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H-BIM for the Torino Esposizioni complex: A fusion of Parametric Digital Modeling and Image Archive, bridging past and present / Lo Turco, Massimiliano; Tomalini, Andrea; Bono, Jacopo. - In: DISEGNARE CON... - ISSN 1828-5961. - ELETTRONICO. - 16:31(2023), pp. 6.1-6.8. [10.20365/disegnarecon.31.2023.6]

Availability:

This version is available at: 11583/2985167 since: 2024-01-17T09:23:22Z

Publisher:

Università degli studi dell'Aquila

Published

DOI:10.20365/disegnarecon.31.2023.6

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H-BIM for the Torino Esposizioni complex: A fusion of Parametric Digital Modeling and Image Archive, bridging past and present

The article explores the outcomes of restoring the Torino Esposizioni complex, a masterpiece designed by Pier Luigi Nervi and a crucial component of Turin's architectural heritage. This building has once again become a focal point in contemporary discussions, given its central role in the Technical Economic Feasibility Plan (PFTE) proposed by the Isolarchitetti studio in collaboration with Rafael Moneo, slated for completion in 2022. This team played a pivotal role in implementing and refining the BIM methodology within the professional realm, specifically for crafting the architectural model of such a distinguished property. The process of breaking down the building into standard H-BIM components began with a preliminary phase of study that leveraged an extensive iconographic collection. This assemblage of images underscores the intricacy of an architectural entity deeply rooted in our heritage and chronicles its myriad modifications and res-

torations over the years. Painting a vivid picture draws profound parallels between historical images and contemporary digital representations.



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Keywords:
Pier Luigi Nervi, Torino Esposizioni, H-BIM, BIM methodology, Image archive

INTRODUCTION

In its ongoing efforts to preserve and elevate its invaluable architectural legacy, the city of Turin has presented a comprehensive proposal to the Ministry of Culture to requalify the Po area. Central to this initiative is the extensive redevelopment of the Valentino Park, coupled with a meticulous restoration of the esteemed Torino Esposizioni complex. The refurbishment of Torino Esposizioni represents a unique opportunity to breathe new life into an architectural gem. Upon completion, it is slated to host the new Biblioteca Civica Centrale di Torino and stand as the nucleus of advanced architectural education and research at the Politecnico di Torino. Envisioned as a vibrant hub welcoming the city's inhabitants, this state-of-the-art facility is set to become the pulsating core of a cultural scene that, at present, seems somewhat fragmented. However, it promises to harmoniously blend elements of immense architectural and landscape significance. This work goes beyond merely chronicling the sequence of events leading up to the development of this landmark building proposal, which stands as an emblem of Italian 20th-century architecture. Instead, it underscores the escalating significance of images within this context. Images serve as potent mediums, capturing the relentless march of time and reinforcing the notion that the visual can be as impactful and complementary as the written word. Through this reimagined perspective, we best narrate the temporal shifts and associated events of this historic building through a visual tapestry. Within this context, cutting-edge digital technologies emerge as pivotal, forging connections between yesteryears, the present, and envisaged futures. Conventional sketches, drawings, and historical visuals evolve, culminating in intricate three-dimensional renderings encompassing axonometric and aerial perspectives. While some of these visuals are deeply technical, others cater to a broader audience, offering glimpses into potential futures and augmenting an already extensive visual repository intrinsically tied to the structure's legacy.

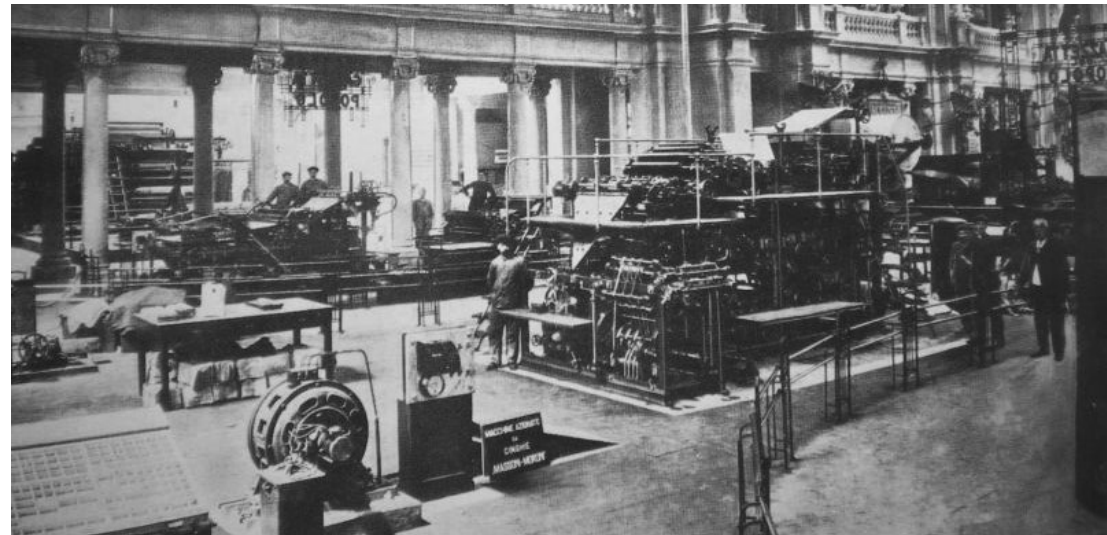
A COMPLEX PAST EXPLORED IN DIFFERENT REPRESENTATIONS

The Sottsass-Nervi building stands prominently in the southern region of Valentino Park, occupying the grounds of the former Palazzo del Giornale. This palazzo was established in 1911 to commemorate the Universal Exhibition, which coincided with the fiftieth celebration of Italy's unification (Fig. 1). The Palazzo del Giornale was envisioned to underscore Turin's global prominence, showcasing its stature as a dominant industrial hub. This city hosted global industrial giants, with FIAT leading the cadre. The infrastructures of the Turin Exhibition Centre are exemplary showcases of architectural and structural design brilliance, brought to life between the late 1930s and early 1960s by the era's leading engineers and architects. Notably, the most emblematic pavilion, curated by Pier Luigi Nervi for the new Central Civic Library, has garnered a spot on the UNESCO World Heritage List. Originally debuting in 1937 as the 'Palazzo della Moda' under the architectural vision of Ettore Sottsass, the complex has,



Fig. 1 - Facade of "Palazzo del Giornale", picture b/n. (Mussatti, 2017, p. 10).

Fig. 2 - Interior of "Palazzo del Giornale" with printing presses, picture b/n. (Balocco, 2011, p. 93, as cited in Mussatti, 2017, p. 21).



over the decades, undergone numerous metamorphoses. This evolution, steered by illustrious designers like Roberto Biscaretti di Ruffia, Pier Luigi Nervi, and Riccardo Morandi, has cemented the building's reputation worldwide as a paragon of structural engineering excellence. Pietro Fenoglio, Giacomo Salvadori, and Stefano Molli were premier architects of the Art-Nouveau era in Italy, having played pivotal roles in designing iconic buildings during this period. The principal pavilion encapsulated a visionary portrayal of the production process of a dominant mass communication tool—the Newspaper. This ranged from the inception of paper manufacturing to typeface casting, typesetting, and culminating in folding (Fig. 2). Exhibitions within the pavilion showcased inducements, portraits of eminent journalists, caricature galleries, as well as compilations of calendars and pictorial postcards (Balocco, 2011; Mussati, 2017). After the Italian National Exhibition in 1928, the initial Palazzo della Moda (Fashion Palace) was erected in 1932, directly across from the Palazzo del Giornale (Garuzzo, 1928). Umberto Cuzzi took the lead in its architectural design. At the same time, the interior aesthetic was entrusted to Annibale Rigotti, Aldo Morbelli, and Gino Levi Montalcini—with Montalcini further contributing to ensuing exhibits (Fig. 3, 4) (Sottsass, 1939). Subsequently, the following year, a proposal was floated to commission the second Palazzo della Moda, which was envisaged to supplant the original Palazzo del Giornale. The architecture of this new building leaned towards rationalism, boasting clean and unadorned designs—a stark deviation from the lavish and ornamented architecture of its predecessor, the Palazzo del Giornale. In 1947, the newly established Società del Palazzo delle Esposizioni confronted the challenge of devising multi-functional exhibition spaces adaptable to diverse events. As a strategic move, the interior regions of the Palazzo della Moda were allotted to this very entity. This pivotal project was entrusted to Roberto Biscaretti di Ruffia, an engineer affiliated with Fiat. In his preliminary designs, he judiciously retained the core principles outlined in Ettore Sottsass's preceding initial designs. Concurrent-

ly, in that same year, the task of refurbishing and revamping the Palazzo della Moda was conferred upon the esteemed engineer Pier Luigi Nervi. As a prominent figure in the realm of structural engineering of his era, Nervi's involvement ensured an unparalleled fusion of technical prowess and design innovation in the building's metamorphosis (Pellegrini, 1948).

For Pavilion 2, Nervi envisioned a basilica-style structure unfolding over a rectangular footprint measuring 81x112 m. Dominating its longitudinal axis was a series of gracefully sloping, cantilevered pillars, each tilting at an angle of 7.5 m. These pillars bore the dual responsibility of upholding the roof vault and an intermediate floor, manifesting as a balcony overlooking the central nave. To stabilize these leaning pillars, they were anchored onto specially designed bases, crafted to counterbalance the force exerted by the expansive vault crowning the main space. Complementing the nave and facing the park stands a grand glazed apse—an architectural feature initially conceived in the preliminary designs by Biscaretti (Fig. 5). In executing the pavilion's design, Nervi leveraged



Fig. 3 - Facade of "Palazzo della Moda", picture b/n. (MAMe, 2021).

Fig. 4 -Interior view of the dance garden in the Palazzo della Moda, picture b/n. (Casabella n.133, 1939, p. 27, as cited in Mussatti, 2017, p. 113).



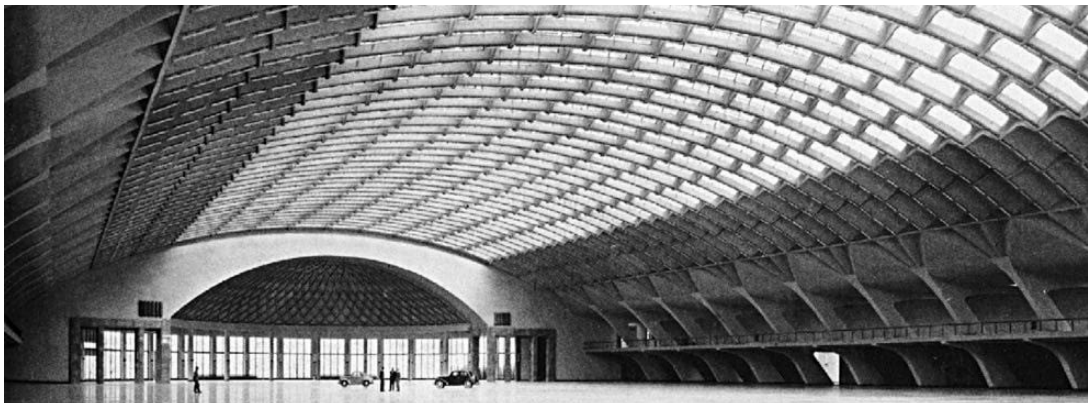


Fig. 5 - Front view, picture b/n. (Domus 231, 1948).

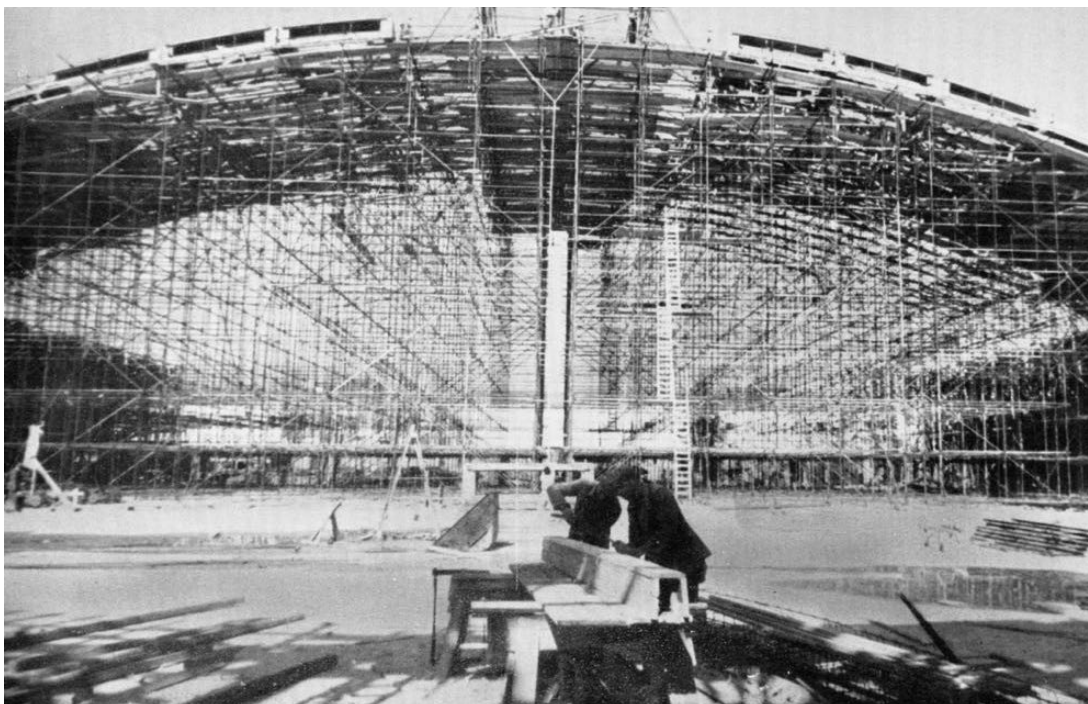


Fig. 6 - Assembly of the prefabricated vault elements on "innocent" tube scaffolding, picture b/n. (Gregnanin, 2010, p. 20, as cited in Carpanelli, 1955, p. 224).

avant-garde techniques, methods previously vetted by the Società Ing. Nervi e Bartoli of Rome. This entity pioneered the fusion of prefabricated ferro-cemento systems, seamlessly blending innovation with structural integrity to strike an equilibrium between aesthetic design and functional robustness. Beyond the notable construction advantages depicted in (Fig. 6), the intricate design of the building stands out for its exceptional architectural eloquence. This is particularly observable in the seamless interplay between the gracefully curved vaulting and the commanding, tilted pillars. A pioneering construction technique was employed to improve the semicircular apse—positioned at the nave's terminus and marked by a remarkable 60-meter diameter. This method uses prefabricated lozenge-shaped elements interconnected with sturdy, on-site cast, reinforced concrete ribs. The overall depth of these fabricated elements, including the ferroconcrete constituting the lozenge tiles, is a mere 7 cm. The integrated design of the horizontal plane, defined by the visible ribs framing its structure, harmoniously aligns with the gracefully curved and open ribs of the expansive vault. This synergy embodies the perfect fusion of structural methodology and design elegance, bearing witness to the unparalleled ingenuity and expertise encapsulated in Nervi's creation (Carpanelli, 1955; Gregnanin, 2010; Vernizzi, 2011). During the 1960s and 1970s, the complex buzzed with vibrancy, serving as a central hub for exhibitions and the primary setting for several renditions of the esteemed Turin Motor Show (Fig. 7) (Getty Foundation, n.d.). Yet, in 1989, the epicenter of trade fair operations shifted to the Lingotto, marking the onset of a period where the complex saw reduced and sporadic utilization. A notable departure from this trend occurred during the 20th Winter Olympics in 2006 when the grand building transformed into an arena for thrilling ice hockey competitions (Fig. 8) (Urban Center Metropolitan, 2014; Marinò, 2015). From 2015 onwards, the Torino Esposizioni precinct has been reinvigorated, playing host to a spectrum of art showcases, notably including the renowned contemporary art festival, 'Paratissima' (Fig. 9) (Bandini et al., n.d.).

CURRENT IMAGES TO PRESENT NEW PROJECT IDEA

Embarking on restoring these structures, some of which are currently unused and visibly deteriorating, the project ambitiously seeks extensive architectural and functional rejuvenation. The initiative envisions infusing novel functions such as reading, study, and research, harmonizing them with the locale's historic inclinations that have perennially resonated with themes of culture, education, nature, sports, and culinary activities.

The blueprint for the upcoming Civic Library is ardently devoted to preserving and accentuating the inherent architectural and structural nuances. It aims to uphold the original integrity and readability of the remarkable twentieth-century constructs. Beyond mere conservation, the design ambit encompasses refining and detailing all spatial, functional, and technological facets of the establishment in full compliance with the principles set forth by the Soprintendenza Archeologia Belle Arti e Paesaggio. The envisioned Library will not merely meet the foundational requisites of a modern-day public library and cultural information hub. Still, it will evolve into a vibrant nexus for community engagement and interaction nexus. Designed to be welcoming and inclusive, this newly created space aims to serve a diverse audience encompassing different ages, cultural backgrounds, and origins. It will house an expanded repertoire of information assets, including multimedia offerings, all set within an aesthetically pleasing and supremely comfortable milieu (Città di Torino & Politecnico di Torino, 2014).

The forthcoming Library is envisioned not just as a repository of knowledge but as a dynamic portal to the modern era and a crucible for stimulating citizens to recontextualize history in light of current and emerging perspectives aligned with the tenets of the Faro Convention. Emphasis will be placed on fostering active community engagement and collaborative content creation. The goal is to bridge the divide between diverse age groups, different cultural demographics, and newcomers, leveraging the library's state-of-the-art digital



Fig. 7 - Showcase of Turin's automotive industry, "Il Salone dell'automobile", 1954, picture b/n. (Getty foundation, n.d.)



Fig. 8 - Ice hockey rink during the Winter Olympics, 2006, picture RGB. (Urban Center Metropolitan, 2014: 16, as cited in Marinò, 2015).



Fig. 9 - Cultural exposure: Paratissima, 2014-2015, picture RGB. (Bandini et al., n.d.)

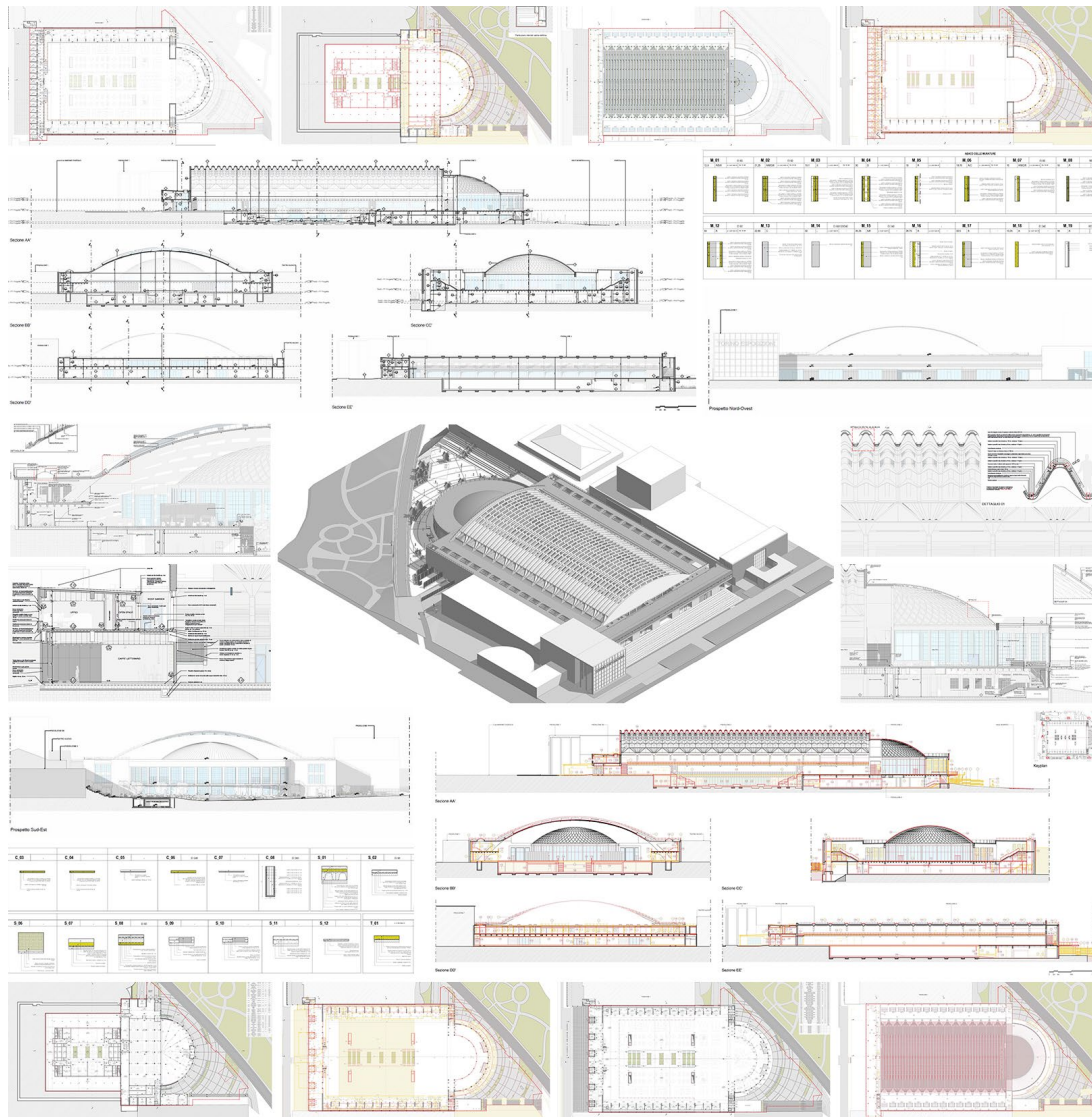


Fig. 10 - Recent images telling the story of the new project proposal, 2023, Digital composition (Bono)

and interconnected framework. In today's digitally-driven landscape, the library stands as a beacon, deeply entrenched in this digital milieu. This endeavour fits with a broader vision that encompasses the establishment of the Architecture, Design, and Landscape Campus. Within this expansive framework, the library is poised to serve as a linchpin—a nexus for the broader community and, more specifically, an indispensable resource for the residents of the Valentino Campus, spanning students, faculty, and researchers. Rejecting the insular approach commonly found in many Anglo-Saxon campus models, this campus aims to surpass academic boundaries and extend an open invitation to the general populace. An architectural design anchors this vision, exuding warmth and resonating with cultural nuances. Thus, fostering a harmonious relationship between the urban public and the academic environment will be crucial. The envisioned library will span three levels: the primary floor will cater to conventional reading and study pursuits, whereas the two lower levels will be earmarked for technological advancements and the preservation of literary artifacts, respectively. The ground floor will also feature collaborative workspaces, private study rooms, and dedicated zones for instructional sessions and informational engagements. Curated spaces foster community engagement near the entrance and seamlessly interface with the external environment. These spaces incorporate a thematic coffee lounge and an arena for collaboratively planning cultural gatherings. Central to the ground floor's design—where traditional reading and study are paramount—is the strategic placement of furnishings, delineating zones without imposing rigid structural barriers. Flanking this core area are accessible bookshelves, utility zones, administrative quarters, and self-serve kiosks. The apsidal section, which affords panoramic views of the verdant expanse beyond, is conceived as a sanctuary for both structured and relaxed reading, capitalizing on the serene backdrop of the park. The creation of detailed point clouds accurately depicted the building's present condition. Subsequent processing within the BIM

framework (Fig. 10) streamlines the orchestration of the building's extant and impending states. Such representations hold more than historical significance; they emerge as a pivotal archive for posterity, encapsulating both a testament to the past and a treasured legacy for future generations (Moneo & Isolarchitetti S.r.l., 2022)

THE H-BIM PROCESS FOR DIACHRONIC HERITAGE DEVELOPMENT: THE ROLE OF IMAGES

In the ensuing discourse, we delve into one of two emergent trajectories stemming from the evolutionary transition of the BIM (Building Information Modeling) methodology. Oriented initially towards new construction, BIM has expanded its scope to encapsulate historical-architectural heritage. This evolution has bifurcated into two primary research avenues: firstly, the nexus between BIM and tools dedicated to data acquisition and surveying; secondly, the collation and stewardship of preliminary survey data about architectural artifacts, commonly referred to as H-BIM. Our examination of the Turin Exhibition complex is anchored within the second avenue. This focus transcends the elementary aggregation and administration of geometric and dimensional datasets, emphasizing the encompassing iconographic ensemble that chronicles the genesis of this prized component of Turin's architectural example. BIM is semantically deconstructed in this context, orchestrating harmoniously across its dual facets: the information architecture and the intrinsic database framework. This intricate approach facilitates the conception of a multifaceted model capable of assimilating and curating complex knowledge associated with historical buildings (Brusaporci et al., 2016).

As a result, imagery plays a pivotal role within this digital canvas, mainly due to its ability to depict specific temporal phases of the structure, outline its numerous uses, and intertwine with significant events highlighting the cultural ethos of the architectural entity (e.g., the Motor Show, XX Olympic Winter Games, Paratissima - Art

Week); and encapsulate collective remembrance. All these facets collectively elucidate the overarching objectives of the BIM methodology during the preliminary design phase, namely the PFTE (Technical-Economic Feasibility Plan). Such goals encompass deciphering the historical metamorphoses of the building (historical hermeneutics) and relaying the narratives inherently tethered to the architectural marvel (storytelling). Within this narrative architecture, images are seminal. They oscillate between roles underpinning restoration and conservation endeavours or augmenting value via evocative storytelling and heritage narration (Empler et al., 2023, p. 161). As an integral part of the Cultural Heritage, the Torino Esposizioni complex boasts an extensive iconographic legacy. This visual treasury has evolved from various alterations and layers added over time. Images prove indispensable during the preliminary phase of understanding such a monumental structure. They depict and witness the culture, events, and stakeholders spanning the complex's history. Their pivotal role in the Building Information Modeling (BIM) process—shaping future digital renditions birthed from this methodology—is undeniable. BIM facilitates the genesis of a multifaceted entity anchored in two core principles. The first pertains to creating an infographic database where images can assume a primary role. The second revolves around navigating within these compiled visuals. This approach crafts a nuanced platform where the three-dimensional model, a salient product of the BIM framework, serves as an interactive portal. It showcases and permits inquiries into its associated data, transcending geometric and dimensional facets (Brusaporci, 2015, pp. 97-114). To sum up, the insights gleaned led to forming of a knowledge-centric model incorporating the fourth dimension (4D) to articulate architectural evolution (De Luca et al., 2023). Time emerges as an indispensable aspect in H-BIM, instrumental both for comprehending heritage in contemporary contexts and as an essential determinant for its enduring conservation. As the building's history unfolds, images gain pivotal significance, bolstering the tangible authenticity of the heritage.

Concurrently, they provide enhanced oversight on potential modifications to the structure, bearing in mind its susceptibilities and vulnerabilities. The H-BIM approach bestows a dual function: the phases of the initial research (documentation) and analysis (data acquisition tools) assume a diagnostic role. In contrast, the subsequent modeling phase adopts a discerning interpretative stance toward the scrutinized architectural legacy (Mammoli, 2021).

CONCLUSIONS

The importance of managing a diverse data set, where images play a pivotal role, must be balanced to achieve a comprehensive understanding of architectural heritage and its progression over time. As E. Cicalò noted, "*le architetture vivono attraverso le loro immagini che, nel divenire pubbliche, danno vita ad un circuito di critiche, speculazioni, dibattiti*" (Rattenbury, 2002 as cited in Cicalò, 2010, p. 117). Furthermore, Cicalò underscores the distinctiveness of modern movement architectures. These designs, emerging in the early 20th century, were paired with the burgeoning communication mediums of the era. The shift was from direct experiential recognition of architectural works to identification via images disseminated in print. It is increasingly evident that the origin of architecture does not solely derive from its material and constructive nature but is linked to the presence and formation of an essential immaterial space, where "*le pubblicazioni, le mostre e le risorse specializzate*" (Cicalò, 2010, pp. 117-120). "*E' proprio questa costruzione immateriale che, paradossalmente rende l'architettura meno effimera, garantendo la permanenza delle opere nella storia per mezzo delle loro stesse immagini*" (Colombina, 1996 as cited in Cicalò, 2010, p. 119)

NOTE

[*]Author Contributions:
Although the contribution was conceived jointly, Massimiliano Lo Turco is author of paragraphs "Introduction" and "Conclusions";
Andrea Tomalini is author of paragraphs "Current images to present new project idea";
Jacopo Bono is author of paragraphs "A complex past explored in different representations" and "The H-BIM process for diachronic heritage development: the role of images";

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