

**WOODS  
BAGOT™**

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**STUDY TOUR OF  
LABORATORIES**



## STUDY TOUR OF LABORATORIES IN CALIFORNIA, US

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“The future fruits we reap will depend upon the continuing collaboration of scientists, artists, humanists, and their benefactors. Together they can provide the means for improving the life of generations to come.”

Jonas Salk, M.D.  
Founder, Salk Institute

This paper summarises the findings from the study tours undertaken by Woods Bagot of internationally leading laboratory facilities in California, US.

The study tour was organised in anticipation of being short-listed for the Department of Agriculture’s new HQ, BioSecurity and Agriculture Research Facility at Murdoch University.

Our laboratory consultant, San Diego-based RFD, organised and facilitated the tour of laboratories they have previously designed as well, as other significant research facilities in California. The findings of the tour are organised under the following discussion topics:

- Creating Social Buildings and Visibility
- Open Labs
- Flexibility and Adaptability
- Design for Technology
- Circulation
- Sustainability

## Laboratories Visited on the Tour



**DAVIS**

Sciences Laboratory Building, UC Davis  
Contained Research Facility, UC Davis

**BERKELEY**

Stanley Biosciences & Bioengineering Facility, UC Berkeley

**STANFORD**

Clark Centre, Stanford University  
Centre for Clinical Sciences Research(CCSR), Stanford University

**SAN DIEGO**

Centre for Molecular Genetics Unit 2, UC San Diego  
Cal IT 2, UC San Diego  
Powell-Focht Bioengineering Building, UC San Diego  
Salk Institute for Biological Studies, La Jolla, CA

### Creating Social Buildings and Visibility

It has been recognised that a laboratory's life blood is research funding, and lab design has become more and more about science on display where visibility is critical so that benefactors have a sense of where their funding is being used. The cultural shift towards greater visibility and more collaboration has been the catch phrase of all modern labs.

However, traditional lab designs where the core and lab support spaces are usually located between main circulation corridors and the open labs, make the public visibility of these labs problematic.

Nowhere has this cultural shift been more evident than in the Clark Centre where the traditional internal core design was turned inside out so that the support spaces are pushed to the perimeter with the open labs all facing an internal courtyard, ringed by external walkways interconnecting labs at various levels. Visitors and staff alike all use this external circulation and at all times have visual connection to the activities within the labs. It has been observed that this may be too much of a shift beyond the comfort zone of some, judging by the number of make-shift paper screens posted on the glass wall of the labs.

More social and educational spaces are seen to be mixed where cafes, breakout and seminar spaces are strategically placed to foster interaction and collaboration. Such emphasis on bringing the labs in close proximity to these social spaces recognises the fact that much of the scientific discoveries and dialogue occurs outside the labs.

As modern science becomes more and more of an intensely social activity, where scientific breakthrough often occurs during chance encounters with colleagues outside the confines of the labs, science functions best when it is supported by architecture that facilitates both structured and informal interaction, flexible use of space, and sharing of resources.



Clark Centre Cafe

### Meeting Places

Most facilities visited had critically considered the establishment of places where people can congregate outside their labs to talk with one another — cafes, break rooms, meeting rooms and atrium spaces. Even stairways, lift lobbies or stairs off atriums and built-in window seats along corridors, all provide opportunities for people to meet and exchange ideas.

### Team-based Labs

The emergence of collaborative research requires teams of scientists with varying expertise to form interdisciplinary research units. So spaces need to be organised to support collaborative research by:

- Creating flexible engineering systems and cabinetwork designs that encourage research teams to alter their spaces easily to meet their needs.
- Designing offices and write-up areas where people can work in teams effectively.
- Creating “research centres” that are team-based.
- Creating all the space necessary for research team members to operate properly near each other.
- Minimising or eliminating spaces that are identified with a particular department or discipline.
- Establishing clearly defined circulation patterns.
- Providing interior glazing to allow people to see one another, improve visibility and consequently safety.



Stanley Quantitative Biosciences – Lobby meeting spaces

### Open Labs

Typically the research facilities visited are open labs supporting team-based work. The researchers share not only the space itself but also equipment, bench space, and support staff. The open lab format facilitates communication between scientists and makes the lab more easily adaptable for future needs.

The labs are normally arranged by function rather than disciplines. This is to discourage ownership of the work space and to encourage flexibility in distribution of spaces to workgroups and promote shared spaces and equipment to keep cost down.

Open labs are seen as conducive to collaborative research and breaking down staff barriers however operational issues such as ambiguous responsibility and ownership of shared spaces and equipment has been a key concern for facility/lab managers.

Other common concerns among users include perception of a less secure environment, noise, difficulty concentrating and a sense that a generic space could easily be taken away.

The separation between different scientific disciplines is diminishing, giving rise to facilities that promote collegiality and communication. It is common to observe different types of studies being conducted in one facility, with scientists often crossing old and defined disciplinary boundaries to engage in work outside of their domain. Labs now accommodate the associated changing requirements. However, closed labs are still needed for specific kinds of research or for certain equipment. Nuclear magnetic resonance (NMR) equipment, electron microscopes, tissue culture labs, darkrooms, and glass washing are examples of equipment and activities that are housed in separate, dedicated spaces.

Some researchers may find it difficult or unacceptable to work in a lab that is open to everyone. They may need some dedicated space for specific research in an individual closed lab. In these cases, individual closed labs directly access a larger, shared open lab. When a researcher requires a separate space, an individual closed lab can meet the needs. When it is necessary and beneficial to work as a team, the main open lab is used. Equipment and bench space can be shared in the large open lab, thereby helping to reduce the cost of research. This concept was seen to be taken further to create a lab module that allows glass walls to be located almost anywhere. The glass walls allow people to see each other, while also having their individual spaces.



Powell-Focht Bioengineering – Lobby  
break out space



CCSR – Open Lab

### Flexibility and Adaptability

Flexibility is a key driver in the design of lab spaces but varies in its degree of application. It can mean several things, including the ability to expand easily, to readily accommodate reconfigurations and other changes, and to permit a variety of uses.

### Flexible Engineering Systems

Flexible engineering services—supply and exhaust air, water, electricity, voice/data, vacuum systems—are critical to most labs. Most labs visited have easy connects/disconnects at the walls and ceiling to allow for fast, affordable hookups of equipment. The engineering systems are usually designed to enable fume hoods to be removed or added, to allow the space to be changed from a lab environment to an office and then back again, or to allow maintenance of the controls outside the lab.

In some buildings, mechanical systems were designed for a maximum number of fume hoods in the building. Ductwork was sized to allow for change and growth and vertical exhaust risers provided for future fume hoods (usually 25% more) in the initial construction. When a hood is required, the duct is run from the hood to the installed vertical riser. The mechanical system is then re-balanced when a fume hood is added or deleted to efficiently accommodate the numbers of hoods in use and the air changes necessary through each room.

Engineering systems are commonly designed with at least an additional 25% for anticipated future programs.



Clark Centre – Overhead service carriers



Clark Centre – Overhead service carriers



Clark Centre mobile bench/desk

### Kit of Parts Cabinetwork

Cabinetwork design varies from moveable under bench storage to those with castors or underslung on unistruct systems under lab benches. Reagent shelves are either supported via ceiling hung services, reticulated spines or from floor mounted service pillars.

The most flexible and adaptable layout seen was at the Clark Centre where lab benches and writeup stations were designed with castors for ease of manoeuvrability and services fed from above via a system of overhead service carriers in the ceiling grid. The design allows for total flexibility of bench layout and writeup space configuration. The services are almost like a “plug and play” setup. It has been noted from user feedback, however, whether such flexibility was justified due to the expense.

Interstitial floor design such as the one at Salk Institute offers a high degree of flexibility that after more than 40 years this building is still a highly desirable lab to work in due to its ability to adapt the work space to changing needs and its aesthetic and architectural iconic status. It has been commented that whilst it may have been expensive to include the interstitial floors, the additional expense has been repaid many times over in the building’s 40 year life span.

### Lab Support Space

Typically the ratio of lab to lab support is 1:2 or less. It has been commented in the tour that this ratio is seen to be inadequate for modern research where there is more and more equipment usage with specialty rooms to support them. These shared support spaces are often arranged in a linear fashion off the ghost corridors. They are used to optimise space utilisation and raise the efficiency of the lab floorplate. These spaces usually, between 3.6 m to 4.2 m deep, often extending the length of the lab block, serve the dual purposes of circulation and housing large non-technical equipment (freezers, refrigerators, centrifuges, supplies). They work best in bioscience labs with high amounts of equipment that must be close to the lab. Core resources (animal housing, electron microscopy, NMR tools, greenhouses, central stores, sequencing, parallel computing, PC3 labs) are shared and often operate on a chargeback basis.



Salk Institute Interstitial Floors



CSSR- ghost corridors- lab support

## Design for Technology

One important change that has occurred in the design of research facilities is that furniture must be designed with computer use in mind. Furniture must accommodate the cabling necessary for PCs or laptop computers. Desks should be modular so that they can be added to or rearranged consistently with the fixed cabinetwork and the lab equipment to meet criteria for the space. Data ports and outlets should be located to accommodate multiple furniture layouts.

Typical dimensions are 1200 mm wide x 750 mm deep minimum for single write up, and 1800 mm wide if sharing computer. In wet labs, computer keyboards are placed away from spill areas, sometimes in separate write-up areas. Electrical outlets are designed to be accessible for plugging in adapters. Mobile carts are sometimes used for vertically stacking computer hardware.

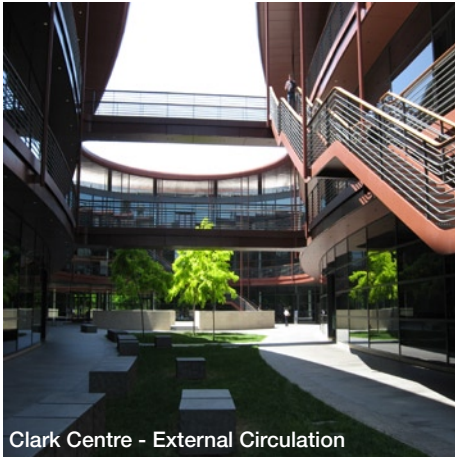
In Cal-IT 2, where IT technology plays a big part in the design of the building, partners are encouraged to converge in unusual teams to make fundamental discoveries. One of the defining characteristics is a constant state of change. The building was designed and inspired by the notion of change and exemplified through interconnected ubiquitous, broadband wireless communication.



Cal-IT 2

## Circulation

Traditional lab design usually has main circulation internally by corridors that depend on artificial lighting and offer little or no view to the outside. This is often disorientating to new users or visitors. Three buildings visited, Clark Centre, Centre for Molecular Genetics and Salk Institute depart from the traditional, where external balcony walkways replace internal corridors. This gives a sense of orientation and offers the added advantage of visibility, enabling flexible lab layouts without the constraints of circulation. However, this application would only be possible in a mild climate such as California or similar climatic areas. A potential solution for colder climates is to use a glazed atrium which will still retain all the advantages of external circulation.



**Sustainability**

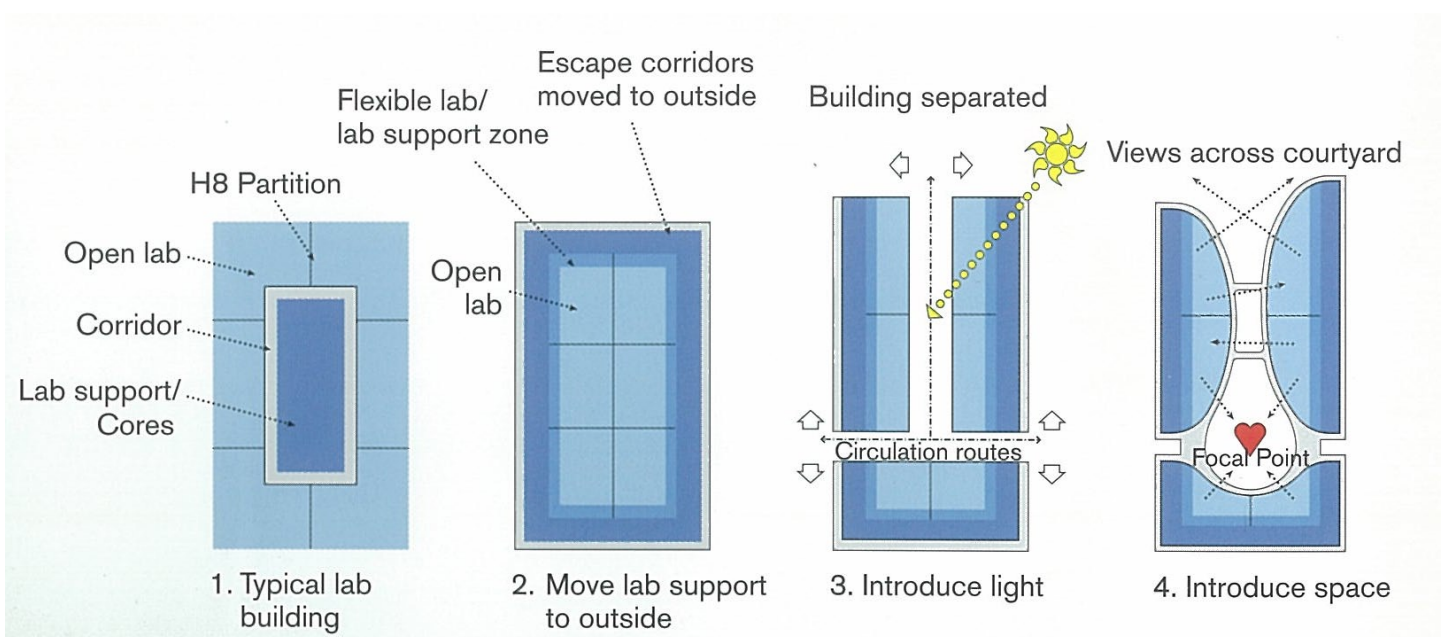
A typical laboratory uses five times as much energy and water per square metre as a typical office building. Research laboratories are energy-demanding for a variety of reasons:

- They contain large numbers of containment and exhaust devices.
- They house a great deal of heat-generating equipment.
- Scientists require 24-hour access
- Irreplaceable and expensive experiments require fail-safe redundant backup systems UPS or emergency power.

In addition, research facilities have intensive ventilation requirements—including “once through” air—and must meet other health and safety codes, which add to energy use.

Examining energy and water requirements from a holistic perspective and an integrated building approach can identify significant opportunities for improving efficiencies while meeting or exceeding health and safety standards. Sustainable design of lab environments will also improve productivity. Key aspects of sustainable design are as follows:

- Increased energy conservation and efficiency
- Reduction or elimination of harmful substances and waste
- Improvements to the interior and exterior environments, leading to increased productivity
- Efficient use of materials and resources
- Recycling and increased use of products with recycled content





#### About the Author

Keat is widely recognised for his design expertise and has over 20 years experience in a large variety of projects in the lifestyle, workplace and education sectors. His skills in conceptual and detail design are evidenced by the consistency with which projects associated with Keat's design input have won numerous architectural and industry awards. He has a hands-on holistic approach to individual projects, with a rigorous pursuit of design excellence and the belief that architectural excellence is achieved through teamwork and collaboration with the client.

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