

“I think it is much nicer on the screen than when it is printed on paper, because the screen gives you a luminosity and paper does not unless you do it through **painting**. You can achieve certain things through technology.”

“It’s not about wire-framing. Rather you can decide to focus on the thing you want to study at the time as you’re doing the drawing. It focuses you more on certain critical issues.”

“However, because I’m sitting there with 15 or 20 computer screens in front of me and I can see them all at the same time, it gives me yet another repertoire. You can see at the same time the section, the plan and several moving 3D views, and in your mind you can see them in yet a different way.”

“At the same time, we did these drawings allowing us to see a project from every possible and impossible perspective, with the kind of animated fly-over. What does it mean to see in a transparent way through a building?”

“At the time I could not present the work in a normative way. The work could not be done just through a simple set of plans and sections only. There was an element of shock, really, which was to shock or challenge normal conventions. But it’s not enough to just, say, do anything formally different.”

“We never set out explicitly with the intention of formal discovery, through a drawing with the prediction that we would discover something. All these drawings that were quite elaborate, needed a scenario. Therefore I would say, the formal repertoire that emerged was not completely accidental.”

This is the way Zaha Hadid viewed the relationship between design and technology and the way she transformed that relationship within the architectural industry, which is the focus of today’s lecture.



Born in **Baghdad**, Iraq (1950) and attended the **Architectural Association** (London) from 1972-77, where she studied under and later worked for Rem Koolhaas. He said she was “a planet in her own orbit.” “The **inventor of the 89 degrees**, nothing was ever at 90 degrees.”

As he would describe her thought process: "The way she drew a staircase you would smash your head against the ceiling, the space was reducing and reducing, and you would end up in the upper corner of the ceiling. She couldn't care about tiny details. **Her mind was on the broader pictures** — when it came to the joinery she knew she could fix that later. She was right.”



Under Koolhaas, she learned about the work of the Russian Suprematist and Constructivist avant garde artists **Ilya Chashnik**, **El Lissitzky**, **Kasimir Malevich**, Alexander Rodchenko, and Nikolai Suetin. Exploring ideas of **abstraction**, **distortion**, **fragmentation** and **flotation** as seen in her thesis project (1976/77).



Coming from the Middle East, her work drew inspiration from **Islamic geometric patterns and calligraphy**. For Hadid, painting was a design tool, an investigative structure for imagining architecture and its relationship to the world we live in.



These paintings she would create in the design process were to capture the feeling and dynamism of the spatial ideas, **not necessarily literal descriptions** or particular design elements. They were giving abstract expressions of what could be aimed for and intended within the design.

Painting was her preferred means to communicate.

As she would say, “Architects do not build, **they draw**.”

After graduation and working two years, she **started her own studio in 1979** (Zaha Hadid Architects), entering design competitions and supporting herself by teaching at AA (until 1987).



In 1982, she won her first competition, for a resort club located atop Hong Kong's highest mountain. Referred to as **The Peak**, this project established Zaha within the architecture community, but more significantly, established the parti that would define her work throughout her career – the transformation of **landscape**.

Swarms of distorted forms suspended in space, maintaining a strong sense of **coherence** despite the richness and diversity of elements. Never monotonous repetition, but **continuous changes in grain** of articulation.

This new form of landscape **transferred from the ground plane to the built structure**, redefining the **horizon within the architecture**, no longer referenced by it as Wright grounded his Prairie houses or as Corbusier raised above atop his pilotis.



The natural topography of the existing hills was to be transformed by excavating the entire site to its lowest level, then constructing artificial cliffs out of the excavated rock, which would be **polished to blur further the distinction between man-made and nature**.



The resort club, a **horizontal skyscraper** would then be constructed of four large cantilevered beams/layers, driven into the side of the new artificial hillside. The four beams/layers are **twisted** relative each other, creating conflict and disturbing the internal structure.



Succession of points of view in a single composition (cubists and Corbusier raising architecture up on pilotis). Each conflict **fracturing** in a different way, **generating different kinds of programming space** (residential accommodation).



The most radical decentering occurring with the upper pair of beams/layers pulled apart, vertically, from the lower pair, creating a deep void. The usual hierarchies and orthogonal order of traditional building is missing, elements float, pinned only by twisted unstable **diagonal lines and oblique planes** playing against each other creating **incomplete and distorted geometries**. (Within the void, a swimming pool, snack bar, library break free of the regular geometry of the beams/layers).



The club is stretched between the emptiness of the void and the density of the underground solids, domains normally excluded create a **new artificial topography**, the hedonist resort is located in the twisted center of modern purity.

In 1988, Philip Johnson curated an exhibition (**Deconstructivism in Architecture**) at MoMA showcasing the work of **Eisenman, Gehry, Koolhaas**, Libeskind, Tschumi, Coop Himmelblau, and Zaha Hadid, despite no built work.



Throughout the 1980s, Zaha continued with **experimentation** in axonometric and perspective projection. Working as a paper architect, allowed creativity to flourish with fewer physical limitations.

Curved trajectories produced by smearing drawings across a Xerox machine, smoothing effects blurred the **distinction between form and content**. Was the architectural object itself twisting, bending, fragmenting and interpenetrating or were these features just aspects of the multi-viewpoint fisheye perspectives?

Line was no longer true/straight but exaggerated/curved, **scale** was no longer accurate measurement/proportion but expressive/emotional effect, **object** placement no longer recorded spatial location but visual collage articulating architectural relationships and narratives. The graphic signatures slowly transfigured into realizable spatial features.



By 1990, first use of computers began to enter the studio (**Model-shop, FormZ**), enabling quick 3D sketches, morphing and smoothing thresholds, foreseen by Zaha's painting techniques (color modulations and gradients of shadow and light), decade before.



In 1993, Zaha completed her first building, the **Vitra Fire Station**, a pivotal point in her career finally realizing her provocative ideas on **fragmentation**, a frozen explosion comprised of projective distortion, deformation, formal impossibility.



“The site was made of enormous pieces, that had no coherent structure, So we did a study of the landscape, as it was imperative to me to really understand how to make a space of this **no-man's no-space**.”



Straight lines and sharp angles were inspired by the nearby vineyards and farmlands. The **lines and planes intersecting in her paintings, became volumes intersecting in the built structure**.

“An incredibly ambitious cantilevering front roof which was indeed pushed too far and actually started to sag. It was over-ambitious. Even though the structural calculations were within the safety margin, which means that the roof had no risk of breaking, it was deforming. I realized at that point that material reality is different from calculations, especially if you do unusual things.”



“Despite the surprising sensation of scale, what we had imagined and simulated in the drawings and sketches, all the views that were hand-sketched, became real.”



“To establish the balance and poise of the massing, to refine the proportions, the flow and tension of the curves. All the elements you need - walls, columns, doors, windows - these elements are like the brush strokes of a painting, establishing an overall legible composition.”



“The idea of gradient of fading effects and the idea of landscape or topography as analogies allowed us to make spaces more permeable, also across levels, and to integrate diverse spaces into a seamless whole.”

“To maintain legibility in the face of spatial and programmatic complexity. These were, I think, potent innovations. I realized early on that they are fitting the contemporary age of a more complex and dynamic society with open and fluid patterns of interactions.”



These new techniques and representations of space led to a new orientation, navigation and inhabitation of space. The inhabitant no longer orients by means of prominent figures, axis, and edges. Instead, by the distribution of **densities**, **directional bias**, scalar grains and **gradient** vectors of transformation define what it means to be somewhere.



Zaha's significant contribution is the realization of this new type of space, **distorted**, **continuous**, **surreal**, the historical progression of these such manifestos, rather than the particular concrete structures and institutional location.

Completing her first building brought confidence in Zaha's work:

“From 1995 to 1998 we did very beautiful and extreme work, so extreme that we indulged doing drawings and designs which were very fluid, and perhaps too extreme at the time to win (competitions). They might have been too difficult, too ambitious or too scary for clients. We lost all of them.”

Late 1990s, the computer-aided software (parametric splines, smoothly deformable meshes, Blobs, NURBS and Booleans) was still not convincing, Zaha continuing to use paintings. It wasn't until the completion of Frank Gehry's **Bilbao Guggenheim** in 1997, that the mood shifted, opening opportunity for more complex built forms.

2004 awarded **Pritzker Prize** (despite only four built projects to date).

Mid 2000s, **Building Information Modeling (BIM)** was introduced, bringing structural and mechanical analysis to architectural design (Revit in 2013).

In 2005, Gehry Technologies created **Digital Project**, bringing an architectural visual interface to CATIA (V5, digital information sent directly to manufacture).



2007 **Computation and Design research group (CoDe)** within ZHA. Continuing the research started in a studio taught by Zaha (Studio Hadid) at the University of **Applied Arts in Vienna** (2000), the digitization of architecture and intelligence augmentation, making **design processes amenable for use of computers**, **materialization of architecture amenable to use of robots**.



“There is no institutionalized form of research and innovation in architecture. If you really want to innovate radically, you have to **develop new geometry and new fabrication techniques**. You need exhibitions and abstract installations to fund and motivate the focus on these aspects of research. They do not serve any immediate purpose, but are experiments that point to potential beyond themselves.”

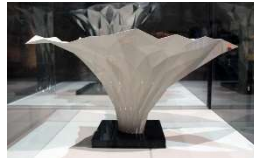


In professional practice, functional problems search for formal solutions, while academic research attempts the inverse. The intuitive **form-finding process** taught in academia is needed in the professional practice. Further, academic institutions are structured to teach functional concerns (design, engineering, manufacturing, ...), in **separate schools, by separate professors**.



Whereas the architectural tradition founded in the Renaissance (Brunelleschi, Alberti, Palladio) had **compositional issues tied instrumentally to functional issues**, ex: how the composition of the house relates to the social order of the household.

Aura (2008) an installation in the 11th Exhibition of Architecture at Venice Biennale was a demonstration of the **exploration into new materials and manufacturing** (Installed in Palladio's Villa Foscari, La Malcontenta).



Arum (2012) an installation in 13th Exhibition of Architecture at Venice Biennale was inspired by origami, creating **double curvature surfaces via pleating**.



Robots cut and scored the elements, then bent metal pieces along curved score lines. Two robot arms synchronized the folding movements. (**RoboFold**, UK firm).



The architecture is calling for robotic construction because of the complexity of the design, in this case the **fold lines are curved** rather than straight.



Through **pleating**, the super-light and super-thin piece gains strength and elegance.



Block (2016) an installation in 15th Exhibition of Architecture at Venice Biennale was a study of **equilibrium in complex, discrete shells**, constructed of **dry-stacked** masonry blocks.

1:40



All of our time-tested typologies adhere dogmatically to the arbitrary formalism of **orthogonal and platonic simplicity** derived from the constraints of measuring, making & stabilizing structures handed down from **a primitive stage of civilization**. To remain locked within these figures at this time & age is more than arbitrary.



The only way out is radical proliferation and testing of other options. All points of departure are equally arbitrary until tested against presumed criteria. There is no absolute optimal. The logic of evolutionary **innovation starts with mutation**, selection and reproduction. Once a strange figure is selected and confronted with a programmatic agenda a peculiar **form-content dialectic** is engendered.

1:45

[TEN MINUTE BREAK]

1:55



In 2012, completed the **Heydar Aliyev Center (Baku, Azerbaijan)**: a complex fluid space that emerges from **folds of topography**, achieving complete **plasticity** in a **seamless transition** between the man-made and natural landscape.



The rationalized precision of the curves or the additional joint-lines or tessellations, are well-designed features that come **out of necessities**, adding an intuitively felt conviction and credibility. Intensely composed, pragmatic elements cannot be simply added without deliberate formal resolution.



Hadid translated the dynamism and fluidity of Islamic **calligraphy** directly into equally fluid tectonic systems. The move from isometric and perspective projection to literal distortions of space. From the superimposition of various fisheye perspectives to the literal bending and melt down of surreal space.



All of these elements come together under ruthless **formalism**. However, this aesthetic work of formal composition and articulation is also functional with respect to the final life process of the building. The building needs to be legible to function as communicative visual frames of **social interaction**.

“I don’t think that architecture is only about shelter, it should be able to excite you, to calm you, to make you think.”



Pseudo-gravitational, geometric force fields (interactions of NURBs meshes), grip, align, orient in proportional amounts related to proximity and direction of peripheral related parts.



Seamless coherence in the warping ground plane and surface folding, creating an **artificial ground plane**, landscape within the architectural structure.



Glass Fibre Reinforced Concrete (GFRC),
Glass Fibre Reinforced Plastics (GFRP) cladding materials.
 From Disneyland's "House of the Future." (1956-7).



In 2014, completed the **Dongdaemun Design Park (DDP)** in Seoul, S.Korea.

Plasticity is elevated to pure form, a total absence of constructed materials, but rather flowing or growing form rendered homogeneous without grain.



Architecture and landscape become one, indistinguishable.

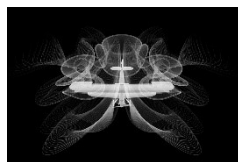


Zaha realized that 3D modelling and scripting was the way forward, understanding that at a certain **scale only the computer can realize** a structure. She was always asking for more and more scripters, to hire the most skilled students.



She always tried to avoid repeating the signatures of her earlier days. She wanted continuous **innovation**.

“History is there to help you make the next discovery or invention, not to prevent you from moving on. I come from Iraq, where history has a very important meaning and it is very important that countries find themselves through a new work or a new era.”



In 2016, **Gallery for Mathematics and Computation** (London Science Museum): brings together **historical artefacts** and design to highlight the central role of mathematical practice in all our lives, and how the tools of mathematicians have helped to build the modern world.

Air foil turbulence as computational **generative design** in the form-finding process, equations of airflow used in the aviation industry.



Positioned at the centre of the gallery is the **Handley Page** 'Gugnunc' aeroplane, built in 1929 for a competition to construct safe aircraft. Ground-breaking aerodynamic research influenced the wing design of this experimental aeroplane, **shifting public opinion** about the safety of flying.



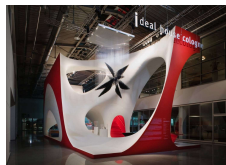
The layout and lines of the gallery represent the air that would have flowed around this historic aircraft in flight, from the positioning of the showcases and benches to the three-dimensional curved surfaces of the central pod structure.



“When I was growing up in Iraq, math was an everyday part of life. We would play with math problems just as we would play with pens and paper to draw – math was like **sketching**.”



Ice-Storm Lounge Furniture (MAK, Vienna, Austria, 2003)



Ideal House (Colone, Germany, 2007)



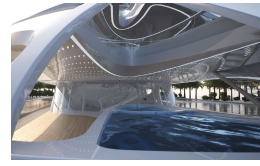
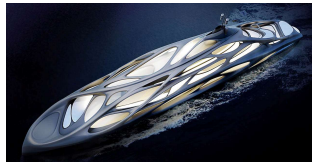
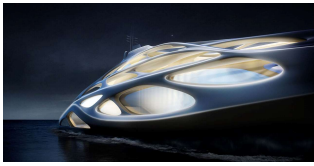
Nordpark Railway Stations (Innsbruck, Austria, 2007)



Mobile Art Chanel (Contemporary Art Container, Paris, 2010)



Guangzhou Opera House (Guangzhou, China, 2010)



Unique Circle Yachts (Blohm + Voss, 2013)



Beijing Airport (Beijing, China, 2019)



Nuragic and Contemporary Art Museum (Cagliari, Italy, 2020+)



“Well, it’s not normal practice, we don’t deal with normative ideas and we don’t make nice little buildings. People think that the most appropriate building is a rectangle, because that’s typically the best way of using space.

But, is that to say that landscape is a waste of space? The world is not a rectangle. You don’t go into a park and say: ‘My God, we don’t have any corners.’

It’s like saying that everyone has to write in exactly the same way. And, it is simply not the case.”

Died in Miami on March 31, 2016 (65 years old).