Architecture of Workplaces 1. Lecture 10_1

Workplace of today and tomorrow
High-tech, Low-tech, and Smart-tech architecture

17-18. The transformation of the **Reichstag** is rooted in four related issues: the Bundestag's significance as a democratic forum, an understanding of history, a commitment to accessibility and a vigorous environmental agenda. As found, the Reichstag was mutilated by war and insensitive rebuilding. The reconstruction takes cues from the original fabric; the layers of history were peeled away to reveal striking imprints of the past – stonemason's marks and Russian graffiti − scars that have been preserved as a 'living museum'. But in other respects it is a radical departure; **within its heavy shell it is light and transparent, its activities on view**.

Public and politicians enter the building together and the public realm continues on the roof in the terrace restaurant and in the cupola, where ramps lead to an observation platform, allowing people to ascend symbolically above the heads of their representatives in the chamber. The **cupola** is now an established Berlin **landmark. Symbolic of rebirth, it also drives the building's natural lighting and ventilation strategies**. At its core is a '**light sculptor' that reflects horizon light down into the chamber**, while a sun-shield tracks the path of the sun to block solar gain and glare. As night falls, this process is reversed – the cupola becomes a beacon on the skyline, signalling the vigour of the German democratic process.

The building provides a **model for sustainability** by burning renewable bio-fuel – refined vegetable oil − in a cogenerator to produce electricity: a system that is far cleaner than burning fossil fuels. The result is a 94 per cent reduction in carbon dioxide emissions. Surplus heat is stored as hot water in an aquifer deep below ground and can be pumped up to heat the building or to drive an absorption cooling plant to produce chilled water. Significantly, the building's energy requirements are modest enough to allow it to produce more energy than it consumes and to perform as a mini power station in the new government quarter.

Form and Massing

The renovation project sought to bring light, and openness into the building. To accomplish this, a large dome shaped sky light was installed to help capture and reflect daylight deep within the structure.

Passive Design

The solar collector brings natural lighting into the heart of the building, whilst an automated solar shade protects against unwanted, direct solar gain. The main chamber of parliament is **naturally ventilated via the cupola**.

Environmental Systems

The building was designed to optimise the use of passive systems whilst minimising active systems. Both the artificial lighting and ventilation are controlled by a central BMS system and a heat exchanger recovers waste heat from the exhaust air.

Renewable Energy

A biofuel powered, Combined Heat and Power (CHP) provides approximately 80% of the annual electricity and 90% of the heat load of the building. A large Ground Source Heat Pump (GSHP) acts as a seasonal store of both heat and coolth. Photovoltaic's on the roof power the solar shade within the light sculpture.

19-20. City Hall is one of the capital's most symbolically important projects, which **expresses the transparency of the democratic process and demonstrates the potential for a wholly sustainable**, virtually non-polluting **public building**. The headquarters occupies a prominent site on the Thames beside Tower Bridge. It houses an Assembly chamber, committee rooms and public facilities, together with offices for the Mayor, Assembly members, the Mayor's cabinet and support staff, providing 12,000 square-metres of accommodation on ten levels.

The Assembly chamber faces north across the river to the Tower of London, its glass enclosure allowing Londoners to watch the Assembly at work. Members of the public are also invited to share the building: a flexible space on the top floor – 'London's Living Room' - can be used for exhibitions or functions, and the public commands the rooftop, where a terrace offers unparalleled views across London. At the base is a piazza with a café, from which the riverside can be enjoyed. Lifts and gentle ramps allow **universal access throughout the building**.

The building has been designed so that it has no front or back in conventional terms. Its shape is derived from a geometrically modified sphere, developed using computer modelling techniques.

This form achieves optimum energy performance by minimising the surface area exposed to direct sunlight. Analysis of sunlight patterns throughout the year produced a thermal map of the building's surface, which is expressed in its cladding. A range of active and passive shading devices is employed: **to the south** the building leans back so that its **floor-plates step inwards to provide shading** for the naturally ventilated offices; and the building's cooling systems utilise ground water pumped up via boreholes from the water table. These **energy-saving techniques** mean that chillers will not be needed and that for most of the year the building will require no additional heating. Overall, it will use only a quarter of the energy consumed by a typical air-conditioned office building.

27-28. Villa Eila is the house built by a wealthy and cultivated Finnish woman, Eila Kivekäs, in the town of Mali, set in the Futa Djalon Mountains of the Republic of Guinea. It was there that, in 1989, Eila Kivekäs founded a non-governmental organization (NGO), Indigo, which aimed to develop traditional crafts and to assist with the general improvement of the living conditions of the population. The house was designed by the Finnish architects Heikkinen-Komonen who **combined their**

native familiarity with timber structures with local materials, improved using simple technological advances. The house was the second of five projects designed by these architects for this client using a similar programme and materials.
The project evolved around two major issues: the exceptionally picturesque qualities of the site and the **requirement to use local materials, improved by means of simple technologies**.
The house is set on a long, narrow platform (6.7 by 33.5 metres), terraced along the contour lines of a 25 per cent west-facing incline, which meets the slope on the eastern side. It is raised about one metre above the yard on the western side. The building layout is similar to that of the dispensary: a **continuous covering** of 200 square metres spreads across the platform and shelters **separate walled-in areas** of 76 square metres **with shaded areas (porches) in between**. These porches act as areas for most everyday activities.
The **walled-in spaces** correspond to a very simple programme and their function is formally identified: round volumes at either end of the complex are **guest rooms**, each measuring 10 square metres; a **quadrangular volume**, measuring 13 square metres, is for **services** (storage, latrine and bathing area); a **rectangular structure is the owner's living-sleeping area** comprising a 17-square-metre bedroom connected to a common room, measuring 26 square metres, with a counter and cupboards at one end for the preparation of meals. The continuous roof extends over these volumes by 1.2 metres at the front and the back and is 40 centimetres higher than the round rooms. The front covered area, which faces west, is the main circulation route for all the rooms. The back gives access to the latrine and bathrooms and is sheltered from the adjacent slope by a continuous bamboo screen, which turns the passage into a corridor. Behind the screen, a well-defined ditch separates the platform from the slope and collects run-off rainwater.
Climatic comfort is provided by the shade of the continuous roof over the detached volumes, by the properties of the wall and roof materials, and by **cross-ventilation at roof level, with air circulation between the tiles and the straw ceilings**. The bamboo screen on the eastern side was also intended as a climate-control device, to filter the morning sun and wind and rain.

32-38. Replacing an existing structure used as a barn on a farm in the region of Bio Bio, it is requested to rebuild a higher-capacity version with 4 stables, 2 cellars and 1 trough.
Because of the **distance and the labour shortage**, it is devised a **mechanized construction system** to be assembled on the site by two carpenters on a short time. The system combines a series of **galvanized steel precast units with pine wood modular elements and the reuse of old demolition roof tiles**.
Throughout a grid of 3 x 3 meters is configured a rectangular floor plant of 6 x 18 meters, defined by a structure of steel posts and crossbars that supports a series of wooden rafters and an open gable roof.
Following the same grid, 4 enclosed modules were intended for the cellars and stables and the remaining under roof space was left for the animal shelter and the feeding trough. One of the cellars needed a special gate, from the side, to charge in straw bales from a vehicle.
All the structure settles over concrete bases and grounds on a floor slab with slopes for the water runoff. With the exception of the concrete base, all the other elements were designed for **dry assembly** and non-welding installation.

39-42. Located in the Templeton Gap area of West Paso Robles, California this **simple agricultural storage** structure rests at the toes of the 50 acre James Berry Vineyard and the adjacent Saxum Winery sitting just over 800 feet away. Designed as a **modern pole barn**, the **reclaimed oil field drill stem pipe structure**'s primary objectives are to provide an armature for a **photovoltaic roof system** that offsets more than 100% of power demands on the **winery** and to provide **covered open-air storage for farming vehicles** and their implements, workshop and maintenance space, and storage for livestock supplies.
Designed to harnesses the local climate to **maximize cross ventilation, daylight and solar energy**, the **recycled oilfield pipe structure holds a laminated glass photovoltaic roof system** that produces 1/3 more power than needed (roughly 87,000 kWh per year), eliminating the dependence of grid tied power for the winery and the vineyard irrigation wells through net metering. Utilizing the laminated glass solar modules as both the actual primary roof and the renewable energy generator, offset any additional costs to construct an additional roof with separately mounted crystalline solar panels. Minimalistic materials were selected to withstand the particularly dry climate, for regional availability, long-term durability and to minimize the need for maintenance.
Salvaged materials do more with less. Barn doors are clad in weathered steel off-cuts that were saved for reuse from the adjacent winery shoring walls, re-used in a "calico" pattern to fit the oddly shaped panels to tube steel framed door leafs. Storage boxes are skinned with stained cedar siding with the interiors clad with unfinished rotary cut Douglas Fir plywood.
This structure is completely self-sufficient and operates independently from the energy grid, maximizing the structure's survivability and resilience.

43-44. Selective Insulation is an artists studio in Hexham UK. The enclosure is a response to the chilly working conditions in the Old School House, an artists facility. In the Fall, Winter and early Spring, the uninsulated building, a masonry construction built in 1849, requires intensive heating in order to keep it thermally comfortable. A conventional approach to improving the buildings thermal efficiency would be to line the inner side of the stone walls with a new layer of insulation.

Selective Insulation is a project by Berlin architects Davidson Rafailidis that creates **insulated workspaces** within a larger, cold room.
The concept has been applied to an artist's studio in Hexham, UK, where the nineteenth-century building makes it difficult to maintain warm working conditions for much of the year.
Rather than trying to insulate the whole building, pockets of warmth shape the workspaces, which include a desk for two people, a door and a window.
"These three elements are positioned as structural anchors, and a connect-the-dots approach is used to create a framework for the volume," the architects explain.
This framework is covered with **two-ply bubblewrap, normally used to insulate greenhouses**.

46-47. "No other project dominates this mature phase of the architect's work as much as the village of New Baris, in a way that is comparable to the notoriety of New Gourna twenty years before. There are so many contrasting factors between the two projects that it is beneficial to examine the parallels between them.
Discovery of a large water well sixty kilometers south of the Kharga Oasis in 1963, which had been estimated to have the capacity to continuously irrigate up to 1000 acres of land, led the Organization for Desert Development to **propose an agricultural community** here at that time. This remote and forbidding wilderness outpost, which is almost in the geographical centre of Egypt, was planned to initially house 250 families, of which more than half were intended to be farmers and the remainder to be service personnel. His previous experience with such a project, and particularly his ability to build it inexpensively, made Fathy the logical choice as the architect for New Baris. Unlike his previous experience at New Gourna, however, where he could actually study and interview his "clients" and the houses and community buildings they had previously used, the potential occupants of New Baris were a totally unknown quantity.
Without a visible clientele to design for, Fathy concentrated on a thorough **study** of both the **traditional architecture and climate** of the region. In addition to examining the fourth century AD mudbrick ruins of the necropolis of Bagawat nearby, he also closely observed the existing village of Kharga, where the **material** used, as well as the **width and orientation of the streets** and **introverted forms of the houses** effectively offset summer temperatures as high as 50C degrees that could potentially cause serious physiological problems for the people living there.
These considerations, along with the additional **need for the cold storage of the fruits and vegetables** grown by the community prior to shipping, and the impossibility of providing air-conditioning, led Fathy to focus on **natural systems** as the formative influence on the new village. For this reason, the souk, or market place, became the active heart of a community which spirals out to fit a rather steeply graded ridge on either side of it. This souk, and other communal buildings around it, differ from their predecessors at New Gourna both in the more realistic choice of functions represented and the compactness of the open spaces between the buildings themselves. To solve the problem of the cold storage of perishables, Fathy turned to the physical solutions provided by **the thermal mass of materials** used and the **manipulation of natural air movement** as the only possible answers. By putting the **storage areas below grade** and **refining the malkaf designs** he had used previously by adding baffles, incrementally reduced airshafts and secondary towers to accelerate circulation, **temperature reductions of up to 15C degrees** were achieved.
This approach also continues throughout the domestic quarters of the village which, again unlike New Gourna, are organized along relatively linear north-south streets to take advantage of the shading that the buildings can cast on the streets throughout the day. In addition to this, the houses themselves are clustered around courtyards which are joined by taktaboosh to adjoining open areas and eventually to the pedestrian way itself, so that a combined convective system provides continuous airflow.

48-49. Officé Nigérian de l'Energie Solaire (ONERSOL) aims to provide facilities for the research, fabrication, and development of **solar energy**, the associated **administration and documentation facilities**, and accommodation for temporary staff. Conceived with the objective of re-introducing traditional forms by adapting them to new functions and of using traditional materials, the project also exploits the **use of solar energy for mechanical air-conditioning**.
Located in a residential area on the outskirts of Niamey, the site is surrounded by others designated to future academic projects. The building is composed of four distinct parts joined by internal courtyards with peripheral galleries. The composition is a direct result of the group of following activities: public facilities; residential facilities; research and development block; and a fabrication block.
The composition is well adapted to local climatic conditions and has taken into consideration the following considerations: **north/south orientation for openings; peripherial external and internal circulation galleries; courtyard organisation**, to permit natural ventilation; façades composed of vertical structural elements acting as sunbreakers; and blind façades protected from the sun by an **oblique spaced double wall, acting as a chimney and creating continuous air flow**. The structure is essentially load bearing concrete block walls, between which span metal trusses. Walls are stabilized mud bricks, made on-site and finished with pigmented cement plaster.

50-52. Though modern buildings tend to use less and less energy, the cost of servicing and maintaining them is growing ever higher.
An international landmark project, Baumschlager Eberle Architekten's the new head office sought to break new ground both in defining BEA's signature style and in its association with a technical revolution that saw it dispense to a large extent with technology.
Realisation
Visionary thinking for the future. Part universal prototype, part example to the world, 2226 asks the question: What is the role for human intervention in an office building that has dispensed with all its heating, ventilation and cooling technology? The answer lies at 2226, an HQ building set in Lustenau's Millennium Park.
In a building that is a **functioning part of its environment rather than just "architecture**", the choice of name is no accident: the ambient temperature inside is a constant 22°C to 26°C. The only heat sources it contains are there for other purposes, from the users themselves – every individual gives off an average of 80 watts of heat – to lights, computers and photocopiers, even coffee machines.
Living in harmony with the elements. 2226's perfect interior climate generates a perceptible feeling of wellbeing by **harnessing the angle of the sun and the flow of the wind**, just as its high-ceilinged rooms and clean, simple lines create a generous, light-filled atmosphere. Behind the space lies a technical vision based on the insights gained over more than 35 years of architectural practice at Baumschlager Eberle Architekten. 2226 impresses on several fronts – its minimalist approach, its low construction and energy costs and a natural climate that produces a pleasant working environment.
Features
One building, four seasons, a host of ideas. In winter, the warmth generated by the building's various heat sources is used to maintain an **agreeable room temperature**. Internally hinged, **sensor-controlled ventilation panels in the windows** open automatically as soon as the CO2 content or the temperature in the room starts to rise. During the heat of summer, the panels open at night to cool 2226 with natural draughts. The air conditioning system's sensors can also be overridden, enabling the ventilation panels to be operated manually.
Innovation and revolution
The necessary level of temperature stability in the building is achieved by its own **thermal mass** thanks to exterior walls that consist of 38cm of load-bearing and 38cm of insulating brickwork. The walls are covered in a smooth lime-render inside and out, natural sunlight making the exterior finish harder and more dirt-repellent over time.

53-56. The ICTA-ICP building, located in the UAB Campus (Universitat Autònoma de Barcelona), is a **research centre in environmental sciences and palaeontology**. In accordance with the research fields of the building users, they chose, from the beginning, a building prepared to give an ambitious response to the challenges of sustainability. The building, an isolated volume of five floors of 40x40m2 and two basements, contains the following program: on the ground floor the hall, bar, classrooms, meeting rooms and the administration area; the next 3 floors hold the offices and laboratories; on the roof there are vegetable patches together with the resting areas. The semi basement holds the parking and the engine rooms while the basement contains the warehouses and other laboratories.
Both **offices and laboratories** are spaces with a lot of **internal load and therefore tend to be hot**. The building has been designed to take **profit** from this internal situation **in winter** while it tends to dissipate it in summer. It has been thought as an adaptable and flexible infrastructure able to suffer changes of use, developing several simultaneous strategies that work complementarily.
Structure
A long life and low cost concrete structure with a lot of inertia has been chosen as the main structure, contributing directly to the passive comfort of the building. The quantity of **concrete** has been **optimized distributing its mass** in favour of the thermal exchange. It uses a **post-stressed concrete slabs** with pipes in the central area where the air circulates, in order to build a lighter structure. At the top and bottom of the slab the thermal mass is activated by geothermal energy.
Skin
The concrete structure is wrapped and protected by a **low cost exterior bioclimatic skin**. By installing a **greenhouse industrialized system that opens and closes its mechanisms automatically**, the solar gain and ventilation are regulated. This way, it is possible to raise the interior temperature naturally and guarantee a base of comfort in the circulation spaces as well as in the in-between spaces.
Climate and management
The building has been designed to host **three types of climates** associated with different intensities of use: Climate A: in-between spaces that are exclusively acclimatized/heated by passive and bioclimatic systems; Climate B: offices that combine natural ventilation with radiant and semi-passive systems; Climate C: laboratories and classrooms that have a more hermetic and conventional functioning.
Each type of climate has its own associated systems. The **behaviour of the building is monitored and controlled by an automatic computer system** that processes and manages an important set of information in order to optimize both comfort and energy consumption. The system has been programmed in favour of the maximum passive behaviour of the building and to minimize the use of non-renewable energy sources. The building reacts and adapts constantly, opening and closing itself, activating and deactivating itself, managing to use all the natural possibilities offered by the environment; therefore the comfort perception is much more real, less artificial than usual.

Materials

A mineral material with a lot of thermal inertia and long service life has been chosen for the structure combined with low environmental impact materials for the secondary partitions. It has been a priority the use of organic or recycled materials and dry constructive systems as much reversible and reusable as possible.

57-59. This public facility houses an **adult education centre**, a language standarization consortium and a hotel on a triangular plot in the Parliament district. Two of the three sides of the site area defined by the heritage-listed frontage of the former Planell glass factory, built on Calle Anglesola in 1913. The building makes use of the entire plot, acting as an intrinsic part of the urban landscape, although the triangular shape and the classified façades prevent it from occupying the entire site.

The programme is distributed across four levels which are **set back from the south-facing heritage facade**. The resulting **atrium** reconciles construction and heritage, improves the natural lighting for the classrooms and provides a **heat and sound barrier**. This **long, narrow courtyard** is reproduced at the northern vertex, which exhausts the geometry but acts as a relational system between the administrative uses of the building and the exterior.

The building section shows how it controls and manages the air under natural conditions. In **winter**, it is necessary to control heat loss due to air renewal, redeem the heavy internal load built up due to the inertia of the wall structure, and **draw fresh air in from the atrium**, which thus acts as a natural air recycle. In **summer**, the heat has to be dissipated by **moving the** largest possible volume of air and **fresh air** must be strictly natural, based on **solar chimneys** and caps that apply the Venturi effect.

Cross-ventilation between the courtyards is ruled out by the programme and the need to avoid conflicting noises. The building therefore gives each strip of usage space a long structural break where the **air circulates vertically**, ‘pulled upwards’ in the chimneys **by the power of the sun**, which also give the building a silhouette and a distinctive, transparent materiality.