[Title Here, up to 12 Words, on One to Two Lines]Name

Institutional affiliation

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Space Program

Table 1: Space program

Space	Area (Sq.m)
Recreational facility	
Accomodation Unit	800
Public area	730
Hospitality area	600
Domestic area	450
Adminstratice area	380
Leisure area	720
Shops	600
Conference halls	580
Subtotal	**4860**
Business Center	
banking area	800
Exhibition center	1000
Administration department	450
Subtotal	**2250**
Research and Develeopment Center	
Research laboratory	1000
Library	890
Innovation center	680
Subtotal	**2570**

Notes

The space program is based on an annual workload while considering ergonometric and anthropometric elements. The user traffic for the building is also assumed to be constant all year long.

The areas denoted in the program are based on net square meters, and they represent the maximum space for every unit. The maximum gross area of the total building may be identified as 118% of the net area.

If the distinct administrative areas are alienated, then they would be located within their respective departments. However, because of circulation and unification, the spaces could be joined to form one independent building section.

Case Studies

KAPSARC

Figure 1: King Abdullah Petroleum Studies and Research Center (KAPSARC) (Drake & Scull, 2012).

Table 2: Building Information

Information	
Location	University Road, Riyadh, Saudi Arabia
Dates	2009-2017
Area	70,000 sq. m
Site area	530,000 sq.m
Footprint area	28,500 sq, m
Architect	Zaha Hadid
Design	Patrik Schumacher
Project director	Lars Teichmann, Charles Walker
Design director	DaeWha kang
Client	King Abdullah Petroleum Studies and Research Center
Expected Completion	2017
Structural services designer	Arup
Interior designers	Woods Bagot
Date of completion	2017

King Abdullah Petroleum Studies and Research Center (KAPSARC) is a futuristic community center designed by Zaha Hadid. The building, which covers a footprint area of 28,500 sq. meters, was designed to meet the functions of energy and environmental exploration (Zaha Hadid Architects, 2017). With its strategic location, the magnificent building is the first

thing people see immediately after arriving in Riyadh and just before departing through the King Khalid International Airport. The structure utilizes several sustainable building features with advanced technology. Specifically, this is necessitated by the harsh desert environment in Riyadh. The building is designed to take utilize available winds to cool the facades and exterior spaces. The natural light into the interior spaces is also delicately controlled to allow for natural lighting but still limit resultant heating. Another salient point is that Zaha Hadid introduced proper landscaping that softened the external temperature within the building's vicinity, which increases user comfort. What is more, all the artificial lighting systems are energy efficient. All the properties above made the building gain its platinum LEED rating. Considering the arid environment in the project's location, the designers opted for water balance schematic to conserve water. The water conservation system is shown in the figure below.

Figure 2: The water balance schematic (Biohabitats, 2018)

KAPSARC is functionally made of eight primary areas, namely masala, IT center and backup, ancillary building, conference center, library, basement, research center, and a canopy. The basement area has public access, and it is connected to the research center, conference area, and library; this space covers a total of 16,785 m^2 (Drake & Scull, 2012). The research facility has three levels, and it measures 23,685 Sq. m. On the other hand, the library has two levels with a total area of 14,832 sq. m. The conference center, masala, IT center, and Canopy cover 21, 318, 1320, 4504 and 11,800 sq. m respectively (Drake & Scull, 2012). It is worth to note that all these centers are connected by naturally-lit passages. The picture below shows the aesthetic interior spaces.

Figure 3: One of the interior spaces in KAPSARC (Drake & Scull, 2012).

The design of the KAPSARC building involved a reorganization of the existing neighborhood. The geometry and servicing of the areas was modified to accommodate the new futuristic design. Some of the conceptual building plans are shown below.

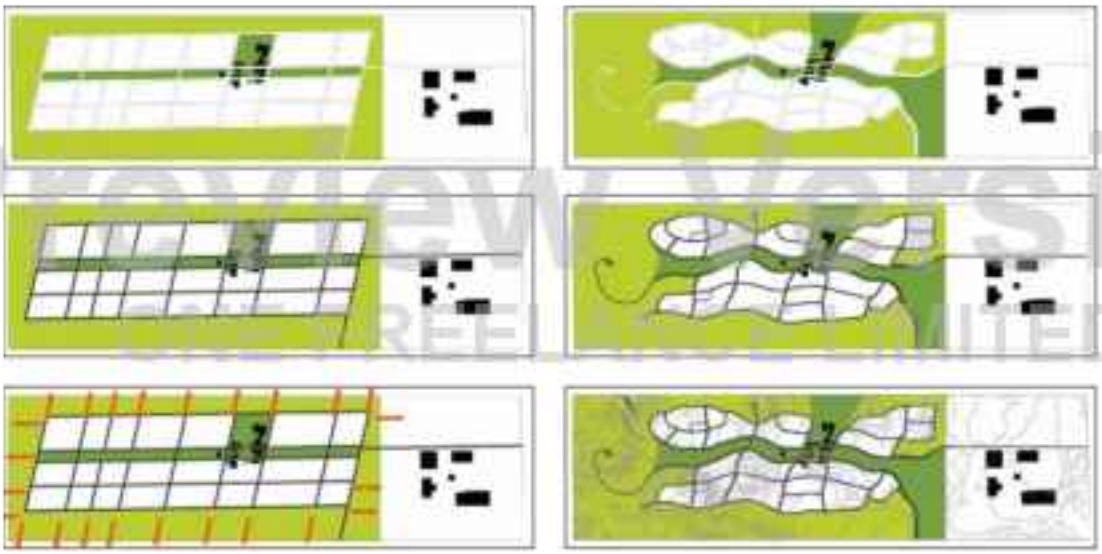
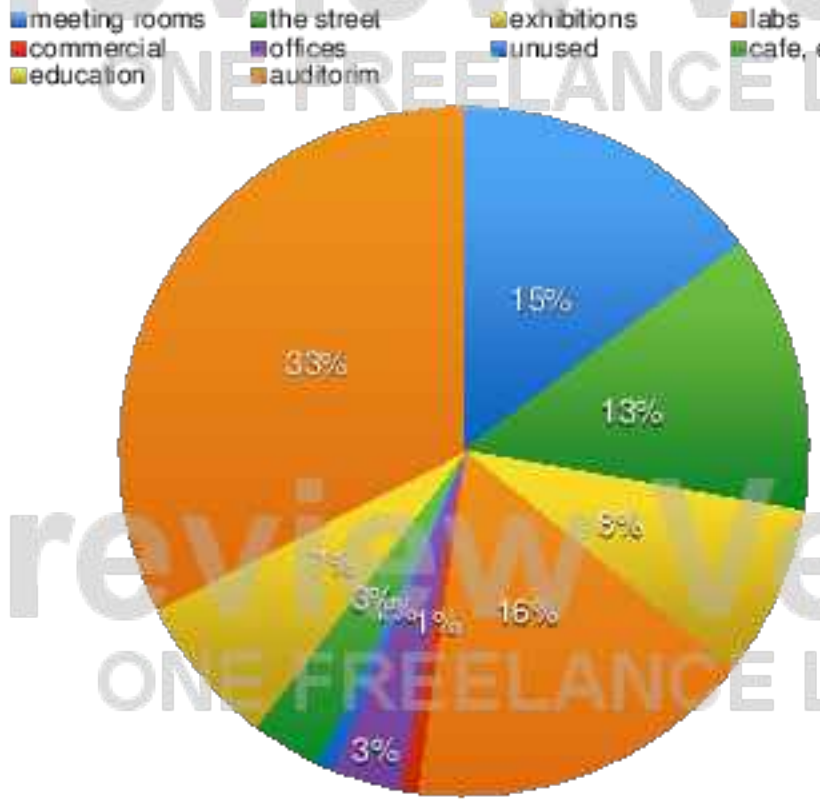


Figure 4: The existing neighborhood schematics with the modifications (American Institute of Architects, N.d.).

Figure 5: The final neighborhood and site plan (American Institute of Architects, N.d.).

Figure 6: Space distribution



National Renewable Energy Laboratory, Science and Technology Facility

Figure 7: National Renewable Energy Laboratory, Science and Technology Facility (Archdaily, 2013).

Table 3: Building information

Information	
Location	Golden, CO, United States
Dates	2005-2006
Area	182,500 sq. ft
Footprint area	71,347 sq. ft
Architect	SmithGroup
Design	SmithGroup

Information	
Client	National Renewable Energy Laboratory, Science and Technology Facility
Expected Completion	2006
Structural services designer	Martin-Martin
Interior designers	SmithGroup
Date of completion	2006

The building is a two-story structure with a net area of 44,800 sq. feet. It was opened in 2006 with an approximate cost of $318/ gross sq. ft. (National Renewable Energy Laboratory, 2010). Notably, the project was designed and implemented by the SmithGroup and JE Dunn Construction (SmithGroup). The ground floor contains laboratories, a lobby, and offices. The second level, on the other hand, comprises only laboratories. There is also a bridge that connects the second floor to the massive adjacent Solar Energy Research facility. The third level houses all mechanical components of the building. Another point is that the layout of the laboratory spaces consists of several modules measuring 10*27 ft. to allow the flexible distribution of utilities (National Renewable Energy Laboratory, 2010). Moreover, the first level holds labs that are vibration and noise sensitive. Such facilities need darkening and, thus, the need to naturally light the ground floor spaces is minimized. Another salient point is that the interiors are adequately spacious to facilitate the laboratory activities. Figure 4 below shows one of the designed laboratories.

Figure 8: A laboratory in the National Renewable Energy Laboratory, Science, and Technology Facility (Archdaily, 2013).

The building at hand is oriented along the east-west axis to allow for adequate natural lighting. Notably, the operable windows face either the north or south, and the characteristic butterfly roof collects rainwater for reuse within the facility. Another salient point is that the contractor recycled more than 80% of recycled waste (National Renewable Energy Laboratory, 2010). Furthermore, the building was designed to consume 41% less power than conventional lab buildings (SmithGroupJJR Architects, 2018). The structure also conforms to solar readiness principles since it has characteristic open roof areas (Lisell, Tetreault, & Watson, 2009). Other notable characteristics of the structure are water efficiency and fan systems. Some of the building drawings are shown below.

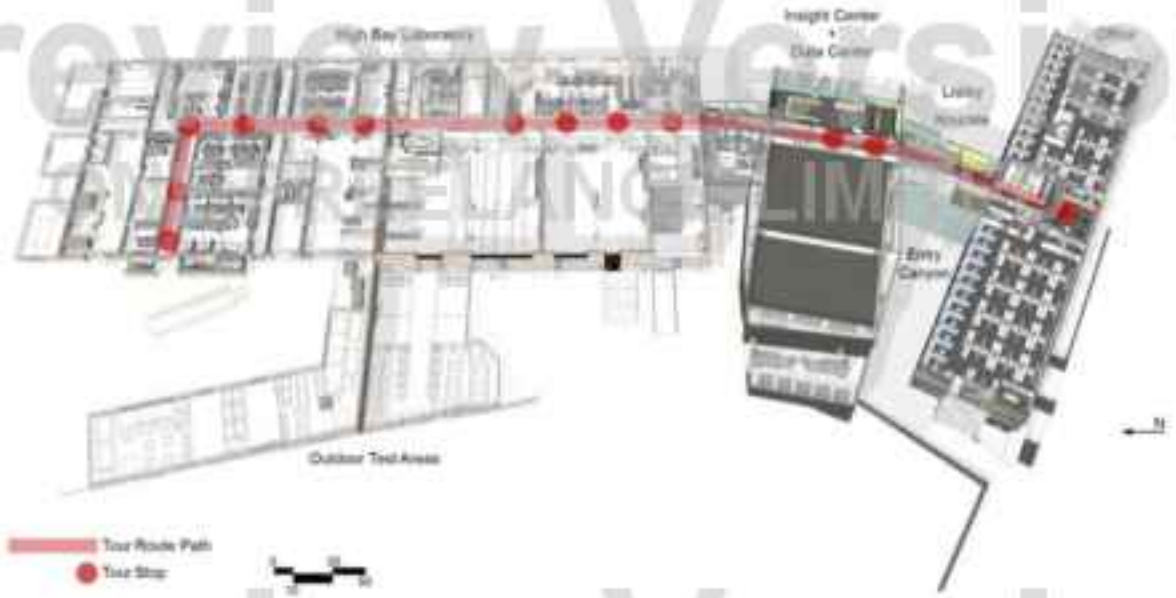


Figure 9: Floor Plan (Archdaily, 2013)

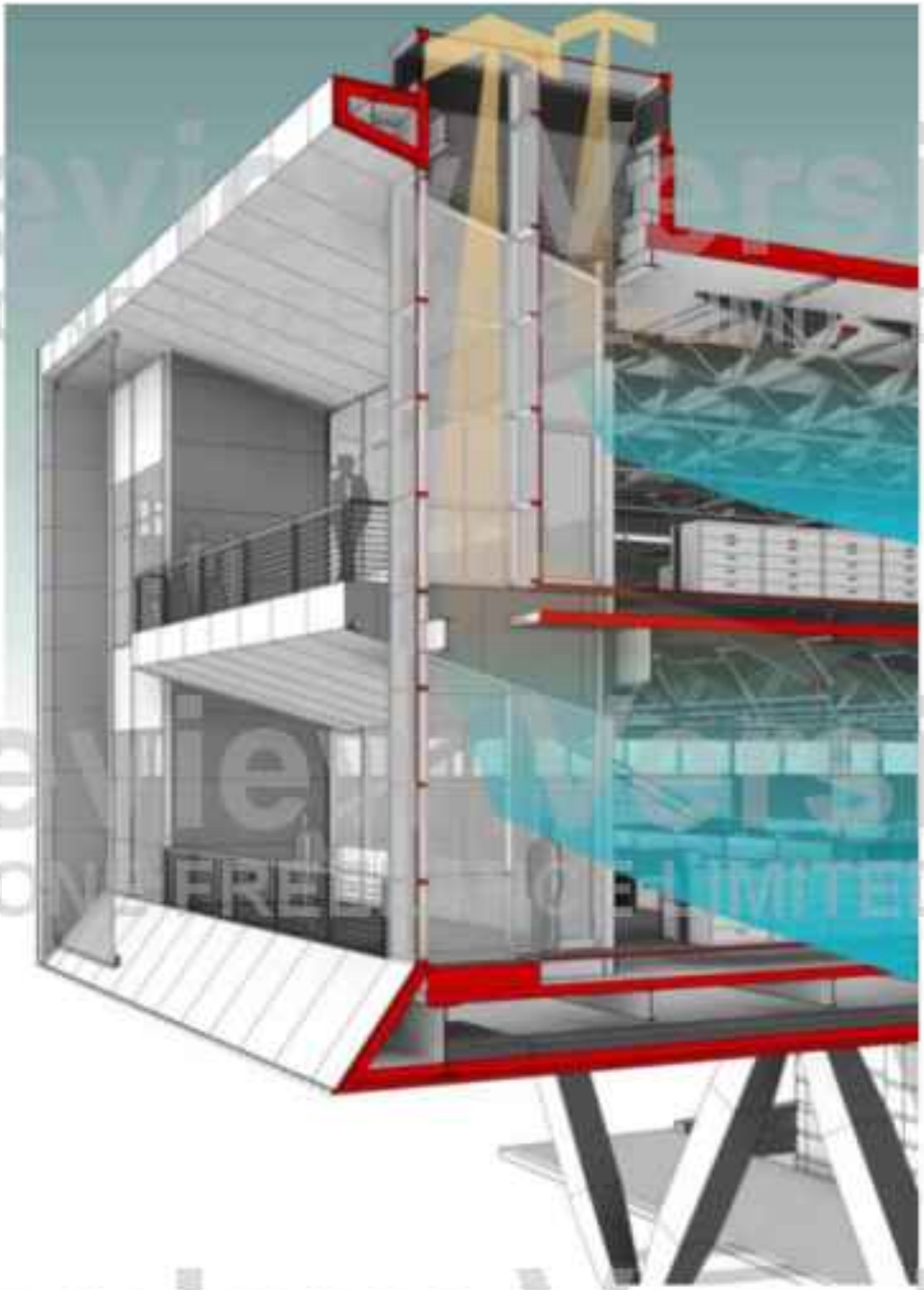


Figure 10: Section (Archdaily, 2013).

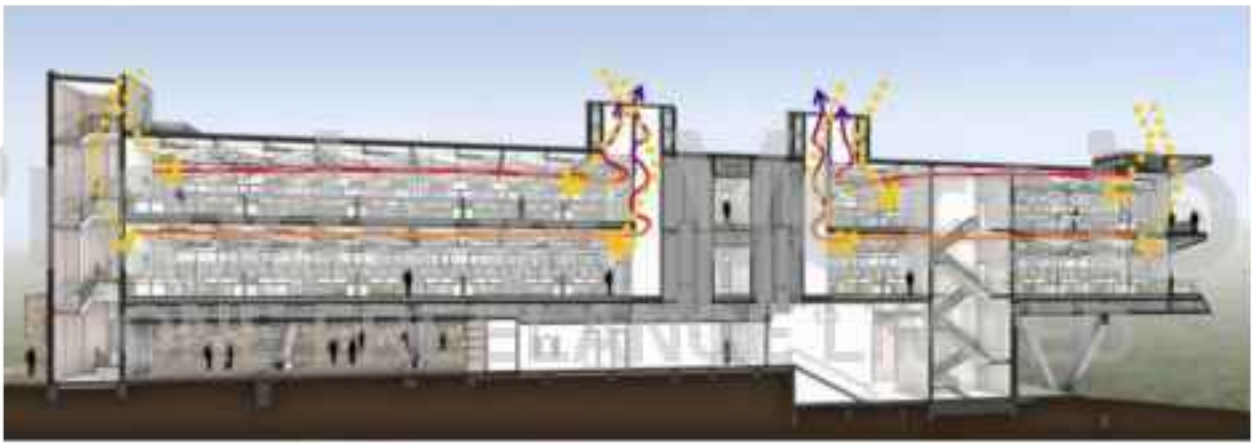


Figure 11: Section (Archdaily, 2013).

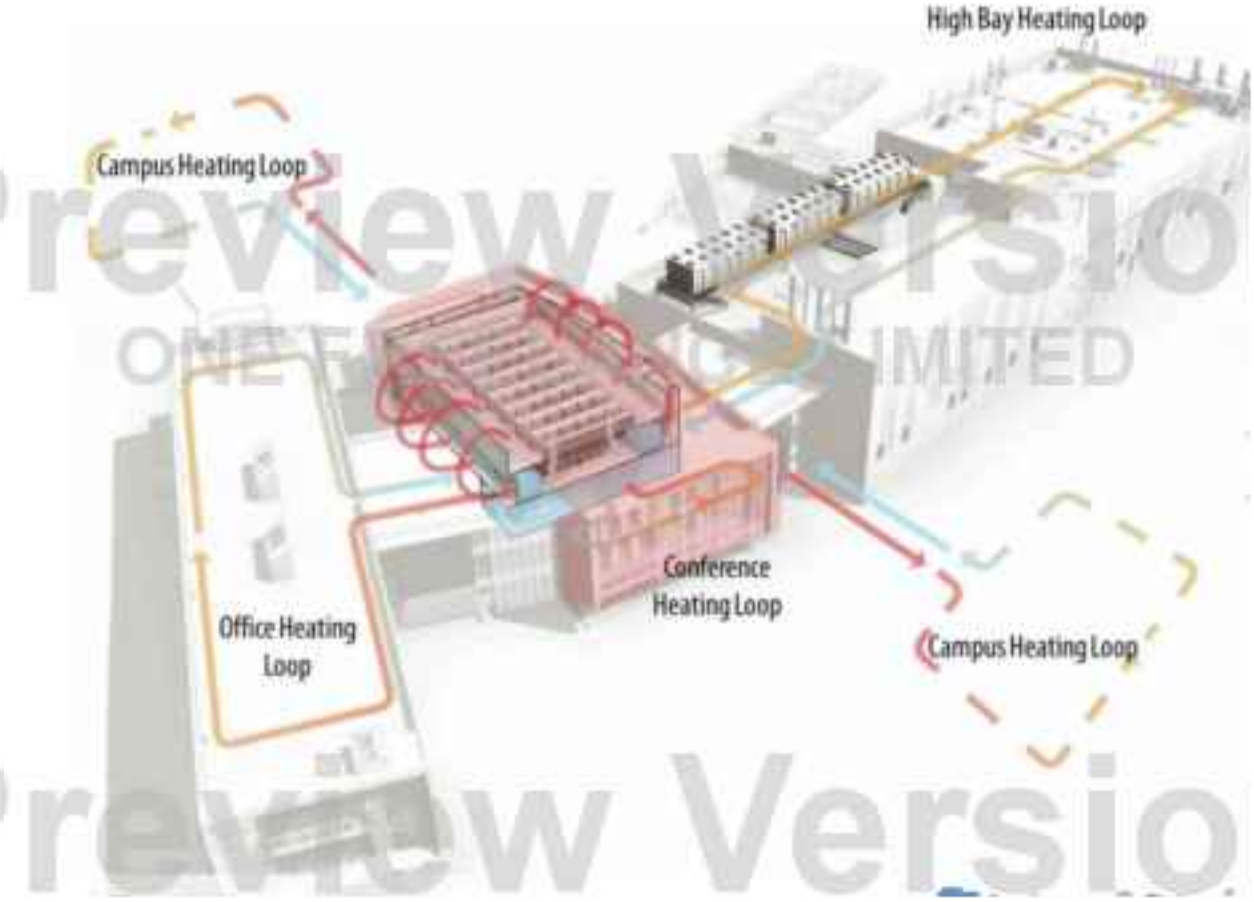


Figure 12: Building diagram (Archdaily, 2013).

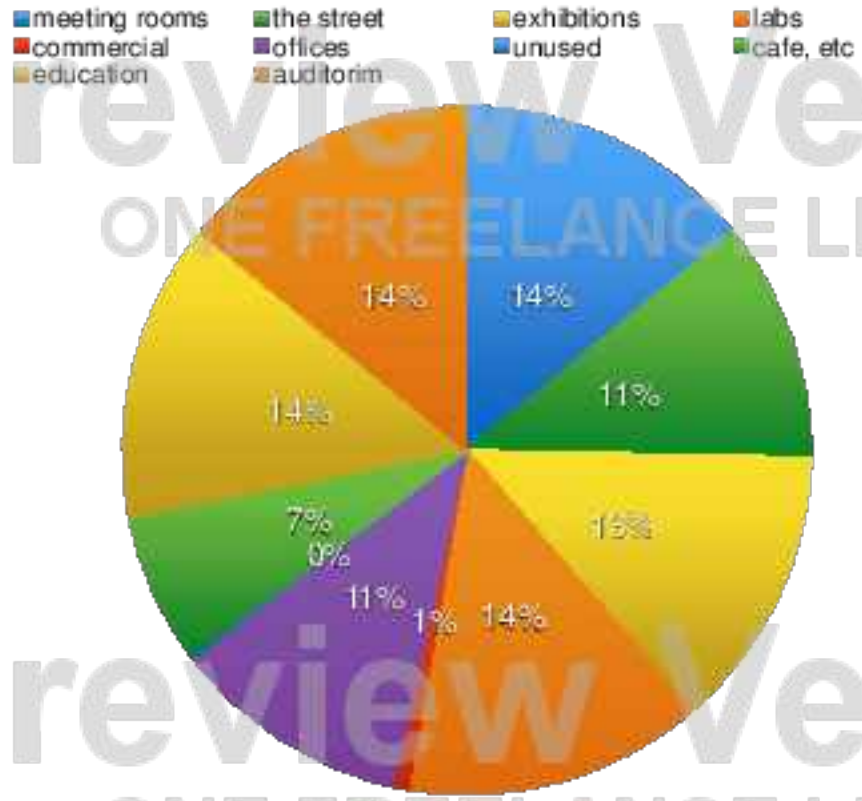


Figure 13: Space.

Chu Hall Solar Energy Research Center

Figure 14: Chu Hall Solar Energy Research Center (Archdaily, 2015).

Table 4: Building information

Information	
Location	Lawrence Berkeley National Laboratory, CA, USA
Area	39,000sq. ft
Architect	SmithGroupJJR
Design	SmithGroupJJR
Cost	$59000,000
Client	Chu Hall Solar Energy Research Center

Information	
Expected Completion	2015
Interior designers	SmithGroup
Date of completion	2015

The building was designed by SmithGroup JJR architects, and it is located in Berkeley, U.S.A. The structure is situated within the Lawrence Berkeley National Lab and has a total area of 39,000 sq. ft. (Archdaily, 2015). It is worth noting that the structure was named after the former lab director, Steven Chu. The three-story facility is the home of over a hundred scientists dedicated to generating artificial fuel based on solar energy. Notably, the building consumes 30% less energy than conventional lab and features naturally lit interior spaces as shown in figure 5 below. The unique sustainable features include runaround heat recovery, individual-office VAV terminals, high-efficiency condensing boilers and chillers, and evaporative pre-cooling hybrid systems (Archdaily, 2015). Generally speaking, these sustainable elements earned the building an LEED gold certification.

Figure 15: One of the spaces in the Chu Hall Solar Energy Research Center (Archdaily, 2015).

The building design schematics of the Chu Hall building are shown below:

Figure 16: Site plan (Archdaily, 2015).

Figure 17: Underground floor plan (Archdaily, 2015).

Figure 18: Ground floor plan (Archdaily, 2015).

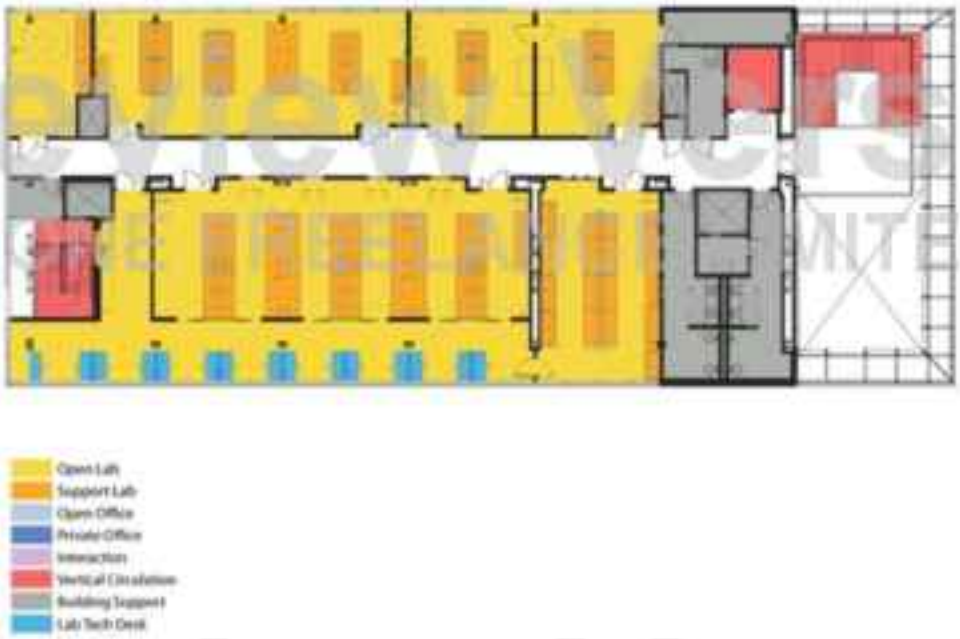


Figure 19: Second floor plan (Archdaily, 2015).

Figure 20: Section (Archdaily, 2015).

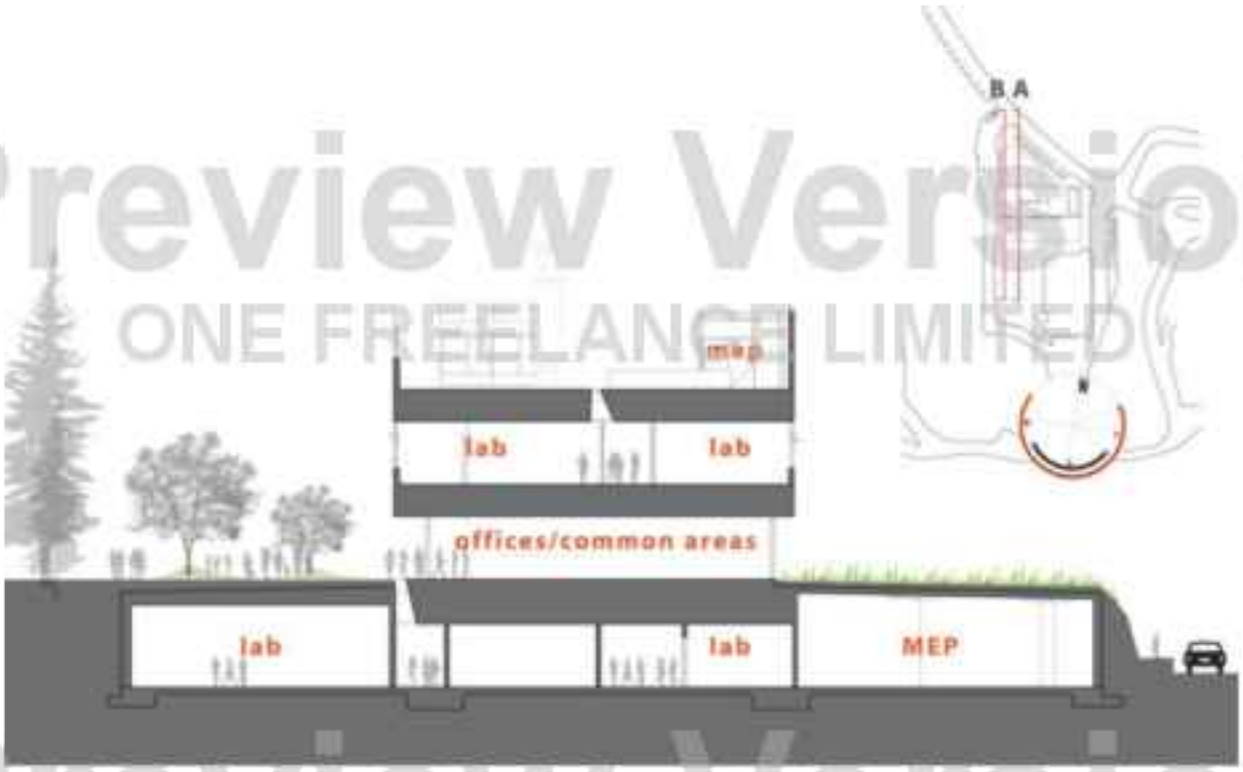


Figure 21: Section (Archdaily, 2015).

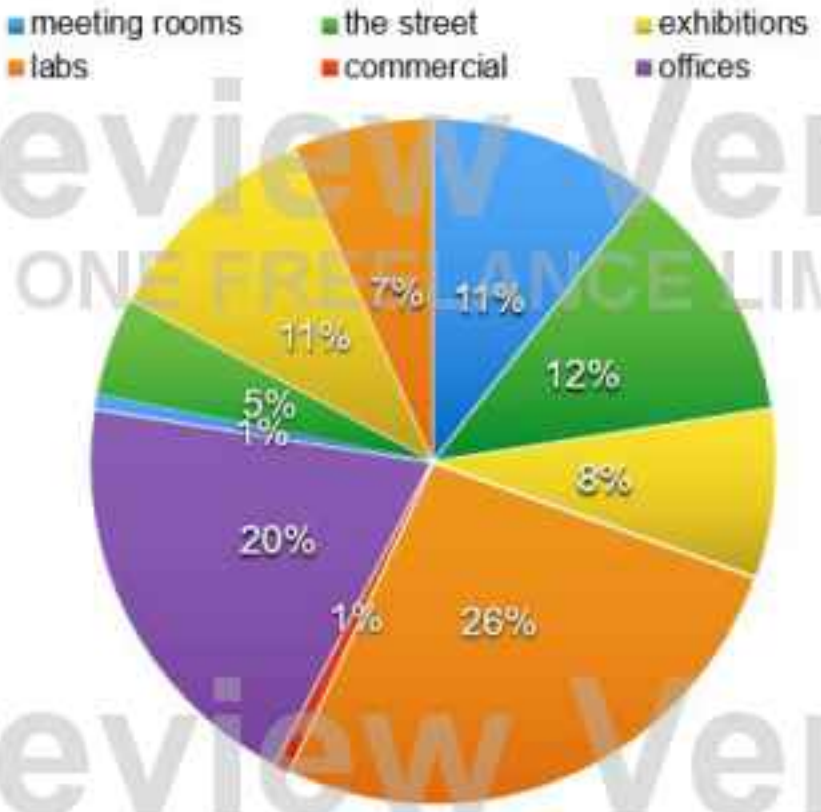


Figure 22: Section (Archdaily, 2015).

The three case studies above delineate the need to design high-performance buildings. Specifically, this can be achieved through the design of low energy buildings; post-occupancy energy performance evaluations; and the incorporation of daylighting, energy efficiency, energy recovery ventilators, evaporative cooling systems, natural ventilation, and waste recycling (Torcellini et al., 2006). On the whole, these measures ensure that a designed building conforms to all sustainability guidelines.

Project Prices

Table 2: Project prices

Elemental Project Price	Floor area 9580 m2	
	Description	**Amount ($)**
1	Sunstructure	80,000
2	Construction of all levels	35,000
3	Structural skeleton	560,000
4	External envelope	630,000
5	Roofing	420,000
6	Internal partitions	80,000
7	Floor finishing	200,000
8	Wall finshing	48,000
9	Fittings	800,000
10	installation of ceiling	90,000
11	Building servicing	600,000
12	instalation of plumbing systems	450,000
13	Fitting of fire-fighting equipment and systems	18,000
14	external works	540,000
Subtotal		4,551,000
15	Preliminaries	228,000
16	Allowance for eventualities	240,000
	Subtotal for construction costs	5,019,000
17	Esacalation	72,000

The estimated project cost, excluding Value Added tax, is $5,091,000. The assumed rate per square meter of floor area is $500.

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