

Architecture + Fashion = Cultural Expression of the Building Envelope as Explored in the Architectural Design Studio

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Abstract

If, in the XX century, soccer stadia celebrated structural ingenuity as epitomized by the examples of Pier Luigi Nervi in Florence and Rome, Paulo Pinheiro Guedes in Rio de Janeiro, or Pedro Ramírez Vázquez and Rafael Mijares Alcérreca in Mexico City, the XXI century awoke with a different preoccupation, the one for the skin. The new trend in stadium design was arguably instigated by the winning design for the Allianz Arena in Munich, Germany, by Swiss architects Herzog and de Meuron, which, in place of expressing structure, proposed a façade composed by some 3,000 ETFE-foil ‘air pillows’ covering the full bowl.

Unlike other building typologies where the skin can be tasked with the dual role of providing aesthetics and environmental responsiveness, in stadia, the need for (a) skin is superfluous, and its implementation is correlated with the making of a *brand*. It can be compared to a haute couture garment manufactured with unique, often unusual, high-quality, expensive materials, and with an extreme attention to detail. And, as in high fashion garments, skin design in stadia is specifically tailored for the individual client, not replicable, and pricey.

The contemporary restless search for uniqueness in stadia envelope design has provided architects the grounds for fertile explorations. To the investigations of materials, patterns, and technologies, parallels a search for skin expressions more rooted in the place and an interest in finding design expressions that reduce the perceivable scale of these mega structures.

Stripped of the thermal performance requirements of other building typologies but extremely driven by tectonics and sympathetic to new materials, we argued that stadia skin design could be a worthy investigation in the architectural design studio. Therefore, as part of a fourth-year design studio, on two recent occasions and concurrently to the ambition of many Italian premier league soccer clubs to promote the construction of new facilities, we assigned our students to design respectively the proposed 52,000-seat AS Roma Stadium in Rome, Italy, and the joint-use 60,000-seat stadium for AC Milan and FC Internazionale Milano in Milan, Italy. Alongside developing proper long-span structural systems solutions to shelter fans from excessive temperatures and inclement weather, students were tasked to envelop the stadium with skin systems designed to simultaneously brand the soccer teams, draw from the unique culture of the host city, and be unmistakable Italian, while providing for refined tectonics.

This contribution examines the correlation between material culture and cultural branding of skin systems through the digital and virtual reality explorations of students’ work.

Preface

A paradigm shift was ignited when, in 1853, French builder François Coignet invented iron-reinforced concrete and built for himself a four-story house in the suburb of Paris, France. Since then, and arguably up to the mid-late-twentieth century, reinforced concrete became the obsession of many engineers who exploited its mechanical

characteristics to advance construction science and produce astonishing structures. From Pier Luigi Nervi to Felix Candela, Eugène Freyssinet to Sergio Musmeci, and August Komendant to Santiago Calatrava, to name just a few, their structural ingenuity compares only to the one exploited in Ancient Rome. Not being immune to the popularity and versatility of reinforced concrete construction and begging for sculptural expression, stadia for different sports became the visible expression of the blending of science, artistic sensibility, and intelligent intuitiveness as epitomized, for instance, by Nervi's visually dramatic helicoidal stairs for the Stadio Artemio Franchi in Florence, Italy (1931), his Palazzetto dello Sport in Rome, Italy, built for the 1960 Olympics Games (1957), Madrid's Zarzuela hippodrome by Carlos Arniches, Martín Domínguez, and Eduardo Torroja (1941), or Hitoshi Abe with Syouichi Hairu's Miyagi Prefectural Stadium in Miyagi, Japan (2000) among others.

However, at the dawn of the XXI Century, the preoccupation of visible structural expressions had largely faded in favor of the envelope, specifically the skin. Thus, borrowing Ellen Lupton's words, "the primacy of the skeleton [had] given way to the primacy of skin."¹

The fascination with skin design that has erupted in architecture in recent years can be attributed to various causes, but principally to the evolution of three-dimensional digital modeling software, the development of new materials, and the advance of robotics in manufacturing. With the introduction of NURBS-based (Non-Uniform Rational Bézier Spline) 3D modeling systems, such as Autodesk Alias, CATIA, McNeel Rhinoceros, or Maya, which have enabled architects to investigate and create at ease complex, amorphous designs formerly thought unachievable, the world of architectural design has shifted dramatically.² The development of parametric plug-ins, like Grasshopper 3D and Dynamo, has further expanded the possibilities for architects by enabling rapid real-time manipulations of

intricate forms to explore different design iterations and automating repetitive tasks.³ The conception and fabrication of a building skin have fundamentally been altered by digital fabrication. Designs are not only created digitally but also implemented digitally using "file-to-factory" procedures using computer numerically controlled (CNC) manufacturing technology.⁴

Before the widespread adoption of these advanced modeling and fabrication tools, architects like the visionary Giovanni Michelucci were among the very few who dared to push the boundaries of architectural form, as exemplified by his Chiesa di San Giovanni Battista in the outskirts of Florence, Italy.

It is not uncommon among practitioners, academics, and specialized press to interchangeably use the words *façade*, *envelope*, and *skin*. However, we argue for three distinctive meanings. Without adventuring in the fascinating etymology of the words and their anatomy analogy, with *envelope* we intend the necessary protective cover of a building, and with *skin* the layer (or layers) applied over the envelope to enhance the building energy performances or simply characterize its aesthetics independently from the envelope or supplementing it. Furthermore, it is possible to associate different structural attributes between the envelope and the skin. The envelope can be load-bearing, as in concrete construction, while the skin is commonly designed only to support itself. Therefore, from our viewpoint, buildings requiring enclosed spaces necessitate an envelope but not necessarily a skin. And with *façade*? Purely the face(s) of a building as perceived by the eye, felt by the heart, constituted by both or either envelope and skin, alienated from tectonics, stripped of any performance annotation, and reduced to a graphic expression. In other words, an elevation drawing materialized.

Unlike other building typologies where the skin may bear the dual role of providing aesthetics and environmental responsiveness, in stadia, specifically, in the context of this

contribution, soccer stadia, due to their intrinsic nature of being generally outdoor arenas and notwithstanding an increased tendency of alighting the vast spaces formed under the stands with a variety of programs, the need for (a) skin is, in some way, superfluous. Its implementation can be directly associated with developing a distinctive identity that is not dissimilar to a brand and might become part of the urban expression and even a tourist destination. This iconic and distinctive design aims to leave a lasting impression, expresses cultural values while promoting local or even national pride, and potentially evokes apprehension in the opposing team.⁵ In this context, the stadium's skin can be likened to an haute couture garment crafted with unique, often unusual, high-quality materials, meticulous attention to detail, specifically tailored to the individual client, and unreplicable.

The new trend in stadium design was arguably instigated by the winning proposal for the Allianz Arena in Munich, Germany (2005), home of Bundesliga's FC Bayern München, by Swiss architects Herzog and de Meuron, which, in place of expressing and celebrating structure, exhibits a façade composed by some 3,000 ETFE-foil 'air pillows' wrapping the full bowl that could be independently lit with different light colors. The Allianz Arena innovative façade lighting concept was the first applied to a stadium design worldwide, replacing transparency and permanency with translucency and mutability.⁶

The contemporary restless search for uniqueness in stadia design has provided architects the grounds for fertile explorations. To the investigations of materials, patterns, and technologies, parallel a search for skin expressions more rooted in place and an interest in finding design expressions that reduce the perceivable scale of these mega structures. One of the early examples that epitomize stated undertaking can be found in the skin design for the expansion and renewal of the Soccer City Stadium in Johannesburg, South Africa (2009) by local architect Boogertman Urban Edge and

Partners in partnership with Kansas City-based Populous as the result of South Africa being selected to host the 2010 FIFA World Cup. The skin, made by a constellation of locally produced fiber cement panels ranging in color from creams to deep browns, was inspired by the *calabash*, a traditional African pot made from the hard shell of the homonym fruit, and deemed as being the object that "would automatically be associated with the African continent and not any other."⁷

Soccer stadia as a design exploration in the architectural design studio

Having committed to a student steel design competition that solicited long-span steel applications and a special emphasis on innovation in steel design,⁸ we reasoned that assigning to design a stadium could be a fruitful endeavor in an architectural design studio that sited architectural investigations abroad and sought responses sensitive to local lexicon yet contemporary in character. If the project would respond eloquently to the competition's objectives, it would also fulfill our pedagogical and research aims by emphasizing skin design as one vehicle that could localize an otherwise program characterized by worldwide standards as published by the international soccer self-regulatory governing body, the Fédération Internationale de Football Association (FIFA). Furthermore, it would expose students to two elements, one structural and one cultural, that no other architectural project offers: the ingenuity of roof stadia engineering, and the fascinating, dynamic, controversial, and, at times, violent, world of soccer's subculture.

Therefore, as part of a fourth-year design studio, on two recent occasions and concurrently to the ambition of many Italian premier league soccer clubs to promote the construction of new facilities, we assigned our students to design respectively the proposed 52,000-seat AS Roma Stadium in Rome, Italy and the joint-use 60,000-seat stadium for AC Milan and FC Internazionale Milano in Milan, Italy. Alongside developing proper long-span

structural systems solutions to shelter fans from excessive temperatures and inclement weather, students were tasked to wrap the stadium with skin systems designed to simultaneously brand the soccer teams, draw from the unique culture of the host city, and be unmistakable Italian, while providing for refined tectonics.

Notwithstanding matching goals, the two design interactions offered distinctive challenges. The AS Roma stadium was to be designed in the same site and location as the proposed stadium to the south fringes of Rome, on the left bank of the Tiber River and along a loop that the river forms as it snakes towards the Tyrrhenian Sea and in the area occupied by the vacant iconic Tor di Valle hippodrome. It had to emphasize the *curva sud*, the south section of the stadium reserved for the most passionate AS Roma fans. As typical in Italy, one of the *curve*, the two sections of the stadium that rise behind the goal lines, is reserved to the team's most vocal, die-hard supporters, known as *ultras*. The apportioned *curva* is the focal point for the team's patronage. It is the site of dramatic choreography of mammoth size waving flags, flares, epic chants, drums, jumping up and down, and other preplanned stratagems to augment the folkloristic spirit.⁹

On the other hand, the joined-used AC Milan and FC Internazionale Milano stadium, being a shared stadium, had to mediate between two distinctive philosophies, ownership and rivalry, and had the difficult task of replacing the beloved and iconic San Siro Stadium. Renamed in 1979 after one of Italy's greatest soccer players, Giuseppe Meazza, San Siro hosted its first game in 1926 and witnessed several expansions and renovations. However, its original stands can still be seen beneath the many alterations.¹⁰ We sited the project not on one of the two locations that the City of Milan, in conjunction with the two teams was exploring, but rather, after having invited Milanese architect Francesco D'Antuono to explore and suggest alternative locations, on the grounds of the former Expo 2015 to the north-west

of the city and a site programmed to become a hub for innovative living and working. Denominated MIND, Milano Innovation District, the one million square meter area (230 acres) had been planned as an ecosystem fostering sustainable and wellness-inspired spaces and a pioneering interconnectivity between nature and the built environment. In addition to the Science Campus of the University of Milan, a branch of the orthopedic research hospital IRCCS Galeazzi, and various headquarters, in MIND were to find home research institutes, offices, shops, residences, and leisure activities encompassing entertainment, culture, and sport.¹¹

Skin as a synthesis of local culture: examples from the studio

Paralleling educating students on structural steel construction, we were interested, from a research perspective, as previously stated, to view how students comprehended and translated forces encapsulated in local culture into viable skin solutions fulfilling the challenging task of being rooted in the place at multiple levels. Defined as a set of customs, traditions, and beliefs, local culture encapsulates the uniqueness of a particular geographic area and encompasses aspects like traditions, languages, food, rituals, beliefs, and apparel.

In Italy, popular crochet patterns often feature delicate lace designs, including intricate filet crochet, *punto a rete* (net stitch), and *punto a giorno* (openwork stitch), commonly used for shawls, tablecloths, and garments with a feminine aesthetic. Craftswomen are custodians of these ancient and precious techniques of needlework.

Since the early 1990s, initiatives for protecting Italy's lace tradition have proliferated. The Cantù International Lace Biennial and the related Merletti e Design, have correspondingly worked to keep this ancient art alive and pass it on to future generations,¹² promoted the collaboration between artists, architects, designers, and

lace makers to give life to innovative projects that enhance artisanal wisdom.

The student's developed skin design for her Milan *Hook Stadium* drew inspiration from the city's rich cultural heritage of textiles and incorporated elements of traditional weaving craft that reflected Milan's identity and its role as a global fashion and design hub.¹³ Informed by the traditional Italian crochet craft, namely the square and a lacy star stitch pattern, the design attempted to capture the soft yet dynamic nature of this fabric while showcasing the plasticity and ductility of steel. The student-researched design framework provided a structural logic of a square grid and nodes, which she then used to develop a kinetic skin system responding to the local sun path. The dynamic interplay between skin and atmospheric conditions created a visual and auditory record of the ever-changing climate. The design surfaced as an iconic architecture effectively meshing cultural and industrial heritage, technology, and the aspirations of MIND.

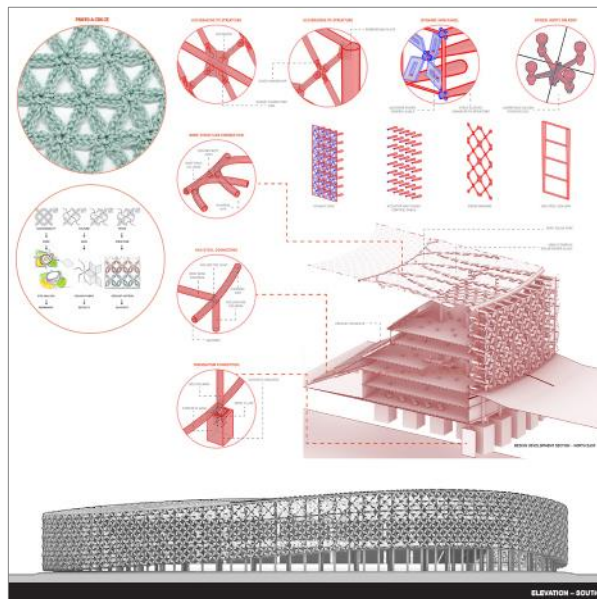


Fig. 1. Hook Stadium proposition by student S. W.

Textiles have long been a source of inspiration for architectural design with the techniques of weaving, knotting, and interlacing informing the construction of built

structures.¹⁴ The Milan *Weave Stadium* project creates an homage to the distinctive leather weaving technique called *intrecciato*, which originated in the 1960s at the Milanese fashion house Bottega Veneta.¹⁵ This method of weaving strips of leather through slits in another piece of leather to create a durable and flexible textile was based on local artisanal basket weaving craft. The concept of *Weave* draws upon this rich tradition, utilizing contemporary leather manipulation techniques to generate a new architectural language for the proposed new home of the two Milanese soccer teams. Beyond the physical translation of craft into architectural form, the visualization of weaving is expressed through a series of defined components that come together to create a dynamic and engaging spatial experience.

The skeletal structure of *Weave* was drawn from the distinctive protruding red girders that distinguish the iconic San Siro Stadium's roofline and evoked the original red girders through vertical components, which, in turn, supported the skin system's latticework. The act of weaving was enhanced by applying differently woven fabrics admitting diverse light quantities, directly reflecting the regional leather crafting techniques that inspired the design. This airy, rhythmic lattice breaks across the facade, allowing patterned light to move across the internal concourses and the exterior plaza, resulting in a captivating and ever-changing play of light and shadows. Within the concourse, vertical structural components emerge from the lowest level, flowing through layers of voids and bridges to interact with visitors roaming the stadium's interior. As this network of structural elements meshes into the vertical support members, the roof above begins to assert a sense of enclosure, with the design culminating with curved polycarbonate panels extending above the stands and recalling San Siro's existing roof condition. The *Weave* scheme captures Milanese nostalgia for a beloved stadium yet proposes a design rich in other cultural references, light to the eyes, and dynamic compelling.

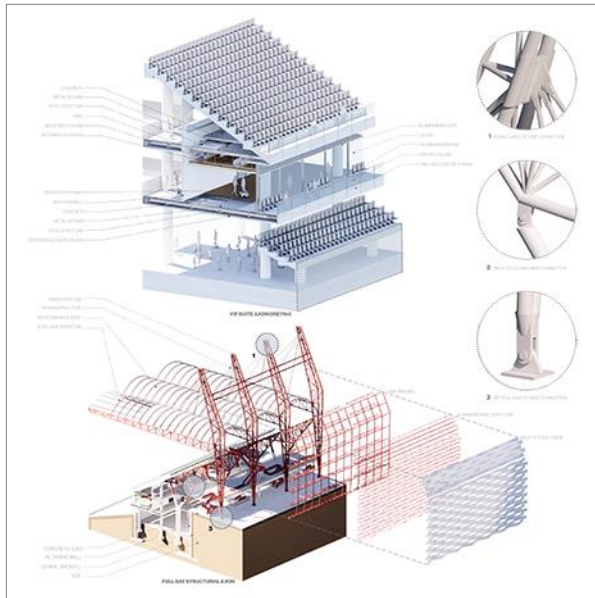


Fig. 2. Weave Stadium proposition by student C. V.

The *Analysis of Binaries*' skin development drew inspiration from one of Milan's most influential design and architecture collaboratives, Memphis Milano, also known as Memphis Group. Memphis was founded in late 1980 by architect Ettore Sottsass when he invited around two dozen Italian architects and designers to discuss the future of design.¹⁶ Sharing a dislike for the minimalist modernism design aesthetics that emerged in the 1960s and 1970s, the group emerged as an energetic and daring countermovement, creatively designing colorful non-conformist furniture, textiles, patterns, ceramics, and other decorative objects, eventually even serving as inspiration to later years haute couture collections like Christian Dior's Fall/Winter 2011-2012 collection.¹⁷ Ettore Sottsass left the group in 1985, and Memphis Milano dissolved two years later.

The student's proposition attempted to translate the essence of Memphis' credo via skin and forms unseen in soccer facilities. To the playfulness of one side of the façade, it was juxtaposed a Miesian architecture articulated by rhythmically placed cruciform steel columns and sober in details and aesthetics.

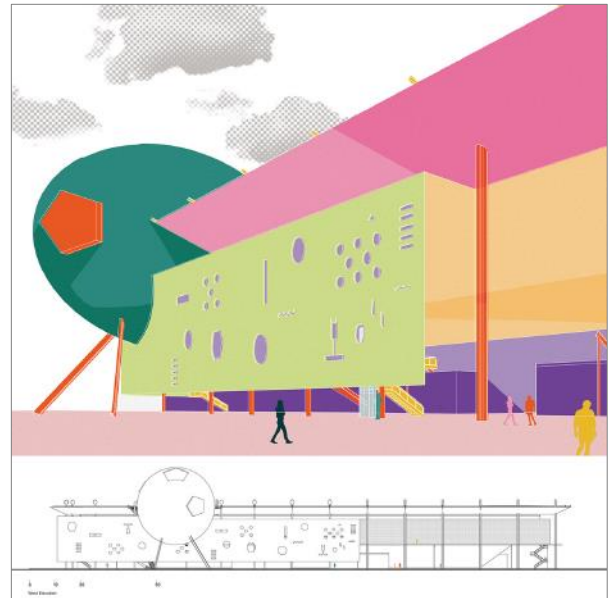


Fig. 3. Analysis of Binaries Stadium proposition by student N. H.

Unlike drawing from broader cultural heritage singularities, the *A Walk in the Park* skin proposal captures, through everchanging LED graphics, the historic accomplishment of AC Milan and FC Internazionale Milano. Extended above the ramps that lead to the various sections of the stadium, the fandoms are immersed in an energetic, vibrant environment before, galvanized by the surreal atmosphere, being discarded to the match to begin awaiting arena. At the end of the game, the skin's interior digital graphics morph to suit the emotions of the ended event.

The walking through the digitally enhanced tunnels leading to the field, albeit not identified by the student, can be compared to the quasi-magical nave space of many Italian Baroque churches, particularly those designed by Francesco Borromini, which he embedded with symbolic meanings and infused with light to which he gave major compositional importance.¹⁸

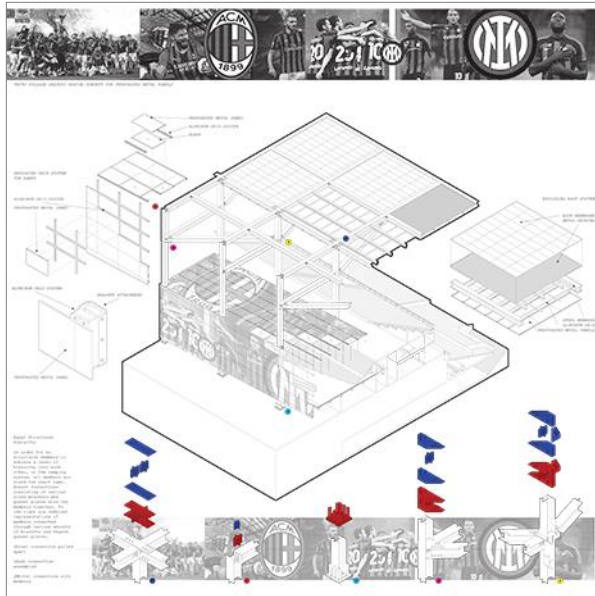


Fig. 4. *A Walk in the Park* Stadium proposition by student H. T.

In contrast to their Milan counterparts, most of the AS Roma's stadium students' propositions derived inspiration from the essence of AS Roma, its colors, badge, fans, and the nicknames that the team is often referred to, *i giallorossi* (the yellows and reds), *la lupa* (the she-wolf), and *the magica* (the magic one).

The stadium geometries of student D. W. arose from the interrelationship between the Tiber River and the original seven hills of Rome. Still, the developed two-layer skin system attempts to embody the energetic and dynamic spirit found in both players and fans. The carmine red of the architectural fabric that wraps the stadium bowl refers to AS Roma's jersey, making no mistake that this is AS Roma stadium. It energizes the fans and intimidates the visiting team and its accompanying supporters. The metal mesh of the outer layer runs alongside the fabric but not parallel to it, providing a visual depth amplified by the reflected light that incoherently bounces on the fabric and animates it.

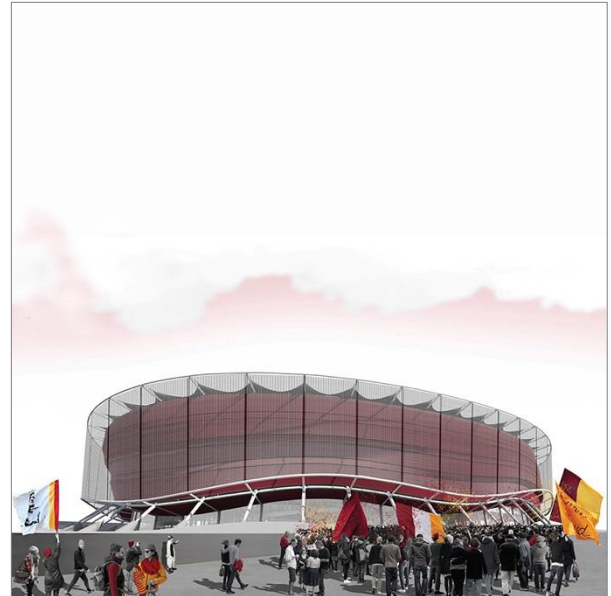


Fig. 5. Student D. W. proposition for the AS Roma stadium

Pictorial anthology of student's projects complementing the one narrated above



Fig. 6. Student M. R. proposition for the Milan stadium



Fig. 7. Student W. C. proposition for the AS Roma stadium

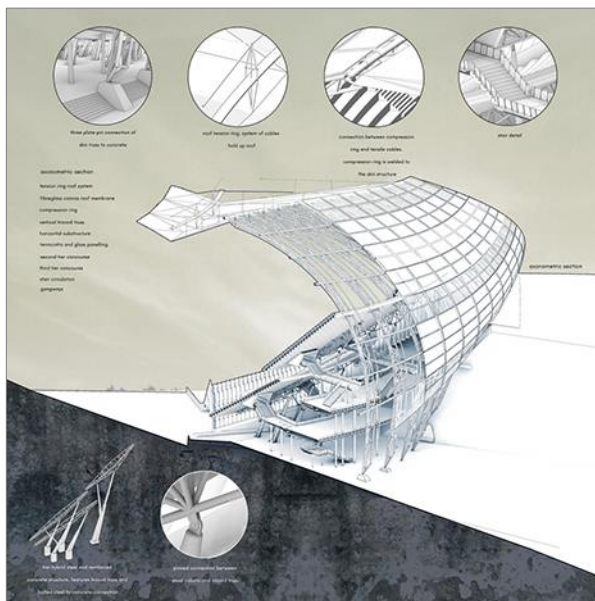


Fig. 8. Student E. L. proposition for the AS Roma stadium

Conclusion

Around the world, the contemporary landscape of soccer stadium design has undergone a significant transformation that has shifted its focus from mere structural expressions to one that prioritizes the skin of the building. The skin is not merely a functional feature that delineates boundaries or a stratum; it has become a powerful symbol embodying local identity and fan culture

and has contributed to the making of stadia sought-after tourist attractions. Therefore, stadia design is an ideal opportunity for architecture students to dive into the rich tapestry of local traditions and translate them into meaningful storytelling designs.

We developed a pedagogical framework that included the active participation in studio of Roman, Milanese, and other Italian architects, engineers, and citizens via remote and in-person dialogues. Within this multidimensional environment, students could question, explore, and draw from culture or local crafting traditions while understanding that material culture is deeply rooted in traditional values and artisanal practices rather than generic expressions. Ultimately, students' design sought to elevate the façade from a practical feature to a medium for cultural storytelling—showcasing what a community values and wants to share with the world.

As part of an assessment strategy, for the Milan stadium project, we invited our colleagues from Italy who participated in the interim and final reviews to respond to a questionnaire that, among other inquiries, sought their opinion on how successful, on a 0-100 scale, selected projects were in exemplifying an Italian identity. The survey revealed an average score of 85.43 points, validating our efforts of having students' solutions coherent with our objective to foster in them a vigorous interest in foreign cultures so as to become the vehicle for expressing in their creature an unmistakable spirit of the place, or *genius loci*. Our efforts were further recognized when three projects were awarded in the American Institute of Steel Construction (AISC) sponsored Association of Collegiate School of Architecture (ACSA) steel design student competitions.

The development of sports arenas, particularly soccer stadia, has evolved into a cultural statement with stadiums frequently acting as urban renovation catalysts and the potential for transforming themselves into iconic

landmarks that not solely embody the identity of the team but also symbolize the city or even the country in which they are located. Given the preceding statement, the pedagogical tactics discussed in this paper emphasize how stadium design provided a rich platform for upper-division design students and future architects to begin to explore cultural expressions, experiment with materials and structures, and reimagine stadia as spaces where global trends and local identities meet. At a time when the distinctiveness of culture is more and more at risk, the examples herein illustrated attest that our students, by researching and incorporating elements rooted in place like Italy's crochet traditions or Milan's famous leather craftsmanship into design elements, seamlessly linked a city's or a nation's traditions to its present, successfully creating structures that evoke and celebrate cultural memory, credence, artistry, dexterity, and technology.

Notes:

1 Lupton, Ellen. "Skin: New Design Organics" in *Skin* (Princeton Architectural Press, 2002), 31.

2 Le, Y., & Lu, Z., "The integrated application of computer software in architectural space design," *Journal of Physics Conference Series*, vol. 1812, issue 1(2021): 12033, <https://doi.org/10.1088/1742-6596/1812/1/012033>.

3 "Breaking down the Benefits of Grasshopper and Tekla Product Interoperability," Tekla, accessed January 19, 2025, <https://www.tekla.com/resources/articles/breaking-down-the-benefits-of-grasshopper-and-tekla-products-interoperability>.

4. Kolarevic, Branko. *Architecture in the digital age: design and manufacturing*, (Taylor & Francis, 2003) 38.

5. Lee, Y. "Re-informative design media in design emergence," *Automation in Construction*, vol. 61 (2015): 66, <https://doi.org/10.1016/j.autcon.2015.10.011>.

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7. "Boogertman Urban Edge and Partners: The Latest Architecture and News," Archdaily.com, accessed January 21,

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8. "Program, Category II-Open," ACSA, accessed January 19, 2025, <https://www.acsa-arch.org/competitions/2023-steel-competition/program/#cat2>.

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13. Neri, Raffaella, "Rehabilitation Projects of the Areas of the Decommissioned Barracks in Milan, 2014," in *Regeneration of the Built Environment from Circular Economy Perspective* (Springer International Publishing, 2019), 169.

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16. "What is Memphis Design Style and Why It Is Back," Hommés Studio, accessed January 25, 2025, <https://hommes.studio/journal/what-is-memphis-design-style/>.

17. "Christian Dior shows first haute couture collection since John Galliano sacking," The Guardian, accessed January 21, 2025, <https://www.theguardian.com/world/2011/jul/04/fashion-dior-couture-galliano>.

18. "An Independent Architect," Britannica, accessed January 28, 2025, <https://www.britannica.com/biography/Francesco-Borromini/An-independent-architect>.