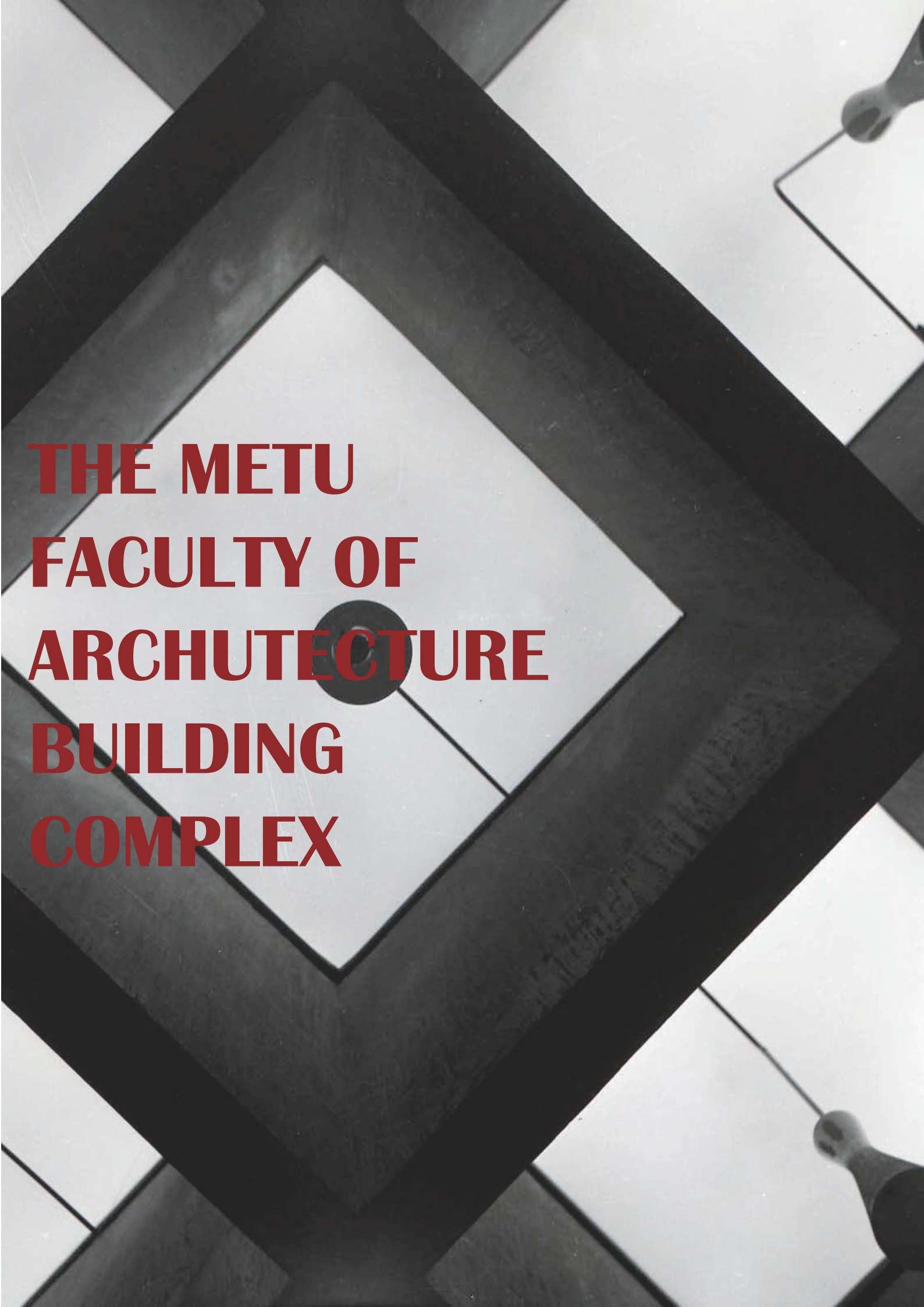


THE METU FACULTY OF ARCHUTECTURE BUILDING COMPLEX

Introduction

METU Department of Architecture 位於土耳其安卡拉，是由Altuğ Çinici和 Behruz Çinici 兩位建築師在1958年到1963年間設計並蓋好。總建築面積為12675平方公尺。

土耳其安卡拉主要為溫帶草原氣候，日夜溫差大且有大雨與大雪。而其也位在歐亞地震帶上。

周圍有大量人造森林與水池包圍，其周邊有約41公頃的人造森林。從METU創校以來，一年一度的植樹活動仍舊持續到現在，甚至成為了校園師生獨特的傳統。而這片人造森林也在土耳其當地被列為國家森林保護區。

安卡拉城市擴張迅速，地下道等構造物漸漸威脅校園群體完整性，新開發的高速公路計畫也將破壞森林的一部份。

保存意識的產生

2013年因METU高速公路計畫正式宣佈，METU成立跨學科研究生團隊，啟動建築、文資保存計畫。

METU Department of Architecture is located in Ankara, Turkey. It was designed and built by Altu□ Çinici and Behruz Çinici, between 1958 and 1963. The total area is 12,675 square meters.

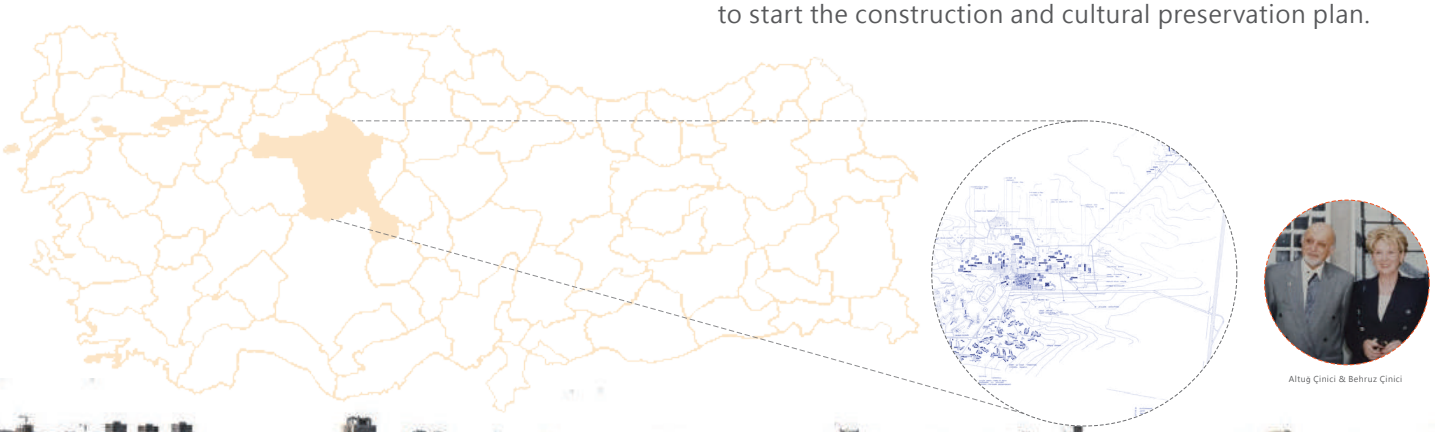
Ankara, mainly as asteppe climate, with a large temperature difference between day and night. It is also located in the Alpine-Humalayan seismic zone.

METU is surrounded by artificial forests and pools, there are about 41 hectares of it. Since the founding of METU, the annual planting activities have continued still and has become a unique tradition to the campus.

With the expanding of Ankara, structures like underground passages are gradually threatening the integrity of the campus community. The newly developed highway plan will also destroy some part of the forest.

The Consciousness

In 2013, due to the official announcement of the METU high-way plan, METU set up an interdisciplinary postgraduate team to start the construction and cultural preservation plan.



Altuğ Çinici & Behruz Çinici

METU Department of Architecture是戰後建築工程創新的展現。建造時整體工地被視為土耳其新材料、機械裝置和建築技術的實驗室。

其校園選址和規劃，在過去 60 年來都被認為是土耳其最佳的，包含其隨後做出的，所有有關功能佈局、基礎設施系統、建築量體連接、空間實虛關係和材料選擇的決策。

在材料上與結構上，不只要求穩固還要有美學，也透過材料應用，實現土耳其工法技術的精緻度和對品質的不懈追求。如多樣混凝土以及有機玻璃窗代表了 1960 年代土耳其的開創性做法，而紅磚則代表了當時最先進的工業生產技術。

在其建築整體內部、外部皆展現出極度精緻和粗獷主義的特質。

METU Department of Architecture shows a post-war construction engineering innovation. At that time METU is regarded as a laboratory of new materials, mechanical equipment and construction technology in Turkey.

Its campus site selection and planning have been considered the best in Turkey for the past 60 years, including all subsequent decisions on functional layout, infrastructure systems, building volume connection, spatial virtual relationship and material selection.

In terms of materials and structure, it requires not only stability but also aesthetics. For example, various concrete and plexiglass windows represent the pioneering practice of Turkey in 1960s, while red bricks represent the most advanced industrial technology at that time.

The interior and exterior of the building show the characteristics of extreme exquisiteness and the feature of Brutalism.

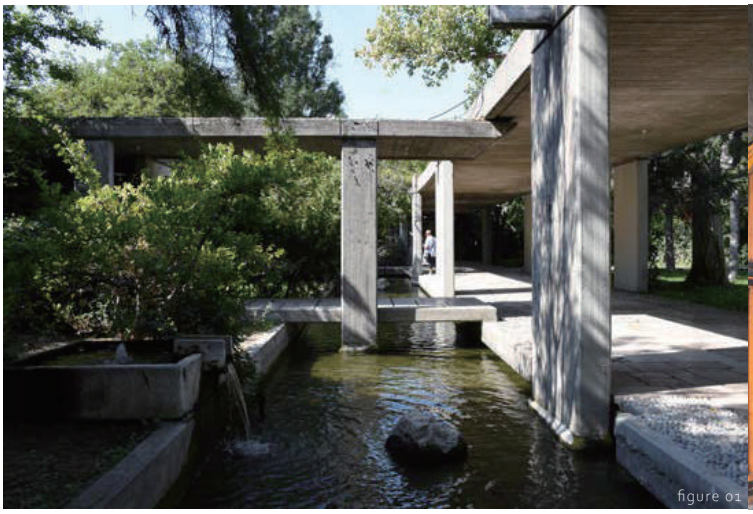


figure 01

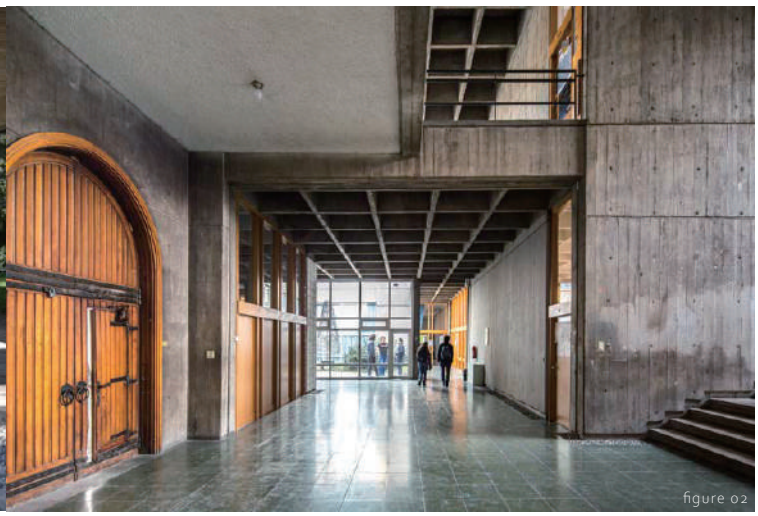


figure 02

Significance

Why can METU get the reward from KIM?

1.歷史地位

- METU是土耳其第一個有校園規劃的大學，原預計成為中東建築和城市規劃的「模式」，使其得以被效仿。
- METU 在當時現代主義蓬勃發展之時，是少數具有代表性的土耳其重要建築。

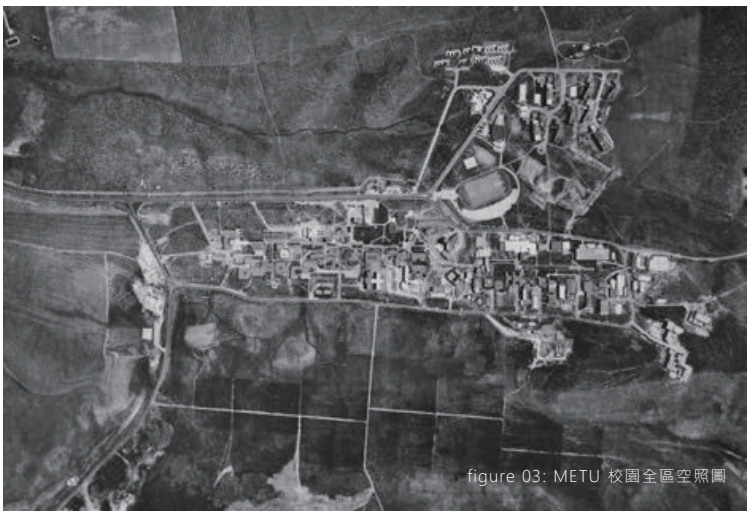


figure 03: METU 校園全區空照圖

Historical status

-METU is the first university in Turkey with planning. It was originally expected as a "model" of architecture and urban planning in the Middle East.

-METU was one of the few modernism buildings in Turkey at that time.

2.材料成就

- 在這樣的環境下，METU嘗試了許多材料與不同的構築形式，甚至被喻為是一所大型的混凝土實驗場。
- 在過去60幾年間卻仍能保存在一個極為良好的狀態，勢必與其材料構成的運用有關，也因此激起了需要趕緊修補損壞建築體的聲浪。

Material achievements

—In such an environment, METU has tried many materials and different construction forms, and is even known as a large concrete experimental field.

—It has been kept in an extremely good state for the past 60 years, which is bound to be related to the use of its material composition, which has also aroused the voice that need to repair damaged buildings quickly.

figure 04: METU 在當時被譽為大型混凝土實驗場，運用並嘗試多種新材料。 figure 05: 都市規劃系系館內部全景。 figure 06: METU 特殊結構形式-格子樑系統。

3.結構成就

- 結構上選用「dominantly waffle slab」（格子樑）也稱作「two-way joist concrete slab」
- 此類型建築經常遭遇的危機：
> 存在潛在的危險剪力弱點 (因柱子和剪力壁周圍沒有扣板或淺梁來傳遞剪力及大跨度)
- 此建築結構其中一個優點為：
> 增加構件面積傳遞剪力並減少剪應力 (將原本位於格子樑下方的柱子尺寸擴大，變成牆。因此格子樑會連接至牆上(而非柱子)，以抵抗轉角處的剪應力。)

Structural achievements

- Structural selection of "dominantly waffle slab" also known as "two-way joist concrete slab."

the crisis that this type of building often encounters:
>potentially dangerous shear weaknesses (because there are no buckle plates or shallow beams around columns and shear walls to transmit shear force and support large span)

One of the advantages of this building structure :
Increase the area of the component to transmit shear force and reduce shear stress. (expand the size of the column originally located under the lattice beam and turn it into a wall. Therefore, the lattice beam will be connected to the wall (not the column) to resist the shear stress at the corner.)


figure 07

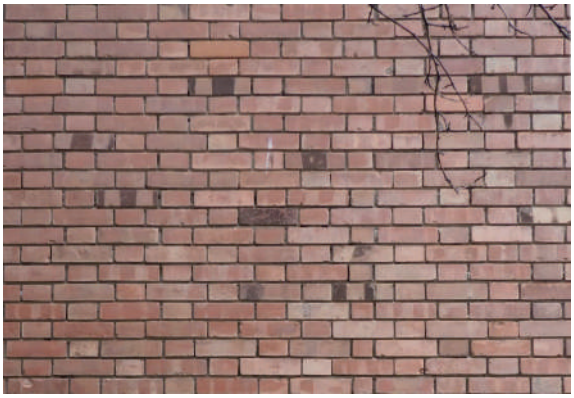


figure 07: 建築系館內常見的大面開窗，Plexiglass有機玻璃。
figure 08: 大量使用的紅磚(工廠磚)。

材料成就

為當時土耳其開創性的工法，反映土耳其獨特的生產技術

- 裸露混凝土：表面不加過多修飾，露出原始模板之紋路 > 較佳的機械強度，良好的孔隙大小，使其建築體於60年間未有過多大型毀損

- Plexiglass（有機玻璃）：反光性小，更有利於透光

- 紅磚：是一種工廠磚，未經擠壓製造(機器成形) > 孔隙率以及表面強度高，60年來亦無嚴重毀損，證實紅磚之良好品質與耐用程度

It was a pioneering work method for Turkey at that time, showing Turkey's unique production technology.

- Bare concrete: the surface is not too modified, revealing the texture of the original template > better mechanical strength and good pore size, so that the building has not been damaged too much in 60 years.

- Plexiglass: It is low reflectivity, more conducive to light transmission.

- Red brick: It is a kind of factory brick, manufactured without extrusion (machine forming) > high porosity and surface strength, and has not been seriously damaged for 60 years, which confirms the good quality and durability of red bricks.

結構成就

METU Department of Architecture如何自1960年代撐過多地震維持至今呢？

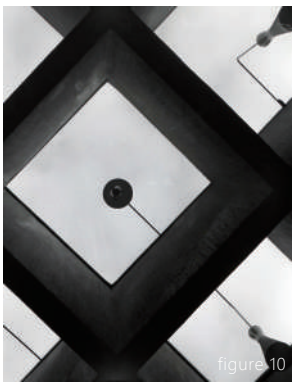
1. 大面積平均分佈格子樑
2. 不對稱、分散的剪力牆
3. 分散模矩化的量體
4. 量體間伸縮縫
5. 低矮的建築群
6.具韌性的空心磚砌牆

Under the influence of so many earthquakes, how has METU Department of Architecture been maintained since the 1960s?

1.Dominantly waffle slab
2. Asymmetrical and scattered shear wall
3. Decentralized modulus of building volume
4. Measure the expansion gap between buildings
5. Low building complex
6. Resilient hollow brick wall


figure 09

figure 09: 不對稱分散的剪力牆，柱子尺寸放大後變成牆體。figure 10: 格子樑的內嵌燈具。figure 11: 無結構力作用的預鑄空心磚立面。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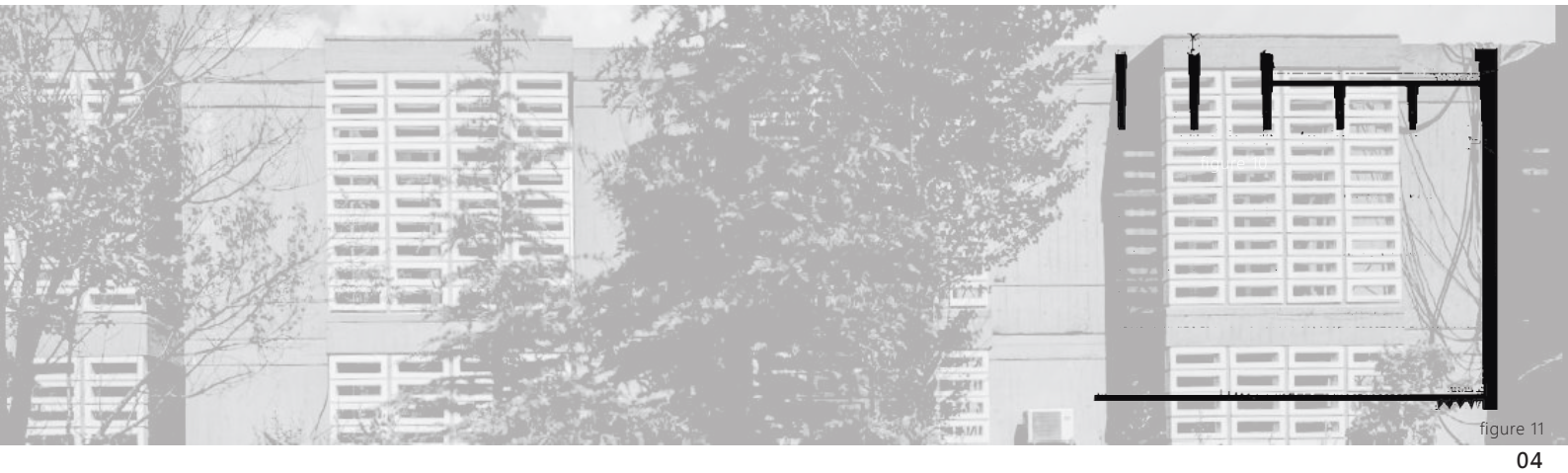


figure 11

Building complex

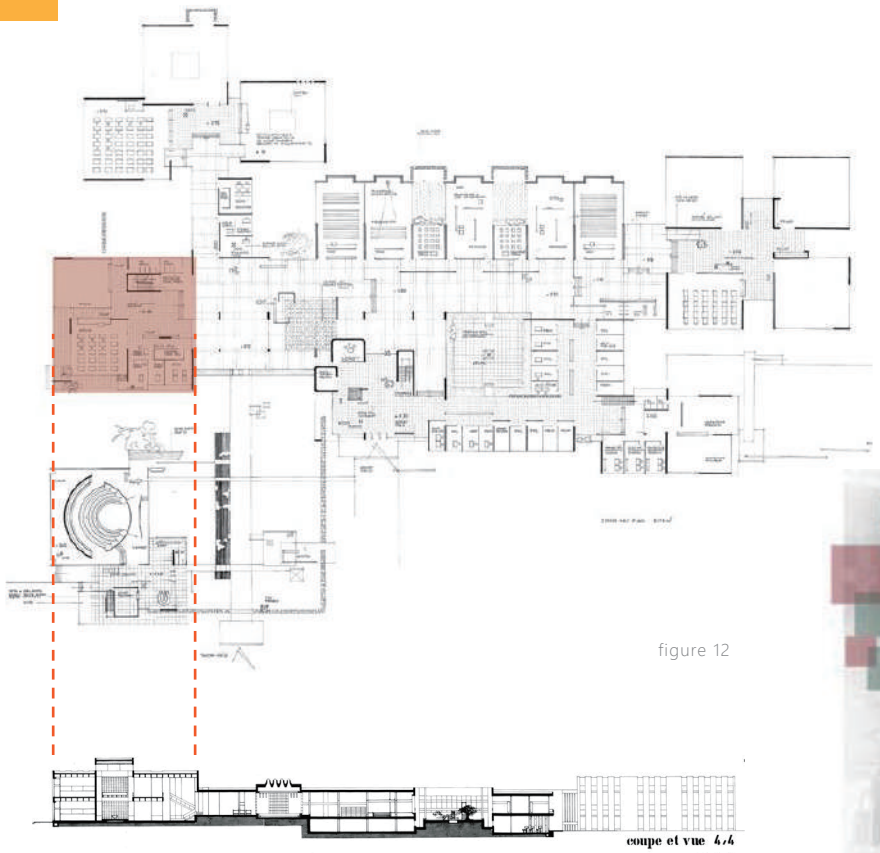


figure 12

figure 13

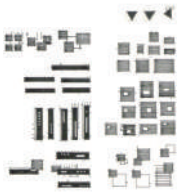


figure 15

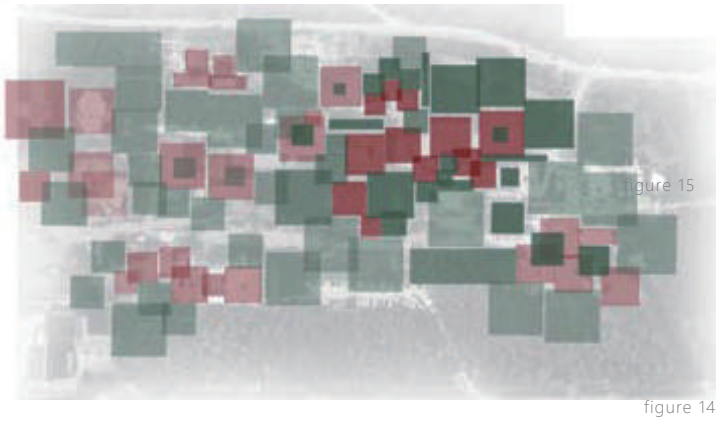


figure 14

1.校園涵構

其校園整體設計脈絡是建立在一條水平直線上，以抽象的網格將校園土地劃分成多個小方塊，而這些小方塊代表景觀空間或建築量體，形成了模矩化的涵構。

2.表達現代主義風格

1.由堅固的網格鐵系統的隱形線條引導整體布局
2.開放式的概念
3.空間的動態不對稱分佈
4.大玻璃表面將教學大樓的立方體轉化為漂浮的體
5.內部明確的開放式平面強化了空間的視覺和物理連續性，並為流通區域和公共空間提供了光源

3.面對自然

1.利用格子樑、剪力牆抵擋地震
2.水平向的空間及多處大面開窗有助於通風

Campus context

The overall design context of the campus is based on a horizontal line, dividing the campus land into multiple small squares with an abstract grid, and these small squares represent the landscape space or architectural volume, forming a modular structure.

modernism style

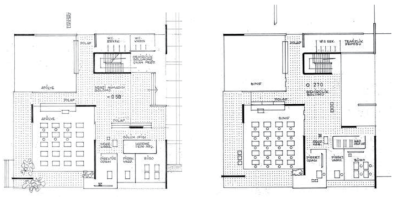
1. The layout is guided by the invisible lines of the solid grid iron system.
2. Open-ended concept
3. Dynamic asymmetric distribution of space
4. The large glass surface transforms the faculty building into a floating volume.
5. The clear internal open plane strengthens the visual and physical continuity of the space and provides a light source for the circulation area and public space.

Be with nature

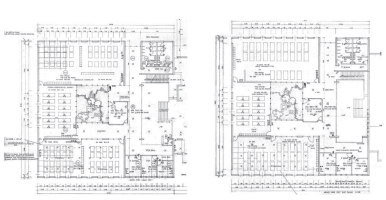
1. Use lattice beams and shear walls to resist earthquakes
2. Horizontal space and many large windows are conducive to ventilation.

競圖、概念圖、施工圖

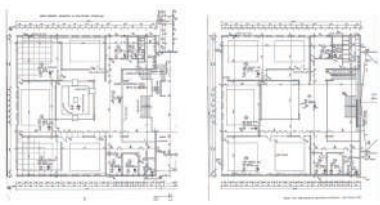
Competition/Concept/Application



競圖 figure 15: Plan drawings of the F block in the competition project.



概念圖 figure 16: The F block plan drawings in the concept project.



施工圖 figure 17: Ground floor and the first floor plans of the F block in the application drawings.

概念圖代表了建築師將夢想轉變為實際建設項目的過渡階段，分別從競圖、概念圖，到施工圖，可以分析建築師在各個階段，遇到什麼問題或可能需求上的變更，因此持續修正他的想法。

競圖到概念圖的過程，概念圖中原使用玻璃作為室內與庭院的劃分，此時庭院是室外；到施工圖階段又有不小改變，將中庭玻璃去除，使庭院成為室內的一部份，利用天井引入天光，凸顯中庭天井的儀式性。庭院的改變，工作室、陪審廳、活動空間等機能使用也跟著改變。

The concept project represents the transition stage of the architect's transformation of dreams into actual construction projects, from competition drawings, concept drawings, to construction drawings, which can analyze the problems or possible needs of the architect at each stage, so he continues to correct his ideas.

In the process of competing to the concept drawing, the concept drawing originally used glass as the division between the interior and the courtyard. At this time, the courtyard is outdoor. At the stage of the construction drawing, there are many changes. The glass in the atrium is removed to make the courtyard a part of the interior, and the patio is used to patio skylight to accentuate the ritual of the courtyard. With the change of the courtyard, the use of the studio, jury hall, activity space and other functions has also changed.

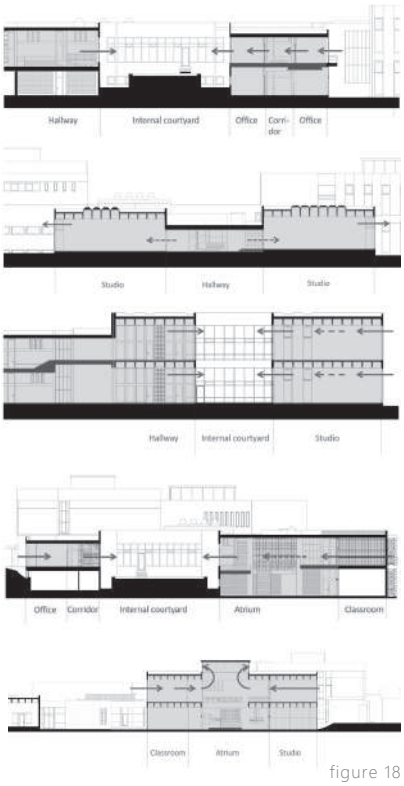
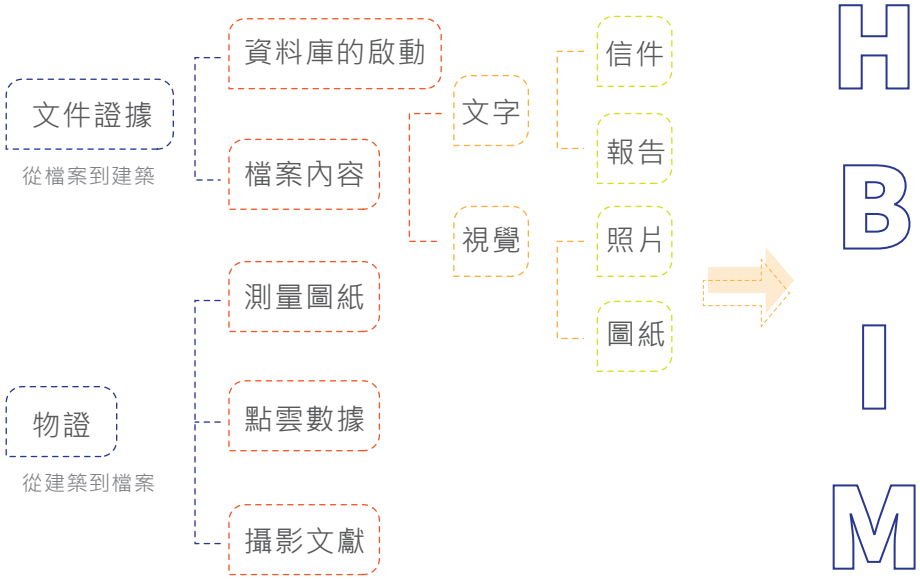


figure 18

從檔案到建築，從建築到檔案



KIM(Keeping It Modern)

管理與經營方式

當METU建築學院的研究小組於2017年向蓋提基金會提案時，他們的宣告非常明確。他們意識到該國政治狀況和迅速的城市設施發展，確立了兩項緊急戰略：透過**文獻建檔**和**創造國際意識**。

When the METU Faculty of Architecture research group submitted their proposal to Getty Foundation in 2017, their statement was clear. Aware of the political conditions and rapid urban developments in the city, the team identified two emergency strategies:Conservation by Documentation and Creating International Awareness.

如何保存 - 資訊建檔Conservation by Documentation
HBIM (BIM for heritage)

何謂HBIM _ 總體介紹

遺產建築的保護規劃涉及收集、構建和存檔與建築有關的大量資料。這些資訊透過數字化可在IC技術的幫助下構建。其中建築資訊建模（BIM）可有效支援保存規劃以及其他建築的技術，例如工程、建築和設施管理等活動。且BIM是以標準、可互動性的單一模型呈現建築資料，提供了整合的建築資訊。

HBIM旨在利用BIM現有功能，並透過現有文件、現場調查等資訊進一步深化。在這項研究期間開發的HBIM用於代表、共享和視覺化所有專案參與者提供的相關資訊。與BIM不同的是，HBIM旨在捕捉變化的的建築，同時為資訊缺失或退化導致的資訊不準確和不完整騰出空間。

BIM for heritage buildings: a general perspective

Conservation planning of heritage buildings involves the gathering, structuring, representation and archival of amounts of data. The management and accessibility of information can be possible by the digitization of building data by the help of diverse IC techniques.Among them, building information modeling (BIM) can effectively support conservation planning and other construction technologies, such as engineering, construction and facility management. And BIM presents building data in a standard and interactive single model, providing integrated building information.

HBIM aims to make use of BIM and deepen it by existing documents, on-site investigations etc. HBIM developed during this study is used to represent, share and visualize the relevant information provided by all project participants. Different from BIM, HBIM aims to capture changing buildings, while correcting inaccuracy of information and incompleteness caused by missing or degradation.

HBIM 的目的與目標

A. 記錄建築物，包括三維幾何、建築意義和評估結果
B. 專案期間工作包之間的資料共享
C. 與第三方分析工具的資料互操作性

The purpose and goal of HBIM

A. Record buildings, including three-dimensional geometry, architectural significance and evaluation results.
B. Data sharing between work packages during the project
C. Data interoperability with third-party analysis tools

HBIM also has the potential to serve as a long-term medium to support future activities related to operation and maintenance, major renovation or analysis.

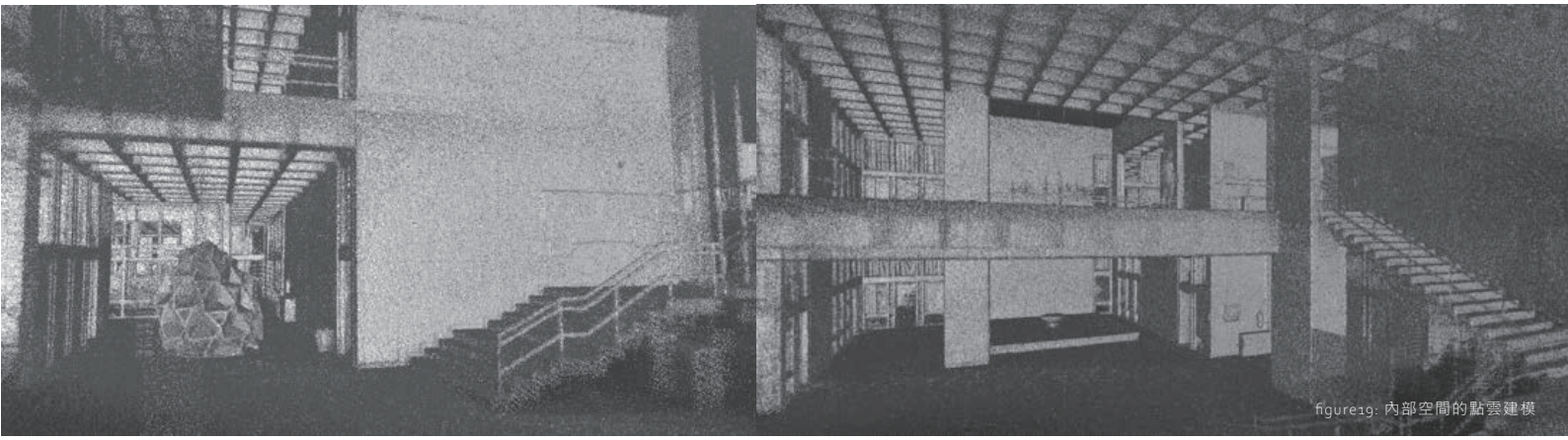


figure19: 內部空間的點雲建模

METU Architecture的HBIM是使用Autodesk Revit Architecture 2018所開發，這是一個3D建模軟體，用於建築、工程和建築/設施管理實踐中的建築資訊建模。

Revit Architecture由三維引數物件組成，用於定義建築元素，並使用元素建立模型和文件。**每個元素的屬性包括幾何和非幾何，並基於不同族群建立的。**例如牆壁、屋頂和地板等定義了各自的族群，這些族群獨立於建築模型，並根據需求載入模型。

HBIM of METU Architecture is developed by Autodesk Revit Architecture 2018, which is a 3D modeling software for building information modeling in architecture, engineering and construction/ facilities management practice.

Revit Architecture consists of three-dimensional parametric objects to define architectural elements, and create building models and documents with these elements. Revit maintains the parametric attributes of each element defined in the model, both geometrical and non-geometrical. Moreover, all building elements that take place in the model are created using families.

figure20: 外掛程式、資料集成表

METU Architecture的HBIM如何建置
How to build HBIM of METU Architecture

A. 現有圖紙

B.低精度3D雷射掃描：教師大樓使用手持式3D雷射掃描器ZEB-REVO進行記錄。

C. 高精度3D雷射掃描：第二階段雷射掃描是專門為學院大樓、博物館和圓形劇場的選定空間進行的。

D. 測量：在最後一步，透過現場調查記錄了之前沒有記錄或雷射掃描器沒有捕捉到的建築細節。

A. Existing drawings

B. Low-precision 3D laser scanning: The faculty building was documented using a handheld 3D laser scanner, called ZEB-REVO.

C. High-precision 3D laser scanning: A second phase of laser scanning was carried out specifically for the selected foucs area of the Faculty building, the Museum and the amphitheater.

D. Surveying: In the final step, the building details that were not previously documented or not captured by the laser scanner were documented by means of on-site surveys.

HBIM 資料來源

A.文件檔案及其社會價值

1.視覺檔案：黑白照片、藍圖、建築模型

2.書面檔案：建築日誌、會議記錄、官方通訊紀錄等

3.物理物品：建築材料、裝飾細節和傢俱

B.材料及結構評估資料結果

C.環境績效表現資料

HBIM data source

A. Documentary Evidence of Architectural and Social Values

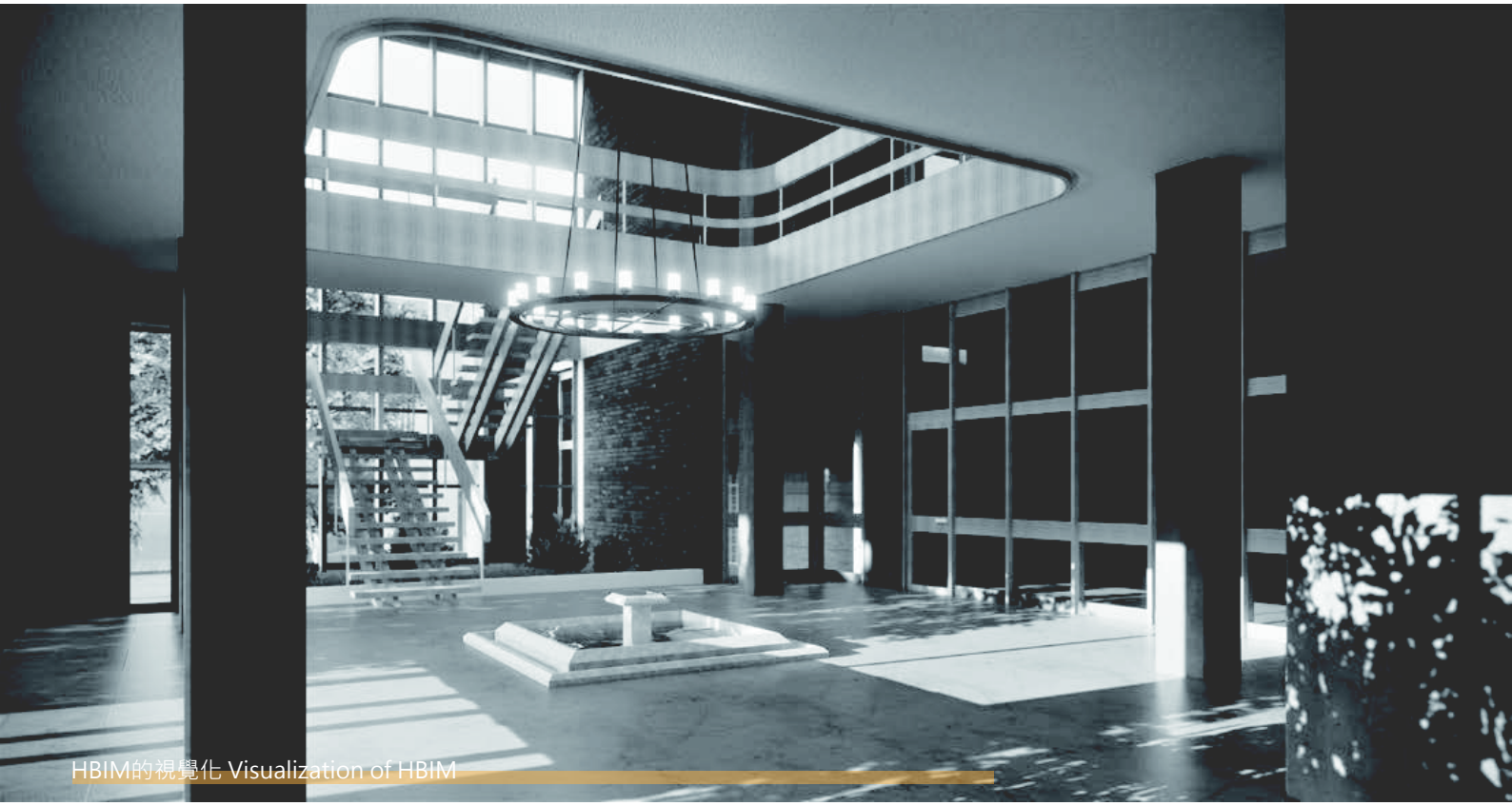
1. visual documents: black and white photos, blueprints, models

2. Written documents: building logs, meeting minutes, etc.

3. Physical objects: building materials, decorative details and furniture

B. Structural and Material Assessment

C. Environmental Performance Assessment



HBIM的視覺化 Visualization of HBIM

標準BIM中的建築資料以及擴充套件，可以在評估過程中為專業人員提供支援。因此，這些資料的視覺化是HBIM開發的主要關注之一。

而這些新、現有資料是對大樓的3D視覺化的補充，因此，這些資料以球形形狀標記被插入到的建築的3D檢視中。單擊標記後這些資料將顯示於3D模型旁。例如，在結構評估期間，使用者可以檢視有關現有裂紋的資料，如裂紋的影象、其深度和危險狀況。視覺化既可用於評估活動，也可用於與更廣泛的受眾分享建築遺產價值。

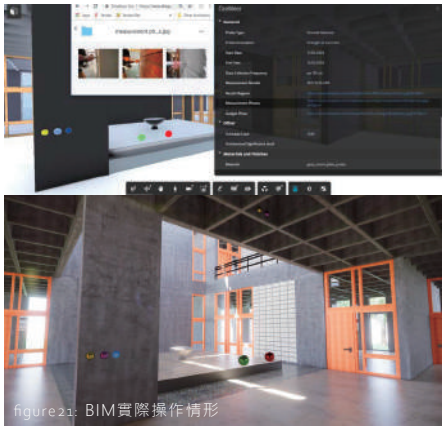


figure21: BIM實際操作情形

Building data and expansion in standard BIM can provide support to professionals during the evaluation process. Therefore, the visualization of these data is one of the main concerns of HBIM development.

These new and existing data are a supplement to the 3D visualization of the building. Therefore, these data are marked in a spherical shape to the 3D view of the building inserted. After clicking, the data will be displayed next to the 3D model. For example, during the structural evaluation, users can view data about existing cracks, such as images of cracks, their depth and dangerous conditions. Visualization can be used not only to evaluate activities, but also to share the value of architectural heritage with more people.

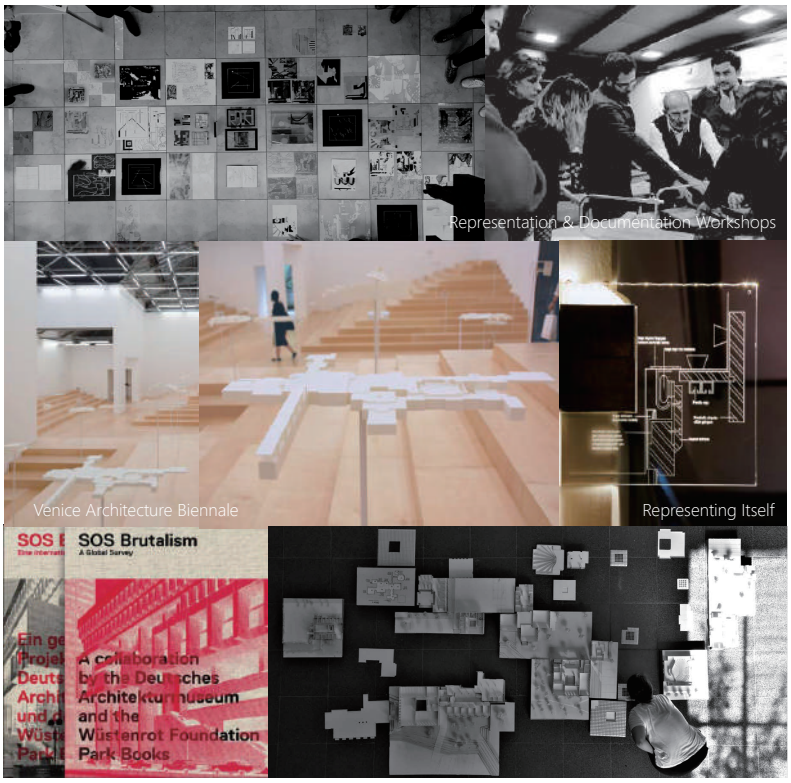
figure22: Faculty building通過HBIM的實際渲染效果

如何推廣 - 創造意識 Creating Awareness

Archive Exhibition Series

METU建築學院透過舉辦展覽、工作坊等活動，意圖創造國際與本土間的保存意識。例如在威尼斯建築雙年展與SOS野蠻主義上發表、展出。除國際認可外，研究團隊還發起一系列活動，如社交媒體專案#HugtheFaculty、校友日展覽、保持現代專案的網站等。

METU Faculty of Architecture intends to create a preservation awareness between international and local through exhibitions, workshops and other activities. For example, it was published and exhibited at the Venice Architecture Biennale and SOS Brutalism. In addition to international recognition, the research team has also launched a series of activities, such as the social media project #HugtheFaculty, the alumni day exhibition, the website of the stay modern project, etc.



Representation & Documentation Workshops

Venice Architecture Biennale

Representing Itself

SOS Brutalism


First Year Design Education at METU Symposium

Core Group

The Architectural Team

Prof. Dr. Ayşen Savaş, Architect, Museolog, Project Manager
Sezin Sarıca, Architect, RA
Bengisu Derebaşı, Architect, RA
Fatma Serra İnan, Architect, RA
Eyüp Özkan, Architect, RA

Conservation Planning Advisor

Assist. Prof. Dr. Zeynep Aktüre, Architect, Conservator

Material Assessment Team

Assoc. Prof. Dr. Ayşe Tavukçuoğlu, Architect
Prof. Dr. Emine N. Caner-Saltık, Conservation Scientist
Assist. Prof. Dr. Çagla Meral Akgül, Civil Engineer
Fatıma Erol, Chemical Engineer, RA

Structural Assessment

Prof. Dr. Ahmet Türer, Civil Engineer
Assist. Prof. Dr. Bekir Özer Ay

Environmental Assessment Team

Assoc. Prof. Dr. Ipek Gürsel Dino, Architect, Project Coordinator
Şahin Akın, Architect, Architect, RA

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from the conservation report of METU university