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Multiple Moderns: Climate, Community, Creativity

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Docomomo 3D Platform: Open, Multi-Modal Models for Modern Architectural Heritage

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Abstract. Since its foundation in 1990 Docomomo International has created a body of knowledge through their documentation "fiches" produced by the national working parties and coordinated by the International Specialist Committee (ISC) Registers. Although based on literature and other publications the fiches often do not contain accurate and complete plans and layouts and little spatial information. The Docomomo 3D Platform addresses this last gap by aggregating and publishing multi-modal spatial content of modern movement architecture, and is designed for clarity, interoperability, and public reuse. The platform curates four primary content types: (1) smart point-cloud models that embed semantic tags and condition notes; (2) 3D Gaussian Splatting (3DGS) reconstructions optimized for photoreal, real-time exploration; (3) HBIM models that encode construction logic, materials, and interventions for conservation planning; and (4) synchronized 2D assets (photographs and short videos) that contextualize each building's design, setting, and use. A consistent metadata schema links these modalities at the building level, enabling users to pivot from a navigable 3D experience to archival stills, plans, and bibliographic notes. The next development phase introduces participatory pipelines: users will be able to upload image sets that the platform processes into community-generated 3DGS models, with automated quality checks and curator review. This opens a path for distributed recording of at-risk sites and creates a living repository that tracks change over time. By unifying documentation types and lowering the barrier to contribution, the Docomomo 3D Platform advances two goals: to improve public understanding of modern architecture and design, its materials, space, and everyday life, and to accelerate responsible dissemination for research, education, advocacy, and finally conservation. The paper outlines the data standards, ingestion workflow, and viewer UX, and presents case studies demonstrating how multi-modal models clarify significance, integrity, and conservation options for modern heritage.

1. INTRODUCTION

1.1. Modern architectural heritage and the need for multi-modal documentation

Modern architectural heritage still occupies a peculiar and often fragile position within the broader discourse of conservation (Pottgiesser et al. 2021; Pottgiesser and Quist 2023). Most buildings from the twentieth century are still in everyday use, visually familiar to local communities, yet they are rarely perceived or listed as heritage in the same way as older monuments (Guillet 2007). At the same time, this building stock is under intense pressure: demolition, speculative redevelopment, low energy performance and unsympathetic retrofitting, and incremental alterations are rapidly transforming the modern built environment.

Conventional documentation methods: plans, sections, elevations, technical reports, and isolated photographs, are indispensable, but they tend to fragment the building into separate, specialized views. Drawings communicate design intent, but not necessarily the current condition; photographs convey atmosphere but not geometry; surveys capture metrics and pathologies but rarely explain cultural meaning. Experts can mentally integrate these fragments into a coherent picture of significance and risk. Yet non-specialist audiences, decision-makers, and even students of architecture often find it difficult to understand why a particular modern building matters, how it works, and what is at stake in its transformation.

In this context, multi-modal documentation becomes a crucial strategy. By multi-modal we mean the integrated use of diverse, spatially coordinated digital representations, such as point clouds, image-based reconstructions, Heritage Building Information Models (HBIM), and synchronized 2D media, to present buildings as complex, layered objects. Multi-modal documentation does more than produce attractive 3D visuals. It creates a structured environment in which different ways of "seeing" a building, technical, historical, experiential, can coexist, cross-reference one another, and be explored at different levels of depth by different audiences (Yu et al. 2025).

For modern heritage, whose value is often contested, invisible, or tightly bound to construction and performance, such multi-modal approaches are not a luxury but an emerging necessity. They offer a way to make the technical and social complexity of late-twentieth-century architecture legible and discussable, opening the door to more informed, transparent, and inclusive conservation debates.

1.2. Digital technologies in modern heritage digitization

Over the last two decades, rapid advances in digital technologies have transformed built-environment documentation (Yu et al. 2025). In heritage practice, three technology families are especially influential: 3D sensing, image-based reconstruction, and information modeling. 3D sensing (e.g., terrestrial laser scanning and mobile mapping) captures dense, millimetric point-cloud geometry and reflectance, making it efficient for large and complex modern sites and useful for detecting subtle deformations and material pathologies relevant to reinforced-concrete and composite structures (Zachos and Anagnostopoulos 2025). Image-based reconstruction, from multi-view photogrammetry to newer approaches such as 3D Gaussian Splatting (3DGS), generates visually rich 3D models from photographs; recent neural rendering enables photoreal, real-time experiences even from sparse or irregular image sets, supporting both professional surveys and opportunistic imagery (Yu et al. 2025). HBIM extends documentation beyond geometry by encoding components, materials, construction logic, and interventions in a structured, queryable environment—an approach that also fits modern architecture with standardized elements and building services (Quattrini et al. 2015). In parallel, web-based 3D viewers, game engines, and VR/AR have matured, enabling high-quality experiences on consumer devices and supporting education, engagement, and participatory heritage practices (Liang et al. 2023).

However, these tools often still produce fragmented outputs: point clouds, BIM files, photogrammetric models, and media stored in separate systems, so without integration and a clear conceptual framework, much of their potential for coherent, usable modern-heritage documentation remains unrealized.

1.3. State of the art: existing platforms for digitized architectural heritage

In response to the proliferation of digital heritage content, several platforms have emerged at regional and international scales to host, share, and visualize 3D and multimedia documentation. Cultural aggregators such as Europeana and large digital-heritage initiatives like Google Arts & Culture or CyArk provide access to a growing number of digitized sites and monuments, including some twentieth-century architecture. These platforms have been instrumental in raising the general visibility of heritage and in establishing technical baselines for long-term preservation of digital assets.

More specialized initiatives, such as Open Heritage 3D and various national or institutional 3D repositories, focus on making high-quality survey data available under open or research-friendly licenses. Many museums, archives, and heritage agencies now publish 3D content through online viewers, often based on game engines or WebGL frameworks, that allow users to rotate, zoom, and sometimes annotate models. In parallel, commercial platforms like Sketchfab have become important venues for sharing 3D models produced in academic, professional, or community contexts (Gaspari et al. 2023).

These platforms have collectively advanced the "state of the art." They demonstrate that large-scale, online access to heritage 3D data is technically and organizationally feasible. They encourage the adoption of open or widely used file formats and metadata practices. They provide intuitive, browser-based interfaces that lower the barrier to engaging with complex models. From the perspective of modern architectural heritage, several limitations become apparent (**Fig. 1**):

(a) Fragmented representations: Most platforms present either a single dominant representation (e.g., a polygonal mesh or a textured model) or a relatively loose collection of separate assets (images, meshes, videos) associated with a site. Rarely do they integrate point clouds, image-based visualizations, HBIM models, and time-based media into a single, spatially coordinated environment where users can move between modalities.

(b) Limited semantic depth for modern architecture: The metadata schemas used in many repositories are optimized for monument-level description and basic technical parameters. They often lack the richness needed to describe the construction systems, building services, modular components, or post-occupancy transformations characteristic of modern architecture.

(c) Weak support for condition and intervention data: While some platforms allow basic tagging of damage or restoration campaigns, few support detailed, spatially explicit condition mapping within point clouds or models (e.g., Potree-based viewers and archives such as OpenHeritage3D), or the linking of those conditions to specific interventions encoded in HBIM.

(d) Restricted mechanisms for participatory contributions: Although crowdsourced photographs or annotations are sometimes incorporated, workflows for community-generated 3D content, especially advanced forms like 3DGS (e.g., SuperSplat for splat publishing/viewing), are still rare and typically not integrated into a structured heritage metadata framework.

In short, existing platforms provide important building blocks but do not yet address, in a systematic way, the specific needs of modern heritage documentation: the integration of multiple digital modalities, the representation of construction-level semantics, and the activation of participatory pipelines for at-risk and under-documented sites.

1.4. Research questions and gaps

Building on the preceding discussion, this paper is guided by four closely related research questions:

(i) How can multi-modal pipelines, combining smart point clouds, 3DGS, HBIM, and 2D media, be effectively integrated to document and interpret modern architectural heritage as a coherent whole?

(ii) What practical standards for metadata, interoperability, and viewer

design are needed to make complex 3D heritage content understandable and navigable for non-specialist users?
(iii) Which methods can enable community participation, particularly image-to-3DGS uploads, validation processes, and long-term stewardship, in ways that allow documentation to scale while remaining ethically and technically robust?
(iv) In what ways can such integrated tools enhance significance assessment, condition tracking, and communication for conservation and education in the context of modern architectural heritage?

Taken together, these questions highlight a clear gap: while individual technologies and repositories exist, there is still a lack of an integrated, modern-heritage-oriented framework that (a) unifies multi-modal pipelines, (b) is grounded in practical standards for interoperability and usability, (c) incorporates participatory image-based 3D content under clear ethical guidelines, and (d) demonstrably supports the everyday work of conservation, design and education. The Docomomo 3D Platform proposed in this paper is conceived as a response to this gap.

1.5 Aim and contribution

This paper introduces and critically positions the Docomomo 3D Platform as an integrated, multi-modal framework for documenting, interpreting, and communicating modern architectural heritage. It contributes: (1) a building-centric model that organizes heterogeneous digital modalities around a single architectural object; (2) a layered metadata and interoperability strategy linking construction, condition, and historical narratives while remaining compatible with existing standards and registries; (3) processing pipelines that transform raw survey and image data into curated, spatially aligned assets for web-based exploration; and (4) a web viewer validated through a questionnaire assessing usability, informational clarity, and perceived support for conservation, design, and education. Use-case scenarios illustrate how the approach strengthens significance assessment, condition tracking, and public communication, positioning the platform as a transferable model beyond a technical prototype.

2. METHODS AND MATERIALS

The Docomomo 3D Platform is implemented as a four-stage workflow that connects field documentation, data integration, multi-modal modeling, and online dissemination into a single, building-centric pipeline (**Fig. 2**). This workflow adapts a stage-based information infrastructure originally developed for architectural heritage, but tailors it to modern architecture.

2.1 From documentation to dissemination

The Docomomo 3D Platform is implemented as a building-centric pipeline that links four main stages: documentation, data integration, multi-modal modeling, and dissemination with validation:

(a) Documentation: For each selected modern building, heterogeneous source material is collected to capture both geometry and context.
(b) Raw data are converted into interoperable assets aligned in a shared model: point clouds are cleaned, registered, and segmented into key elements with basic condition tags ("smart point clouds"); curated image sets are processed into 3DGS and linked via the same building IDs; and a lightweight schema connects all modalities through stable identifiers.
(c) Multi-Modal Modeling and Viewer: From the integrated data, multi-modal models are generated and deployed in a web viewer. A browser-based viewer exposes smart point clouds, 3DGS, and HBIM through a unified interface, with simple navigation and layer toggles for non-specialists, and optional metadata panels for expert users.
(d) Dissemination and evaluation: the platform was piloted in teaching and

stakeholder sessions. After exploring selected case studies in the viewer, participants completed a short online questionnaire (Likert items plus open comments) on navigation, clarity of information across modalities, and perceived usefulness for understanding significance, condition, and conservation options. The results informed iterative refinement of the data structuring and interface design.

3. RESULTS

3.1. Platform outcomes after documentation, integration, modeling, and VR deployment

On the desktop/web interface, each building is introduced via a concise metadata panel (name, location, architect, dates, typology, heritage status, short statement of significance) and a thumbnail. From this entry point, users can switch among three main 3D tabs: 3DGS, Point Cloud, and HBIM, plus a media panel with photographs, drawings, and short videos, making the multi-modal structure explicit while keeping initial interaction simple. On top of this core, a VR prototype based on the 3DGS data has been implemented for selected case studies (**Fig. 3**).

In the 3DGS view, users experience a photorealistic, real-time rendering of key exterior and interior spaces, navigated with standard mouse/keyboard controls. Hotspots mark important architectural zones (entrances, cores, main halls, key transitions); triggering a hotspot repositions the camera and reveals short annotations on design, construction, or use, effectively providing an accessible "guided tour" for non-specialists.

The smart point cloud view emphasizes geometry and condition. Point clouds are streamed as tiles and can be filtered by semantic categories (structure, envelope, circulation, secondary elements) and basic condition tags (cracking, spalling, staining, later infill). Filters highlight corresponding points, allowing users to isolate structural frames, facade systems, or damaged areas. Because point cloud and 3DGS share a coordinate system, users can approximate matching viewpoints and compare photorealistic appearance with analytical, condition-focused readings.

Where available, the HBIM view presents a simplified information model. Selecting an element (e.g., slab, facade panel, stair) opens a property panel with type, material, construction phase (original vs. intervention), and linked condition notes. Cross-references connect HBIM elements to segments in the smart point cloud, supporting movement between abstract construction logic and observed fabric.

The 2D media panel aggregates contemporary and archival material. Building on the same 3DGS content, a VR mode renders the models in immersive stereo with hotspot-based teleportation, optional free exploration, and controller-adapted menus.

Taken together, these outcomes show that the pipeline from documentation and integration to multi-modal modeling and VR deployment can produce an operational environment in which heterogeneous digital assets for modern architectural heritage are coherently organized, explored on the web, and experienced immersively in VR.

3.2. Findings across different participant types

The qualitative analysis draws on a questionnaire (N = 200; Figure 4) completed by two groups: experts (professionals and students in relevant disciplines, n = 101) and members of the general public (non-specialists, n = 99).

Across both groups, responses were analyzed in relation to the three dimensions defined earlier: usability, interpretability, and perceived value, while noting differences in how participants engaged with the platform's modalities. Experts more frequently referenced smart point clouds and HBIM when discussing construction, condition, and technical reading, whereas non-specialists tended to focus on 3DGS/VR for exploration and comprehension, while acknowledging the presence of more technical layers. Open-ended comments also raised requirements for clearer metadata, smoother navigation, and the potential role of optional authoring features, alongside expectations around quality control and attribution.

4. CONCLUSION AND FUTURE WORK

The Docomomo 3D Platform proposes a practical framework for structuring, visualizing, and sharing multi-modal documentation of modern architectural heritage. By integrating smart point clouds, 3DGS reconstructions, HBIM models, and synchronized 2D media within a shared metadata schema and web-based viewer, it aims to make complex technical information accessible to diverse audiences while still supporting expert workflows.

Future development will focus on several directions. Technically, there is ongoing work to improve automated segmentation of point clouds, refine 3DGS reconstruction quality from non-ideal image sets, and deepen the integration of HBIM with conservation analysis tools. On the participatory side, pilot collaborations with local Docomomo chapters and community groups will test the social and ethical dimensions of open contribution pipelines. Finally, evaluation studies with both experts and non-specialists are planned to understand how different audiences navigate and interpret the multi-modal models, and how the platform might better support teaching, advocacy, and decision-making.

Ultimately, the Docomomo 3D Platform is not just a repository of digital objects but an evolving framework for seeing, discussing, and caring for modern architectural heritage. By lowering the barriers to producing and understanding 3D content, and by foregrounding the interplay between technical documentation and lived experience, it seeks to contribute to a more informed, inclusive, and sustainable culture of conservation for modern architectural heritage.

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Biographies

Yingwen Yu is a PhD student at Delft University of Technology, affiliated with the Digital Technology group. Her research focuses on architectural heritage, point cloud, 3D Gaussian Splatting and information infrastructure, Geographic Information Systems (GIS). Currently, she is dedicated to the development of the DOCOMOMO 3D platform, contributing to the advancement of 3D modeling and heritage conservation through innovative digital tools. She combines theoretical knowledge and practical experience to push the boundaries of technology in her field.

Edward Verbree (Ir.) is an Assistant Professor at Delft University of Technology (TU Delft), working within the Faculty of Architecture and the Built Environment and its Digital Technologies/Geomatics community.His research and teaching focus on geoinformatics (GIS) and 3D geo-information, including point clouds, indoor positioning/localisation, and related 3D spatial data structures and modeling methods.

Peter J. M. van Oosterom is Professor of GIS Technology at Delft University of Technology (TU Delft) and chairs the GIS Technology group within the Faculty of Architecture and the Built Environment.He is widely known for research on 3D cadastres and land administration (including work connected to LADM), as well as spatial databases, real-time/3D geo-information, and map generalisation/vario-scale concepts.

W.J. (Wido) Quist is an associate professor at Delft University of Technology (TU Delft) in the Faculty of Architecture and the Built Environment, where he leads the Heritage & Architecture section.His work focuses on building conservation, historic building materials, and the adaptive reuse of modern heritage, including research on materials such as natural stone and concrete. Beyond TU Delft, he serves as Secretary General of Docomomo International, chairs Docomomo Netherlands, and (since 2022) is co–Editor-in-Chief of the Docomomo Journal.

Uta Pottgiesser is Professor of Heritage & Technology at TU Delft's Faculty of Architecture and the Built Environment and Professor of Building Construction and Materials at TH OWL, Germany. Her work bridges sustainable building construction and the preservation, reuse, and improvement of modern built heritage, with research interests spanning modern built heritage, building culture, and participation and co-creation in the built environment. As Chair of DOCOMOMO International and editor-in-chief of the Docomomo Journal, she leads international initiatives on twentieth-century architecture and contributes to projects such as the DOCOMOMO 3D Platform that explore digital documentation, multi-modal visualization, and collaborative approaches to conserving modern architecture.

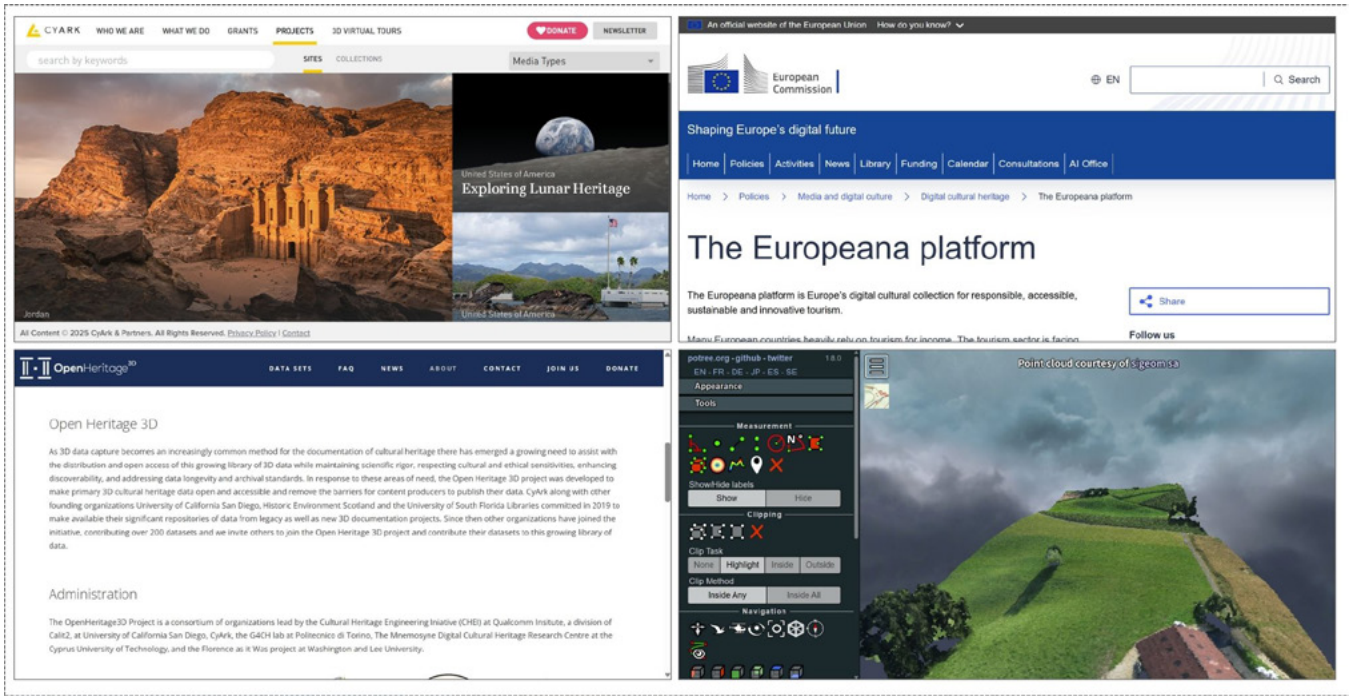


Figure 1. Examples of existing digital platform related to architectural heritage. Accessed January 25, 2026.

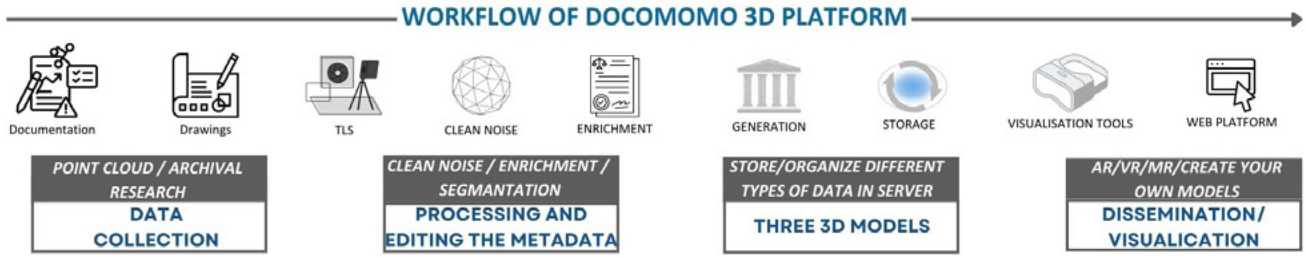


Figure 2. Workflow of the Docomomo 3D Platform (Authors).

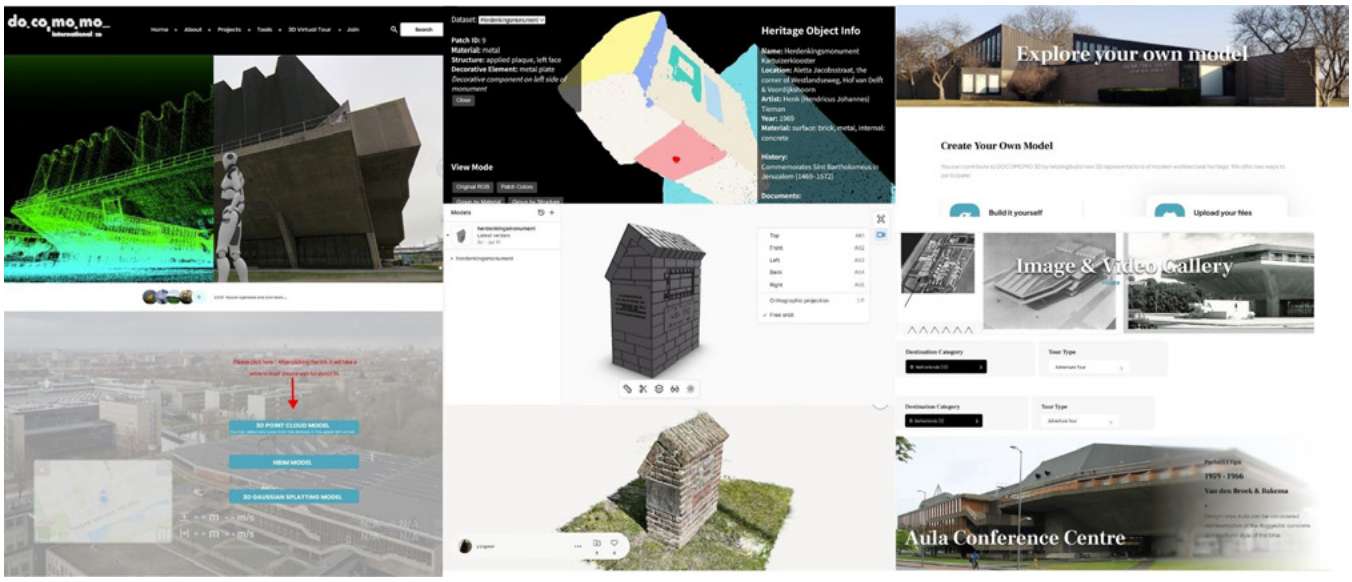


Figure 3. Details of Docomomo 3D platform.

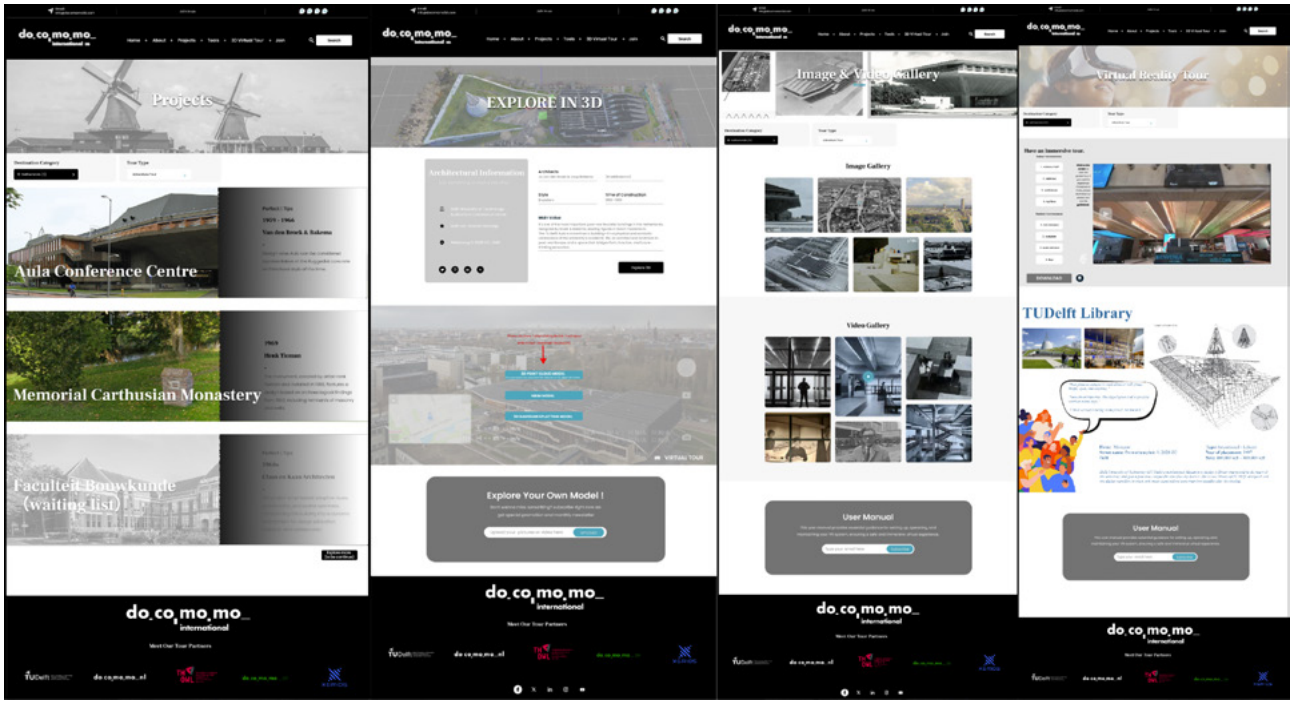


Figure 4. Participants' test interface.