, introducing conventional terminology and giving consideration to the structural requirements of buildings to facilitate laboratory fit out and operation.





Contents

Laboratory Building Design

Laboratory design plays a fundamental and critical part in ensuring laboratories are safe places to work. Careful consideration is given to the function of the laboratory, hazard identification and mitigation, laboratory equipment needs, the use of bespoke technology, and the degree of flexibility required for future growth or process change. Operational efficiency is vital for occupiers, raising additional design considerations.

Laboratories are heavily serviced buildings, requiring increased plant provision, space and height, vertical distribution, and horizontal distribution zones. There are multiple services on every floor, including general & process ventilation ductwork, HVAC units, piped services (water, lab gases & drainage), and electrical services. Coordination of these services is complex and requires adequate space for installation and ongoing maintenance. This requires significant vertical riser space and horizontal distribution space on each floor. Overall, the spatial requirements are considerably more than other more lightly serviced buildings such as offices.

Laboratories also see a significant level of change throughout their lifetime and need to adapt and evolve to suit the changing needs of the science. As such, laboratory layouts often change and service provisions need to be adjusted or augmented to service a new process. Having sufficient service distribution space is crucial to enable these changes to be carried out and for the building to be flexible and adaptable over its lifetime.

Construction considerations

Slab to slab height
Preferably 4.50m but can be 5.50m
(office standard is 3.50-4.20m)

Floor to Ceiling height
Minimum of 2.75m

Floor Loading
4-7 kN/sq m (offices 2.5-4 kN/sq m)

Grid spacing
6.6m x 9.9m to fit standard lab model

Lab to write-up ratio
Typically, 60/40

Ventilation
6-20 air changes per hour

Power demand
3 to 5 times greater than offices

Vibration tolerance
Preferably below 1 hertz
(offices usually 4 Hertz)

Roof strength to support additional plant

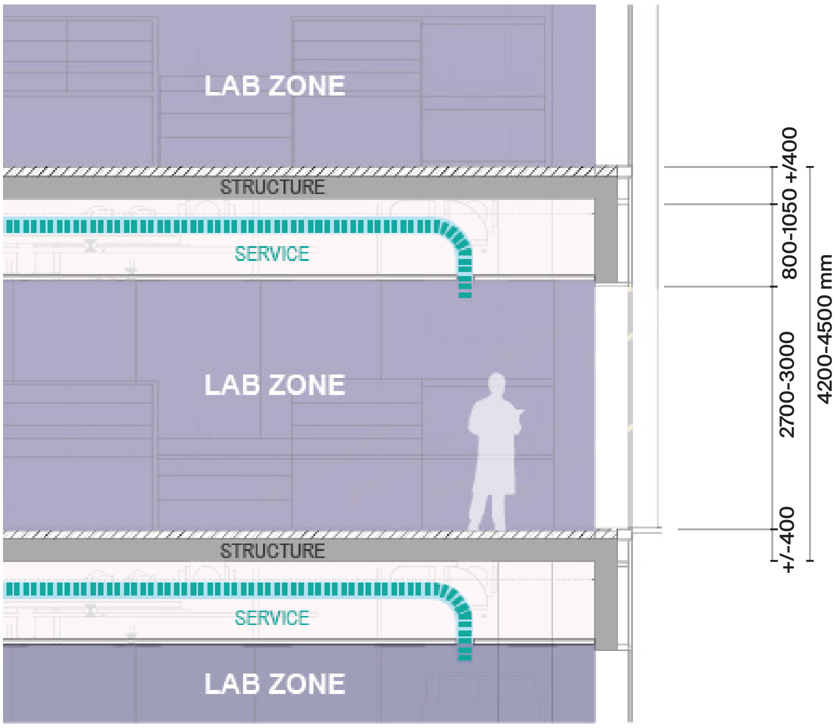
External storage for gases and lines to feed labs

Chemical storage

Drainage and waste management

Fit out considerations & components include

Benches (fixed/flexible)
Worktops (chemical/bacterial/water/moisture/scratch resistance, easy cleaning, high impact)
Shelving
Fume cupboards and extract
Cleaning/sterilising machines
Safety cabinets
Specialist requirements (cold/clean room, industrial gasses, liquid nitrogen, temp/humidity control, additional plumbing)



0.8-1m ceiling service zone to cater for lab containment level requirements.

2.7 - 3m clear floor to ceiling height for full lab fit out flexibility and optimised day lighting.

Optimised structural design to reduce embodied carbon impact and respond to lab minimum lab vibration requirements (impact of 500mm additional excavation depth: 1.4%).

Diagram illustrates typical slab-to-slab height for a laboratory building.

Floor-plate size
Large 25,000+ sq ft floor plates promote scientific efficiency and room proximity in labs. Labs demand extra space for plant facilities, vertical and horizontal zones, and various services like ventilation, HVAC, plumbing, lab gases, and electrical systems. Managing these complex services necessitates ample riser and distribution space on each floor, making lab spatial needs surpass those of lightly serviced buildings like offices.

Flexibility
Laboratories also see a significant level of change throughout their lifetime and need to adapt and evolve to suit the changing needs of the science. As such, labs layouts often change and service provisions need to be adjusted or augmented to service a new process. Having sufficient service distribution space is crucial to enable these changes to be carried out and for the building to be flexible and adaptable over its lifetime.

Outdoor areas and Amenity
Requirement for amenity space such as a terrace or wellness centre given scientists often work in intense and stressful environments.

Slab-to-slab height
With additional air handling equipment and other services delivered to benches, the requirement for slab-to-slab height is notably greater than conventional office space. Purpose built labs will naturally be designed to 4.50m or more for a best-in-class provision. An office conversion with a typical slab-to-slab height of less than 4.00m (commonly 3.75m) is very tight for labs conversion and requires serious consideration about the laboratory use which can be applied.

Vibration risk
Many conventional commercial properties are ultra-light in structure, causing even the vibration of occupant movement in a lab to be a potential problem. With hyper-sensitive tolerance standards, vibration-sensitive robotics, and use of equipment ranging from electron microscopes to nanotechnology testing, existing vibration levels and the feasibility of mitigating them both for present and potential future use. Vibration should be below 1 hertz.

Air-Cooling
Significant cooling load to deal with the heat output from the large amount of equipment within labs (typically 2-3 times that allowed for in offices). Some equipment will have specific water-cooling systems.

Ventilation
Labs are high energy consumption, typically 3-5 times that of a standard office and required by BCO standards. Over 60% of this energy consumption is used in ventilation, the HVAC system. General labs using hazardous materials should have

a minimum of 6 air changes per hour (ACH) with a typical range of 6-20 ACH; the rate depends on the activity undertaken in the room. More extreme conditions can be created but these are rare. Exhaust ventilation is continuous and designed to be shut down and isolated in case of an accident. Fume hoods provide immediate extraction for localised work but cannot be relied upon for ventilating a whole room. Likewise, more flexible “elephant trunk” local extraction pipes (LEV) can be installed.

Since a ventilation system designer cannot know all possible laboratory operations, a single air change rate cannot meet all conditions. Furthermore, ACR/hour is not the appropriate concept for designing contaminant control systems. Excessive airflow with no demonstrable safety benefit other than meeting an arbitrary air change rate can waste considerable energy

Resilience
Many functions in laboratory work have critical systems which cannot be allowed to fail. Back-up generators are normally required to ensure systems continue to function so experiments run or freezers remain at essential temperatures (-80c is regarded as ultra-low deep freeze but -150c is also used). Commonly the generators are diesel, bringing issues for sustainability, fuel storage and secure external space. Resilience also includes critical safety management systems depending on the type of research being undertaken, e.g. fire, explosion, gas leaks, which are in addition to CL controls.

Gases
The most common laboratory gasses are Air, Oxygen (O_2), Carbon Dioxide (CO_2), Carbon Monoxide (CO), Nitrogen (N_2), Argon (Ar), Hydrogen (H), Helium (He), Krypton (Kr), Neon (Ne), Xenon (Xe). External bulk gas storage compound required to reduce the number of weekly servicing visits and to increase operational efficiency vs having on floor plate gas. Liquid Nitrogen (LN_2) requires very specific storage and distribution.

Servicing
Many lab products, equipment and chemicals cannot be handled in public areas. Dedicated passenger and goods lifts with redundancy provision are required, contributing to large service cores. Additional lift capacity in an office conversion needs to be considered carefully. Failure to provide this will restrict the end use.

Waste management and drainage
Laboratories typically produce large amounts of waste and require specific drainage systems distinct from human waste systems. Specific labs may require a Effluent Treatment Plant, a treatment method designed to purify laboratory waste water to meet stringent safety standards. Chemical resistant pipes must be installed in the system and separate drainage from standard drainage stacks within the building. Access for collection must also be considered as should the provision of fume extract discharge above the highest point of the building.

Risers
Multiple large service risers to provide suitable vertical routes to accommodate the mechanical and electrical infrastructure.

Power and connectivity
Resilient and large power supply due to the significant increase in user equipment compared to an office and best in class internet connectivity to handle the terabits of data that are produced from items like Next Generation Sequencing machines.

Plant
Significantly more plant than a comparably sized office building due to the highly serviced nature of laboratories and the need to achieve and maintain closely controlled internal environments. Lab buildings require plant space equating to c.15-20% of GIA, whilst offices require ≤10% of GIA. Roof top plant of sufficient scale for all the plant required and to facilitate air flow into the air handling units and heat rejection plant. Locating plant on the roof as opposed to on individual floors also avoids disruption to the science during maintenance, eases operation and maximises operational efficiency, as well as aiding control of access to authorised areas. Ambient noise levels at ground level can also be better controlled with plant located at roof level. There is typically 50-75% more plant space in lab than in an office.

Loading
Significant floor loading to accommodate specialist equipment and achieve acceptable vibration response factors. This is typically double the imposed load in comparison to an office.

Integrating use types
Lab buildings contain multiple uses: labs, equipment rooms, write-up space, support offices and plant rooms. Whilst integration of these key elements increases building efficiency, there is no singular correct layout for all users, so flexibility is key. Commonly, write-up space is adjacent to labs, to allow easy movement between the two. Office space for support functions is usually separate from this and on a different floor. Equipment rooms house heavy or specialist kit and should be close to the labs, so samples/chemicals are not exposed to unprotected areas. Usually, these rooms have additional floor loading and safety measures. Plant rooms should have the shortest access route to the labs, minimising pipework where the additional HVAC needs are greatest.

Sustainability
Sustainability must be considered, both in terms of building design and end user operation. Labs consume large amounts of power and water and produce high levels of waste from packaging and raw materials. Achieving a BREEAM accreditation of ‘Excellent’ or ‘Outstanding’ is now seen as a minimum requirement and something developers should aim for to maximise value. The end user must also look after their own sustainability and manage their processes. Where possible, developers and investors should focus on installing energy-efficient technologies, such as water conservation and recycling, low energy exhaust systems, air quality monitoring systems, and more sustainable heating technologies.

Investing in sustainable interventions and flexible design will help to future-proof the asset.

Typology:
Lab Enabled vs Lab Ready

As the Life Sciences market diversifies, we are witnessing demand for space being directed by the R&D and science being undertaken. Specification between purpose-built schemes and repurposed offices differs, though both have the capacity to deliver different lab typologies. These are lab enabled, lab ready, or fitted and serviced. Our industry needs to ensure we use the correct language when describing these typologies.

For purpose-build laboratory

Lab Enabled

Lab enabled buildings may be ground up or repurposed. The base build will be suitable for lab use and should contain all the elements of design mentioned above; however, the finish will include:

- 6-10 ACR/hour as the baseline performance
- Landlord/core areas fitted, including toilets
- Higher volume risers
- Additional space for waste management
- Ability to supply increased power and water
- Solid floors in lab space and raised floors in write-up areas but not fitted
- Base plant supplied
- Additional drainage channels for dangerous waste
- Space for chemical and gas stores
- Goods and passenger lifts installed
- Provision for heating, cooling and extract equipment

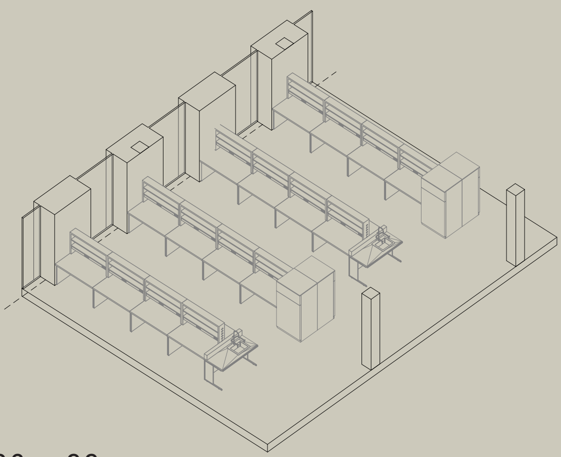
Lab Ready

An extension of lab enabled, the finish has additional levels of services so the building is ready for the tenant to install their final laboratory fit out without significant alternation works to the base build. Whilst not fully fitted, the installation of benches and other lab equipment can be included.

- Baseline HVAC prepared for use, extract horizontally distributed
- Solid floors vinyl floors in wet labs and raised carpeted floors in write-up space
- Roof plant space for labs, split systems and space for tenant plant allowed for within enclosure
- Gas storage area constructed, and primary pipework installed to building entry point
- Extract flues part of base build
- Gas detection systems installed
- Lab benching, fume cupboards, autoclaves and fixed furniture all fitted
- Eye wash and hand wash stations installed
- Water supply fitted to lab space as required
- Wash basin and eye wash facilities
- Drainage from fitted benches
- Chemical drainage and waste disposal

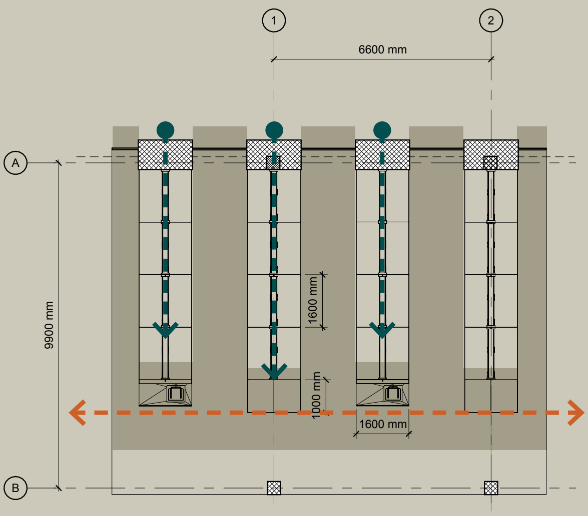
The diagrams below illustrate the flexibility of the structural grid between a laboratory layout and an office use:

Laboratory



6.6m x 9.9m

Laboratory Circulation Plan

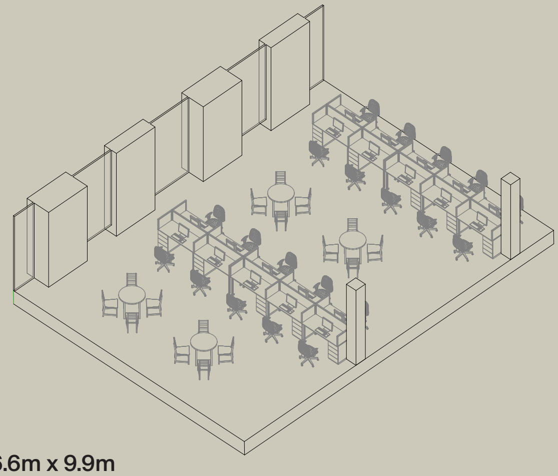


6.6m x 9.9m

Benches are located along the facade allowing for water and service reticulation from external walls where possible.

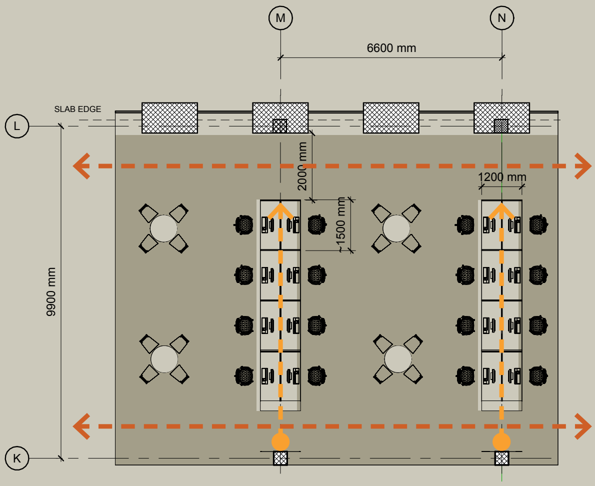
Tall units or sinks are at the end of each island of benches adjacent to Lab interior circulation routes.

Office



6.6m x 9.9m

Office Circulation Plan



6.6m x 9.9m

Work-desks can be located away from the facade allowing for views out and benefits all occupants.

Electrical services can be reticulated via service droppers, vertical structure or raised floor systems.

Workstations can be alternated with co-working spaces to allow for flexible/collaborative working.

Layout strategies for laboratory and office spaces

The approach to laboratory layout is fundamental and is often driven by the use and function of the building. For instance, a speculative commercial laboratory that requires flexibility and efficiency inbuilt for either chemistry or biology can drive the footprint to be a singular floorplate with both lab and office spaces adjacent to a central core/ service risers. A laboratory with an end user client will be laid out specifically for their use and function. Similarly, an academic or university-led laboratory can vary from a commercial layout to suit their specific needs.

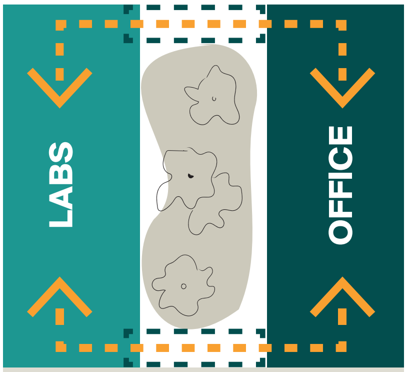
When designing the internal layouts and functions of laboratory spaces, including supporting write-up areas, several crucial considerations apply. Examples of these are:

Work-flow optimisation
Arrangement of spaces to minimise unnecessary movements and promote efficient work-flows. Ensure write-up spaces are easily accessible from the laboratory to encourage prompt documentation.

Collaboration zones
Areas that foster teamwork and idea sharing. These areas can accommodate discussions, brainstorming and quick consultations.

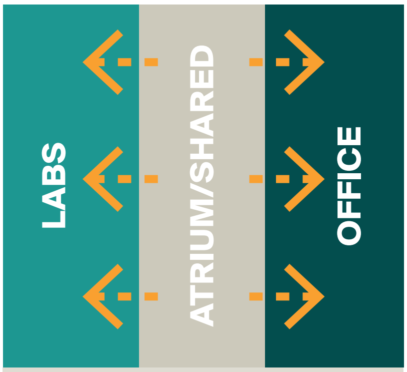
Aesthetics and comfort
Creating visually pleasing and physically comfortable environments, natural lighting, biophillia or access to outdoor landscaped areas can positively impact productivity and occupant well-being.

Future expandability
Plan for future expansions or modifications allowing for scalability as research needs evolve.



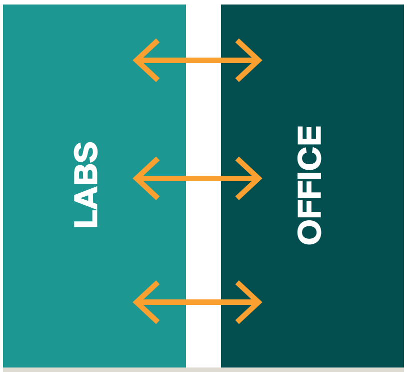
Completely separating laboratories from supporting write-up and office areas may occur where strict contamination control is required or in instances where there might be risk of chemical exposure.

Some researchers also find it mentally beneficial to have a clear psychological separation between experimental and analytical work. Introducing green spaces and/or pedestrian links across two separate buildings housing the different functions can help create this separation.



Using a central atrium as a shared space between lab areas and supporting write-up/office areas offer benefits such as opportunities for collaboration and interaction across floors and/or different tenants.

Atriums can also provide natural light where deep floor-plates have been used and can contribute to energy efficiencies by allowing for natural ventilation and daylight harvesting.



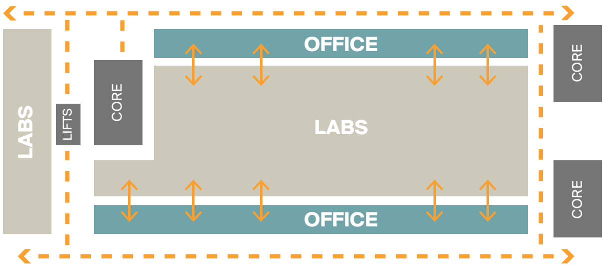
Directly adjacent lab and office spaces is primarily seen in commercial labs with multiple tenants due to the spatial efficiencies and flexibility achieved.

This configuration offers scalability and adaptability without the constraints of fixed walls within the same floor plate. This in turn increases cost efficiency.

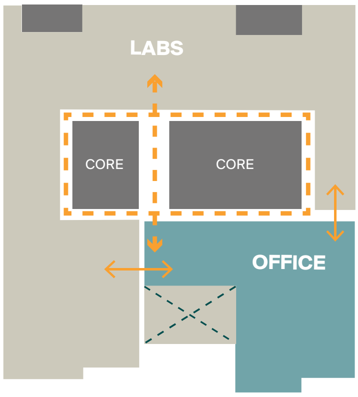
Smaller building envelopes would ensure that adequate daylight is harvested from the building facade.

The diagrams below illustrate various layout strategies for Life Science building precedents. Note: Diagrams are not to scale.

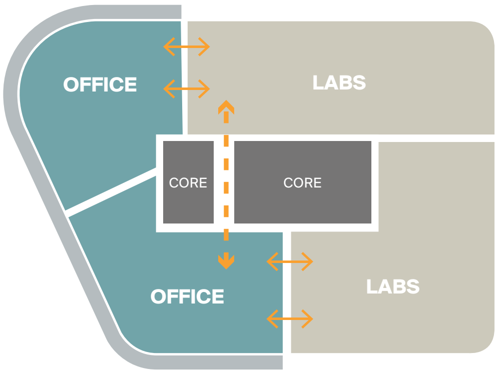
UKCMRI Building
Francis Crick Institute, London
Architects HOK International & PLP



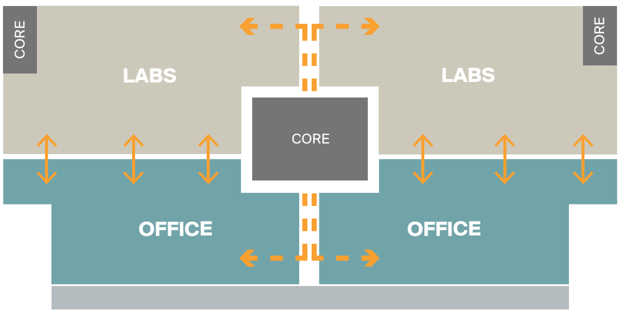
Imperial Collge Molecular Science Research Hub
London
Architects Aukett Swanke



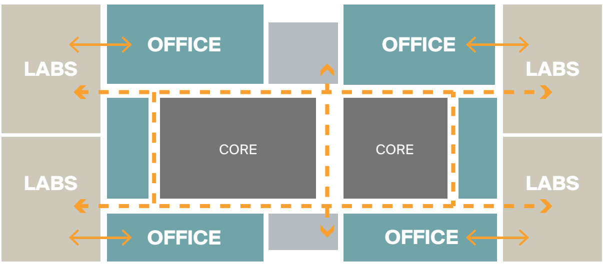
Trinity by Breakthrough Properties
Oxford Science Park
Architects Niazi Roden



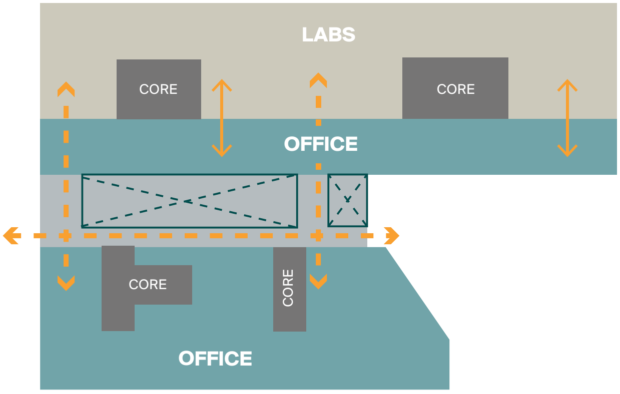
One Granta Park by BioMed Realty
Cambridge
Architects Niazi Roden



One North Quay by Kadans and Canary Wharf Group London
Architects Kohn Pedersen Fox Associates



Life and Mind Building by University of Oxford
Oxford
Architects NBBJ



Warm v Cold Shell

These are US terms which have been used in the UK by US led life science operators and real estate developers. A cold shell is the same as the UK shell and core. Warm shell has some of these elements, such as heating, but still leaves the vast amount of fit-out design down to the occupier, so not quite as far as the UK Cat A lab enabled. Labs fit-outs are bespoke to each organisation, the type of science and the specific processes employed, so going too far with the fit out can result in waste and alteration to suit the end design. This usually applies to organisations taking larger space. There is a move to provide fitted labs to smaller occupiers to improve speed to entry.

Re-purposed office buildings

In a bid to meet demand, property owners and developers are seeking to repurpose existing buildings, which can help significantly on sustainability and speed to market. However, this approach can result in a compromised substructure or structural considerations which need to be addressed:

- Not necessarily on a lab grid of 6.6m but uses an office grid of 7.5m or 9m (can result in some inefficiency in lab planning layouts).
- Slab-to-slab tend to be less than 4.2m and commonly around 3.75m, which is tight and can restrict some lab uses.
- Risers not always sized to laboratory ready levels, which can be 30% larger.
- Air change rates tend to be office based (c.2-4 ACR/hour) rather than labs which require 6-20 ACR/hour.
- May have raised floors rather than solid/void former floors and will require strengthening in lab areas but not necessarily in write-up space.
- Structure may require strengthening to reduce vibration to acceptable tolerances.
- Loading allowance in offices tends to be 2.5 - 4 kN/sqm; however, laboratory buildings will require additional floor loading capacity.
- Roof plant space may not be as extensive/strong as a purpose build development.
- Provision for flue extract rather than included as part of base build.
- May not include external gas storage area.
- A lab drainage system will need to be incorporated into the building.

A danger of repurposed buildings is reduced adaptability. Laboratories also see a significant level of change throughout their lifetime and need to adapt and evolve to suit the changing needs of the science. As such, laboratory layouts often change, and service provisions need to be adjusted or augmented to service a new process. Having sufficient service distribution space is crucial to enable these changes to be carried out and for the building to be flexible and adaptable over its lifetime.

One Granta Park by Biomed Realty at Cambridge. Architects: Niazi Roden

Wet and Dry Labs

Wet Lab

A laboratory where drugs, chemicals and other types of biological matter can be analysed or tested using various liquids.

Dry Lab

A laboratory focusing on applied or computational mathematical analyses for an array of different applications, physics experiments, electrical based research.

Depending on the type of life science innovation you wish to create, it may be necessary to use both lab environments. With a dry lab, you can complete the analysis of the product before starting full development. A wet lab environment is going to be essential if you need to work with any kind of liquid when conducting either chemical or biological research.

Wet Labs

Liquids involved in wet lab experimentation may be chemicals or hazardous products. Conducting experiments with these substances requires additional features, such as drain and vent services, chemical fume hoods and materials resistant to chemicals and bacteria. Alongside this, appropriate environmental conditions must be maintained to be able to accurately and safely test new technologies and products. A major consideration is the slab-to-slab height to enable air handling systems, power, service lift, risers, waste management, drainage and safety.

Biology versus Chemistry

Biology and chemistry are the two main wet labs uses. Both are experiment-based using liquids but have distinct characteristics and perform different functions.

Chemistry deals with the composition of materials, their properties and understanding how each property can confer a certain functionality to that material. Chemistry experiments are focused on studying the properties of organic or inorganic molecules, use of acids, examining compound and molecule structure etc. Equipment includes, fume hoods, titrators, spectrometers, polarimeters and chromatography.

Biology experiments use biological samples, such as cells, tissues or biological chemicals (e.g. Genetic/DNA research), plant cells or handling disease samples. Equipment will include centrifuges, autoclaves, incubators, dissection equipment, microscopes, thermocyclers, -80 freezers and biosafety cabinets.

Dry Labs

Examples include the testing of electro-magnetic noise, semi-conductor development, computational modelling of space theories, quantum state analyses. Dry labs often require humidity and temperature control, dust control, and fire suppression systems, to ensure that any electronics are well maintained.

A wet lab is one where drugs, chemicals, and other types of biological matter can be analysed and tested by using various liquids

WET LAB

VS

LIFE SCIENCE FOCUS

Activities include tissue culture, pathology, cell biology, molecular biology, organic chemistry, and physical chemistry

LIQUID ANALYSIS & EXPERIMENTATION

Experiments conducted in a wet lab typically involve liquid substances

ADDITIONAL FEATURES

Features include drain and vent services, chemical fume hoods, and materials wholly resistant to chemicals and bacteria

CONTROLLED ENVIRONMENT

Able to test out new technologies and products in a controlled environment without risking the safety of patients and staff

A dry lab environment focuses more on applied or computational mathematical analyses via the creation of computer-generated models or simulations

DRY LAB

CALCULATIONS & RESEARCH

Dry labs are designed primarily to perform any kind of computational or applied mathematics to solve complex problems

LABORATORY EQUIPMENTS

Usually equipped with electronics, large instruments, or dry materials that need to be stored

COMPUTER-ASSISTED EXPERIMENTS

Experiments include text interpretation, coding, ground theory methodology for the analysis of certain data, and quantum state analysis

COST-EFFECTIVE & ACCESSIBLE

Benefits include very low costs, access to high-end equipment, the ability to perform extensive networking, access to community of professionals, and many shared resources

Principles of Biosafety

Governing all lab practice are classifications of hazards and the processes to ensure a controlled and safe working environment.

LABORATORY PRACTICES AND TECHNIQUE

SAFETY EQUIPMENT

Primary Barriers and Personal Protective Equipment

FACILITY DESIGN AND CONSTRUCTION

Secondary Barriers

The Control of Substances Hazardous to Health (COSHH) Regulations act as the primary legislation for Biosafety in the UK and classifies biological agents into one of four Hazard Groups (HGs):

HAZARD GROUP 1	Unlikely to cause human disease in a healthy individual.
HAZARD GROUP 2	Can cause human disease and may be hazard to employees, usually an effective prophylaxis or treatment available, for example measles and mumps.
HAZARD GROUP 3	Can cause severe human disease and may be a serious hazard to employees; it may spread to the community, but there is usually effective prophylaxis or treatment available e.g., Hepatitis, TB
HAZARD GROUP 3	Causes severe human disease and is a serious hazard to employees; it is likely to spread to the community and there is usually no effective prophylaxis or treatment available e.g., Ebola virus, Small Pox

Labs are categorised in to Containment Levels, the higher the level the greater the security. Containments Levels 1, 2, 3 & 4 correspond with biosafety levels 1-4. Containment Level is terminology used in the UK and Biosafety is a US term.

Note Hazard Groups are not the same as Containment Levels. HGs show the danger of the pathogen. CLs specify handling procedures.

Containment Level considerations

CL1
- Controlled access
- Hand washing sink
- Sharp hazards warning policy
- Personal protective equipment (PPE)
- Laboratory bench
- Autoclave

CL2
- Controlled access
- Hand washing sink
- Sharp hazards warning policy
- Personal protective equipment (PPE)
- Laboratory bench
- Autoclave
- Physical containment device

CL3 with risk-based enhancements
- Air-tight when disinfecting
- Self-closing, double-door access
- Controlled access
- Sharp hazards warning policy
- Hand washing sink
- Sealed penetrations
- Physical containment device
- Laboratory bench
- Autoclave
- Powered air purifying respirator*
- Personal shower out*
- Exhaust HEPA filter*
- Effluent decontamination system*

*Optional risk-based enhancements

CL4
- Air-tight
- Self-closing, double-door access
- Controlled access
- Sharp hazards warning policy
- Hand washing sink
- Sealed penetrations
- Physical containment device
- Positive pressure protective suit
- Laboratory bench
- Autoclave
- Chemical shower out
- Personal shower out
- Supply and exhaust HEPA filter
- Effluent decontamination system

To provide some context to this, there are only nine CL4 labs in the UK, all in the Southeast, including MoD Porton Down and the National Institute for Medical Research (NIMR), eight of which are government operated/sponsored. It is estimated that approximately 70% of UK labs are CL2 classified.

Clean Rooms

A cleanroom is designed to control contamination by the removal of airborne particles, such as dust, microbes, aerosol particles and chemical vapours. Cleanrooms are necessary in many industries where small particles can affect the research, manufacturing and quality of a product or assembly. They are most commonly used in the manufacturing process and found in industries such as pharmaceuticals, semiconductor, biotech, medical device, life sciences, optics, aerospace, automotive, and military facilities.

There are many sources of contamination to control, including environmental and personnel sources. Cleanrooms can be filtered out by air handling units known as HEPA (High Efficiency Particulate Air), which remove 99.99% of particles. Depending on the level of contamination control required, cleanrooms are classified by the International Standards Organisation (ISO) or British Standards (BS).

Future-Proofing Assets

Artificial Intelligence (AI), Machine Learning (ML), Robotics, 3D printing, nanotechnology, and tissue engineering are changing many aspects of how the Pharma and Biotech industries operate. The day-to-day activities of companies in these industries will likely look very different in 2040 compared to today.

As an asset owner or developer, ensuring the buildings in your life sciences portfolio can meet the needs of the market in the medium and long term is an essential element of design.

What to think about to future-proof your life science building

Power and data
The increased use of AI, ML, and Robotics will place an even greater importance on being in a geographical location and building that can deliver a plentiful supply of power consistently. In the same vein, having access to a strong and consistent connectivity feed will become increasingly important.

Power contingencies
Prospective tenants will want to know about the backup power strategy.

Floor loading
Robots are significantly heavier than people, up to 300 kg so additional load capacity should be considered.

Increased automation in laboratories may lead to increased thermal load in lab buildings. The MEP consultant must ensure the building achieves the necessary air quality standards and cooling/heating capabilities.

Design in a sizeable loading bay and an easily accessible, well positioned goods lift.

Locations and capabilities of plant rooms
For a spec lab building or a building designed for multi-tenant use, the design team will need to make MEP assumptions early in the design process, such as agreeing on appropriate air-change rates, fume hood capacity, and locations for important MEP equipment such as process chillers, back-up generators, heat exchangers (to name but a few).

If the building owner decides not to provide certain services (such as certain compressed or liquefied gases), designing the building in a way that allows future occupiers to easily install these at a later date will make the building a more attractive proposition.

Understandably, incorporating greater flexibility will bring greater cost; however, increased flexibility from the outset will ensure market demands are met across the medium and long term.

Amenity and services

It is important to review and agree the level of servicing the campus expansion needs and how this is phased. The value of this is considerable to the occupier but costly to develop and operate.

Introducing appropriate amenities across a campus will improve comfort, activity, and connectivity. A sizeable campus requires a specific volume and variety of amenity offering.

An amenity strategy will need to be compiled addressing what amenities should be provided for each building, cluster of buildings, neighbourhoods, and, of course, the whole campus as a collective. The graphic below shows likely amenity that will be needed.

The amenity offering could also help to draw the local community into certain parts of the campus (by creating destination amenity) if required.

Understanding the End User

Quality lab design usually starts by thinking about the end user and how they will use the space. Having a good idea about the tenant profile at the outset will help to optimise process flow and the ergonomics of the different spaces in the building. It can also help inform the MEP strategy by thinking about environmental requirements of certain spaces, such as temperature and humidity control, and air pressure differentials. Controlling air pressure is an important aspect of lab design and we are seeing more requirements for positive and negative pressure rooms.

If the end user is not fully known during the design stage, engaging a cross section of likely users, and discussing the proposed design with them can be useful (this is a service that Knight Frank can provide).

Being Part of an Ecosystem

An ecosystem is a geographical concentration of interconnected businesses, academic institutions, research bodies, governmental groups, and supporting organisations that collaborate and innovate within a particular field.

Being a part of the right ecosystem can facilitate access to knowledge, resources, technical expertise, and, importantly, help to commercialise research.

For example, a Life Sciences ecosystem with a focus on drug development would have a concentration of SME Biotech firms (possibly originating from university spinouts) to produce novel R&D, Contract Research Organisations (CROs) to help conduct trials, Contract Development and Manufacturing Organisations (CDMOs) to help produce the drugs, legal firms to assist in navigating the legal complexities of drug development, as well as tech, marketing, and sales expertise to promote new discoveries.

It's important to note that it's not just SME Biotech firms that are eager to join prosperous ecosystems; Big Pharma also has a vested interest. Their desire to be close to innovative Biotech firms has only intensified in recent years due to the fast-approaching patent cliff that could see the erosion of large chunks of revenue of the world's largest drug companies – nearly 70 medications will come into the public domain by 2030 as patents expire, allowing other companies to make cheaper, replica "generic" drugs. To replenish their research pipeline and manage new product launches to replace lost revenue, Pharma companies are looking to M&A to plug the gaps.

Life sciences ecosystems work for both Biotech companies and Big Pharma – they need each other. Many Biotech companies operate at the leading edge of innovation; however, often lack the commercial power and expertise that established pharmaceutical companies can bring. Big Pharma is eager acquire the latest innovation to continue to grow and find new treatments.

The days of Life Sciences companies (particularly Big Pharma) adopting a silo strategy (insular, inward looking, protective of their IP) are over... for now. In today's market, a collaborative and knowledge sharing approach is more fruitful – this approach is giving birth to multi-occupier campuses and dynamic ecosystems (increasingly in urban locations).

Glossary

ACH air changes per hour (also ACR/hour)

Autoclave a machine requiring elevated temperature and pressure to disinfect and sterilise surgical equipment. They work by using pressurised saturated steam at 121 °C (250 °F) for around 30-60 minutes.

Biosafety Cabinet a ventilated enclosure offering protection to the user, the product and the environment from aerosols arising from the handling of potentially hazardous micro-organisms. The continuous airflow is discharged to the atmosphere via a HEPA filter.

Centrifuge a device for separating various elements by spinning at high speed. Can be bench mounted or larger machines.

CFM cubic feet per minute.

Chromatography a technique for separating the components of a mixture.

CL/BSL containment Level (UK) or Biosafety Level (US), the grading of security and handling procedures. Ranging from 1-4, 4 being the highest level of containment.

COSHH control of Substances Hazardous to Health is the law that requires employers to control substances hazardous to health.

Cryogenics the branch of physics that deals with the production and effects of very low temperatures. The Large Hadron Collider (LHC) is the largest cryogenic system in the world and one of the coldest places on Earth. Cryogens are ultra-low temperature fluids (-153c and below) for storing samples and gasses where required.

Dewar also referred to as a cryogenic storage dewar. This vacuum insulated flask is used to store cryogens at very low temperatures.

ETP Effluent Treatment Plant. A type of waste water treatment method designed to purify laboratory waste water, to meet stringent safety standards.

HG Hazard Group, ranging from 1-4, 4 being the highest in terms of the danger of the pathogen.

HEPA Filter High Efficiency Particulate Air. The Institute of Environmental Sciences and Technology dictates that a HEPA filter must trap 99.97% of particulates 0.3 microns or larger. The standard lifespan of a HEPA filter varies between 3 and 5 years in a standard cleanroom environment.

HVAC heating, ventilation, and air conditioning.

In vivo “within the living”. Experiments or procedures performed on living organisms.

In vitro “within the glass”. Experiments or procedures performed outside of living organisms, often in a test tube or petri dish.

IVC Individually Vented Cages, to keep animals separate.

LEV Local Exhaust Ventilation. “Elephant trunk” moveable pipes which capture dust, vapours, and fumes.

Pathogen an organism that causes disease.

Polarimeter a scientific instrument used to measure the angle of rotation caused by passing polarized light through an optically active substance.

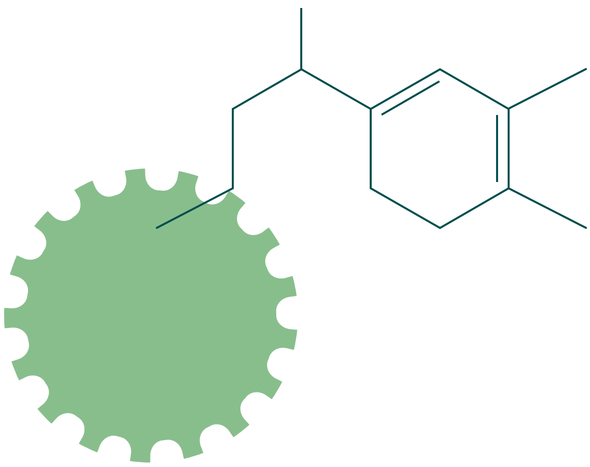
Prophylaxis a measure taken to prevent or protect against disease.

Spectrometer a device for detecting and analysing wavelengths of electromagnetic radiation, includes mass spectrometers and spectrophotometers.

Titrators a common laboratory method of quantitative chemical analysis to determine the concentration of an identified substance.

Thermocyclers used in molecular biology for DNA sequencing, cloning, generation of probes, quantification of DNA and RNA, and many more techniques.

Vivarium a building to keep live animals in semi-natural conditions for observation and study.



Contacts

Knight Frank's Life Science and Innovation team have created this document in conjunction with architects, Niazi Roden.

Knight Frank's specialist team researched and wrote the document, liaising with a range of sector specialists including occupiers, fit-out designers, M&E . consultants, architects and life science facilities manager.

Niazi Roden is an architectural practice specialising in architecture, urban design and masterplanning led by David Roden and Elias Niazi, with a strong years' track record in life sciences and research projects, and over experience by the directors in the sector. They are currently undertaking life science projects within the golden triangle in Cambridge, Oxford, and London, including Trinity by Breakthrough at Oxford Business Park for Breakthrough Properties and One Granta for BioMed Reality at Granta Park Cambridge. The directors previous life science experience includes projects at Cambridge Science Park for Trinity College Cambridge, Melbourn Technology Park Cambridge, St John's Innovation Park Cambridge.

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