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Front Pages

Athens Journal of Architecture

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The current issue is the first of the ninth volume of the *Athens Journal of Architecture* (AJA), **published by the Architecture Unit of ATINER**

Gregory T. Papanikos
President
ATINER

Athens Institute for Education and Research

A World Association of Academics and Researchers

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3-6 July 2023, Athens, Greece

The Architecture Unit of ATINER, will hold its **13th Annual International Conference on Architecture, 3-6 July 2023, Athens, Greece** sponsored by the Athens Journal of Architecture. The aim of the conference is to bring together academics and researchers from all areas of Architecture. You may participate as stream organizer, presenter of one paper, chair a session or observer. Please submit a proposal using the form available (https://www.atiner.gr/2023/FORM-ARC.doc).

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- Submission of Paper: **5 June 2023**

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The City on the Rails

By Nikoleta Slováková [*]

The research focuses on the application of the elements of the theory of linear urbanism to the current solution for the rural settlements, from which life is lost and they are becoming open-air museums. Rural settlements are currently experiencing a crisis, most of their residents are moving to the big cities for work and in order to improve the quality of their life. This work is inspired by utopian cities from the early 20th century, such as The Roadtown by Edward Chambless, Plan Obus by Le Corbusier or Green City by Konstantin Melnikov. Similar tendencies as in previously mentioned works could be found in highly developed cities such as Tokyo. The book, "Made in Tokyo," from Atelier Bow-Wow,[1] has already mapped the use of those utopian tendencies in Tokyo and tries to apply its forms to the existing typology of cities and landscapes. The aim is not to put all the functions in one conglomerate, but rather to create a superorganism within the country. The superorganism consists of several settlements with insufficient facilities. The settlements are interconnected by an already existing railway. The most important transformation is hidden in the utilisation of the transport infrastructure and in the further addition of the necessary facilities in such a way that the individual necessary facilities within the linear composition can be shared between multiple dwellings. The presented paper uses an artistic research approach, using the method "research by design". It is an applied (practical) normative research, which relies on the theory of linearity and the theory of the garden city and their radical and coherent design concept. The starting point of the research is a critical look at the current methods of chaotic construction in protected landscape areas in Slovakia. It uses the Margecany-Červená Skala site as a case study to demonstrate how linear theory would work in the present day, using Geographic Information System (GIS) data to analyse the site. The main goal of the project is to bring back the attractiveness of the region with the usage of contemporary artistic concepts, technologies and strategies.

Introduction

The restoration of the life in rural settlements is a complex subject, as is the revitalisation of the railway lines and the use of its potential. In addition to transportation-related challenges, the railway is also rising in the issues related to other areas ranging from regional economics, sociology, urban planning, architecture, ecology and technical heritage. Almost 200 years have passed since the creation of the first public railway, and since then the railway has managed to radically change the appearance of cities and landscapes. It has been an agent of change and enormous financial capital has been invested in it. The railway inspired the ideas for the new towns and cities which were using these new modes

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1. M. Kaijima, J. Kuroda, and Z. Tsukamoto, *Made in Tokyo* (Tokyo: Kajima Institute Publishing Co. Ltd, 2016).

of transport.

The first proposals emerged in the late 19th century. These were new designs for gardens and linear cities, and also new theories were developed regarding cities built into the landscape (garden cities). These were ideas that still, a century later, seem bold.

Today, the situation is different but the advantages of the railway remain—it is environmentally friendly, it has extensive infrastructure and it is safe. The railway has a potential which just needs to be harnessed properly because it is not just a mode of transport, its impact is greater. The railway is a city-forming element that gives the region it passes through character and a common identity. It is characterised by its line. We all move around, to work, to school or for recreation, creating real and abstract lines.

The aim of this project is to examine and show the potential of the railway, which lies in the qualities other than just transport. The project is focused on the revitalisation of the railway into a cultural/sociological institution, promoting the region and contributing to the quality of the environment in the area where it is located. The fundamental pillar of a good quality life is the creation of quality living places. This can be understood as the creation of quality housing, spaces for leisure and culture, spaces where people can engage in mutual interaction and be inspired together. It is important to offer the same quality spaces even for small settlements as ones that could be found in big cities.

Literature Review: The Theory of the Linear and Garden Cities and its Present-Day Shifts

In the following part, two fundamental approaches to the theory of the linear cities will be presented. These two major linear cities' projects from history have heavily influenced the research and they will be presented together with the architectural interventions made in Tokyo, which are mapped in the book, *Made in Tokyo*.

Roadtown - E. Chambless, 1910

Edgar Chambless was intrigued by the relationship between the means of transport and land already in the early 20th century. His radical vision was translated into an idea of creating a *residential transport corridor – the Roadtown*. The basic idea of his proposal was the decision to lay a modern skyscraper on its side and run the elevators, the pipes and the wires horizontally instead of vertically.

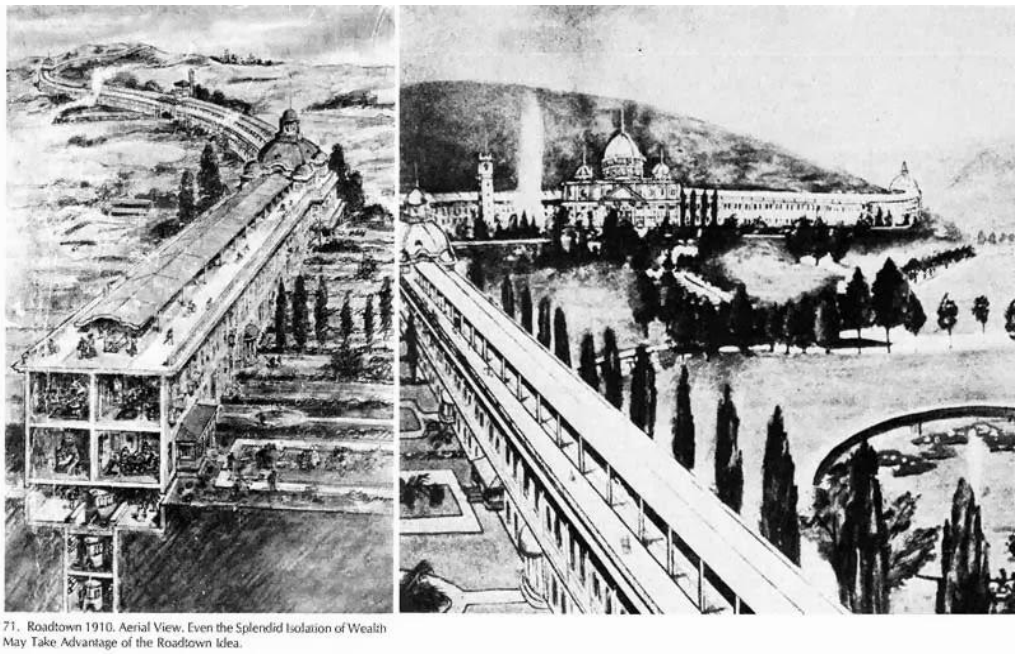

Figure 1. *Roadtown – E. Chambless*
Source: publication Unbuild America.

Thus the size of the houses was not limited by the bending of the steel structure (see Figure 1). In doing so, he found a way to combine transportation and housing into one mechanism. In modern life, then and now, connections are essential, whether the transport links to housing, to work and businesses or to leisure activities. The ideal solution is when all these functions are as close together as possible.

The biggest driving force for the Roadtown proposal was the need for the creation of housing for the farming community. Chambless, already at that time, tried to make the town as self-sufficient as possible. The idea of self-sufficiency was key for him and it is also something we are nowadays more and more often confronted with. The community of farmers were to work in the adjacent fields after they finished working in the town, and therefore supplied all the needs of the inhabitants.

Roadtown is a proposal that combines production, consumption, and transportation into one unit. The project envisioned a quiet monorail transportation connecting two-story apartment buildings. The design includes adjacent gardens and a promenade deck. Everything was to be constructed in mass concrete, using materials that would be modern and sourced locally. The Roadtown differs from the other linear city designs by being the city in the country. It sought to bring a new symbiosis between the city and the countryside. Roadtown was to be a linear city with a thousand people per mile surrounded by farmland. The fields are placed directly perpendicular to the railroad so people can move around the line easily.

Chambless believed that the best mode of transportation would be a monorail system. He was acquainted with Mr. Boyes, who was able to supply a monorail

car.[2] The transportation system would be housed in an underground deck, with stairways leading from it directly to the houses. The roof of the subterranean train transportation would serve as a walkway. In the centre, the walkway would be roofed with glass panels and during the winter possibly heated by a steam engine. There would also be space for the cyclists or skaters on the sides of the roof. Thus Roadtown would not have streets because it does not need them. It would be divided into several floors so that the houses could overlook their gardens. On the upper floors, more luxurious dwellings would be built, either for the visitors of the Roadtown or for high society.

At the time when the project was created the farm colonies looked simply as an unmaintained farmhouse in the middle of a large field with no connection to the utility grid system. This was also the time of electrification and the expanding need to get connected to the utility grid. Therefore each farmhouse would have to be connected, the wiring would have to be stretched, the farmers would have to get their own boiler, dynamo, etc. The economic benefits of the proposal are apparent– it would make the connection to the electricity and pipe system cheaper. The situation was better in the cities because people were located closer to each other and the electricity and pipe system were therefore not as costly.

From a technological point of view, Roadtown was exceptional in situating the whole technical infrastructure into the basement. Therefore it would be easy to carry out revisions and repairs without need to interrupt or limit the life of the inhabitants in the city.

The proposal was ground-breaking not only in the perfectly thought out concept of the residents' lives, but also by being thought out to the last detail. The project was addressing not only the matters regarding the heating and cooling system, but also such a details as the piping for soap for showering, considerations of a central vacuum cleaner, telephone and telegraph, and even the possibility to discharge a disinfectant gas for the specific housing units.[3]

Green City - Konstantin Melnikov, 1929

In 1929, Soviet authorities launched a competition to design a garden suburb outside of Moscow where workers could be sent to recover from the strain in the factories. The "green city" was to house 100,000 workers at a time and provide a range of recreational and cultural activities. Many Russian architects and planners who had long been concerned with the questions of how socialist communities could avoid the shortcomings of the capitalist metropolis—squalor, overcrowding, exploitation and alienation—seized the opportunity to project their ideal visions (see Figure 2).

2. M. Novak, *William H. Boyes Monorail (1911) High-Resolution Photo* (Abstracted: Novak Archive, 2020).

3. E. Chambless, *Roadtown* (Breinigsville: BiblioLife, LLC, 2010).

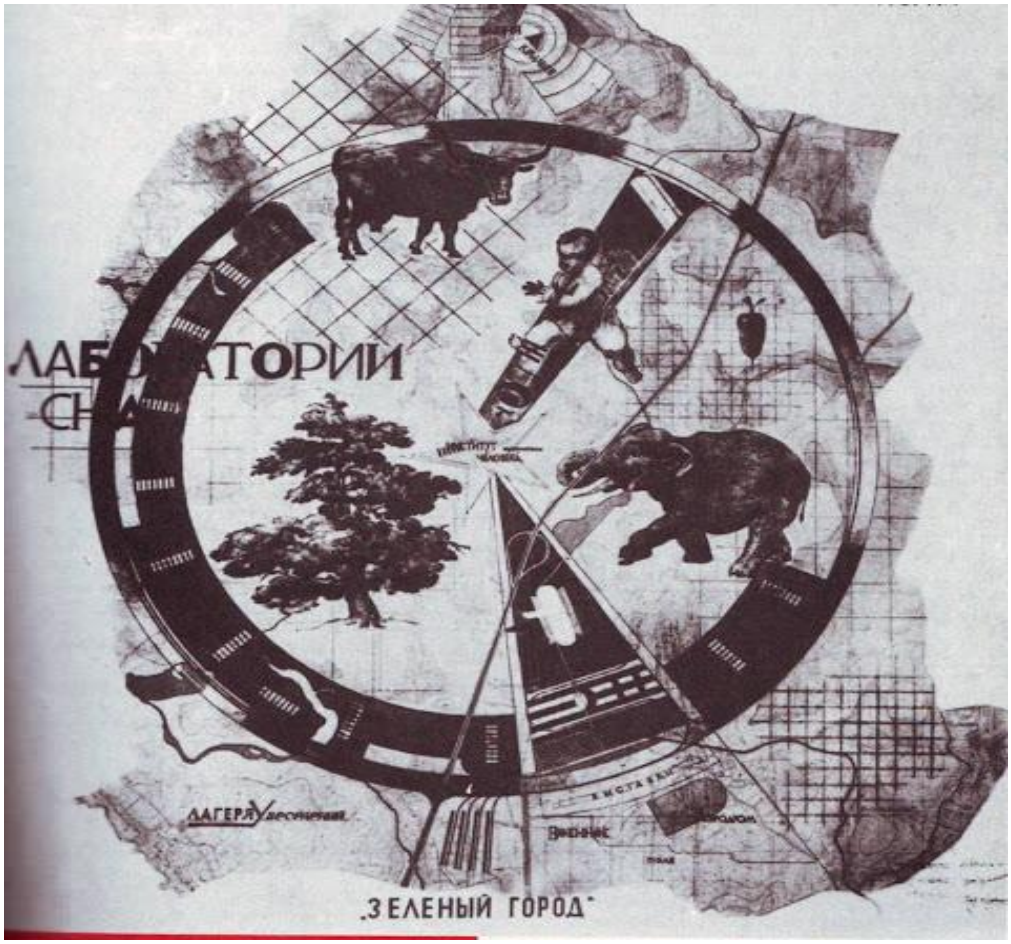

Figure 2. *Green City – K. S. Melnikov*
Source: publication Konstantin S. Meĺnikov and the Construction of Moscow.

Among the most remarkable of the proposed projects was Konstantin Melnikov's project. For his proposal of the circular city, he planned green spaces with forest, gardens and orchards, a zoo, a children's city and a public sector, with a train station combined with a concert hall, a "solar pavilion" for sunbathing and "bedrooms" located in dormitories, which were the building units for the workers' rest. For Melnikov, sleep was a healing resource, more important than food and air. Melnikov argued, "And now, when I hear that good health requires nutrition, I say - no - it requires SLEEP. Everyone says that recreation requires fresh air; wrong again - I believe that fresh air is unable to recharge our energy without sleep ... I suggest domes and chambers for 'victorious sleep'. Without sleep, fresh air will do little for our health."[4] Based on this opinion, he devised a building in which hundreds of workers could enjoy the benefits of sleeping simultaneously. Called the "Sonata of Sleep," the building consisted of two large dormitories. On both sides of a central block it contained toilets with hydro-massage and the thermal regulation of heat and cold was provided by stone stoves.

4. S. F. Starr, *Solo Architect in a Mass Society* (Princeton: Princeton University Press, 1978).

Dormitories had sloped floors to eliminate the need for pillows, and beds were to be built in like lab tables. Melnikov, who envisioned control over the entire sensory experience of sleep and atmosphere, played an important role in orchestrating the sleeping experience. Control booths were to be placed at the both ends of the long buildings. Inside of them, technicians operated devices regulating the temperature, humidity, and air pressure, as well as controlled wholesome scents and "diluted condensed air" that wafted through the halls. He also wanted to introduce sound regulation by means of the rustling of leaves, the noise of the wind, the sound of watercourses, and similar sounds of nature, including storms. These sounds would be heard by placing special sound horns at opposite ends of the dormitories. Symphonies and readings would also be reproduced. Melnikov planned to replace the annoying "pure noise" (showers, washbasins, neighbours, conversations, snoring...) with "organised sound" based on musical principles. Specialists would broadcast from a control centre a series of sounds to intensify the sleep process "based on the scientific facts". All of these sounds would instantly relax even the most overworked worker from the metropolis. If these failed, the mechanized beds would then begin to rock gently until consciousness was lost.

Gardens, playgrounds, forest, zoo, recreation hall, tourist pavilions, mobile restaurants and cafes, libraries, and sports equipment distribution points were all within the reach of the highways and railway. The Institute of Man, the place where the residents live, was located right in the middle. The twelve buildings of the sleep laboratory, which were to house 4,000 people at a time, were placed in a circle in the woods. The professional community began discussing the construction of such centres across the country, but by 1931 the project was shut down because of the debates over city planning and the persecution of the avant-garde had begun.[5]

Melnikov's ideas were too extreme for the 1920's, but were of great significance and seem progressive even in 2021.

This project was so unusual and confusing for the audience of his time that it was never executed. Six years later, Melnikov, or "the stuntman", "the magician" and "the formalist", as the Soviet mass media called him at the time, was dismissed from his position as head of the architectural and design workshop "City Council" and stripped of any further commissions. Everything he designed for the rest of his life accumulated only in his desk drawer. Although he managed to survive the Stalinist purges, he was never rehabilitated.

Melnikov had read about an experiment at the US Naval Aviation School in Pensacola, Florida, where cadets learned languages while they slept. This was probably the starting point in development of his own theory. It was also in the US that his ideas were first put into practice, although none of the Green City schemes ever became reality.

Melnikov's ideas attracted the attention of Samuel "Roxy" Rothafel, the famous New York showman and businessman, who visited Russia in 1931. Rothafel was gathering the ideas for the Radio City Music Hall that he and John

5. M. Fosso, O Máčel, and M. Mariggi, *Konstantin S. Meĺnikov and the Construction of Moscow* (Milan: Skira, 2001).

D. Rockefeller proposed to build.

Apparently, the control booths regulating the sounds was just the idea he liked: "During several months, Rothafel's advertising department was bombarding the American public with Melnikov's claim that 'two hours in the washed, ionized, ozonized, and ultralarized air of (Radio City Music Hall) is worth a month in the countryside'." While Rothafel's enthusiasm grew out of a desire to manipulate consumers, he was the only one who followed Melnikov's theory.[6]

Current Tendencies - Tokyo and Osaka

The following section offers the summary of some of the tendencies in Asian architecture and the formation of a new set of typology that has developed from the idea of the use of the transport infrastructure.

In many Asian countries, land in cities is very valuable. Therefore there is a tendency to use, develop and densify the city as much as possible, thus creating new hybrid spaces using the particular location and the connection to the transportation infrastructure.

The research which mapped these hybrid projects in the city of Tokyo was carried out by Atelier Bow–Wow. For example, in one case the empty railway bridge infills are combined with the commercial arcades that are 300m long. Each arcade has 3 floors and a small forecourt. Another interesting example of the project is the combination of an office building with corporate housing and a secure car park connected directly to the city's expressway in Roppongi, Minato area.

Another appropriate use of the residual land that arises in the areas of intersections or radii of street curves is the design in Nishikahei, Adachi. It combines retail, office, parking and sports (see Figure 3).

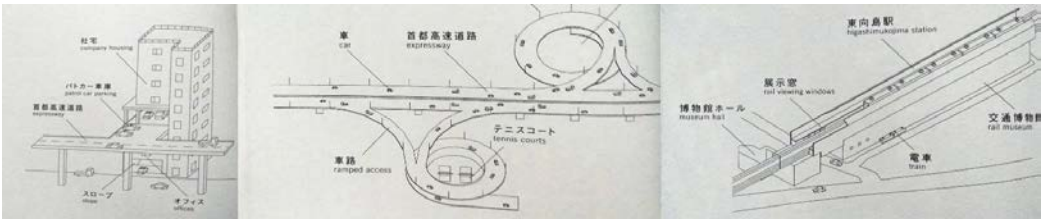

Figure 3. *Tokyo Tendencies*
Source: publication Made in Tokyo.

In Higashimukojima, Sumida-ku we can find the combination of the rail corridor with the Higashimukojima Railway Museum. The linear nature of the structure directly suggested its function as a railway museum, where visitors of the museum are automatically part of the existing transport infrastructure.[7]

With all the interventions, in Tokyo they are able to make efficient use of each parcel of land and add to the lost value eroded by the need for massive infrastructure.

6. R. Melnick, *American Showman: Saumel "Roxy" Rothafel and the Birth of the Entertainment Industry 1908-1935* (Columbia University Press, 2012).

7. Kaijima, Kuroda, and Tsukamoto, *Made in Tokyo*, 2016.

The vision of the linear city was eventually constructed on a similar scale in the Osaka Loop-line project, in the form of a city under the railway corridor. By combining the railway with other functions, an area of 19,000m^2 was valorised in Osaka with a stretch length of 1km.[8] Similar projects are also appearing in Europe, such as the viaduct project in Zurich by EM2N architects, which addresses the question of how an infrastructure element that is a protected monument can be made a part of the urban system. They describe the viaduct as more than just a bridge.[9]

Selected Location: Margecany - Červená Skala Railway

The reasons for selecting this particular locality as a case study for the paper are that there is an un-renovated railway line in the locality, and it is located in a neglected region of Slovakia with great potential.

The building of railways was a great milestone in the development of entire regions. This was the case also with the Margecany – Červená Skala railway line, built in the 1930's. This is a railway line of local importance connecting the villages of Červená Skala and Margecany and thus the centre and east of Slovakia. It is considered as one of the most beautiful lines in Slovakia running through the natural gems Muráň Plain, Slovak Paradise or Hnilec valley. There are as many as 281 bridge structures, 9 tunnels (originally 12 - before the project was modified) with a total length of 3,801m. There are 12 stops and a number of guard posts. The Telgárt Loop located on the line is one of the 69 spiral tunnels in the world and the only one in Slovakia.[10]

This new railway is not a usual construction. It was not built easily, but laboriously, for it runs through the mountainous terrain. A great deal of construction work has been devoted to its construction because the railway has wider tasks than being just another part of the Czechoslovak Railsystem. It has a great economic, social and cultural mission, which it will hopefully fulfil.[11]

The only railway line connecting Slovakia with the Ostrava region (Czech Republic) was the Košice-Bohumín railway. The Czechoslovak Railway Company extended the railway and created a Central Slovak transversal line. Margecany – Červená Skala line is a continuation of the line from Banská Bystrica to Brezno that continues up to Červená Skala. The line was also significant economically. It brought a new life to the region and trade and tourism began to develop. Not only were new settlements in the form of villages created, but also the water reservoirs, warehouses and accommodation for railway staff were built along the line. Even the watercourses in the region had been regulated due to the railway construction. On its line there is also a unique cave structure - Dobšiná Ice Cave.

8. P. Hájek, *Kombinace Funkcí v Architecture* (Prague: Czech Technical University, 2010).

9. R. Frei, *Refurbishment Viaduct Arches / EM2N* (ArchDaily, 13 May 2015).

10. Ministerstvo Železnic, *Pamětní spis o Stavbě, Červená Skala- Margecany* (Slovakia: Ministerstvo Železnic, 1936).

11. Vo Vlaku, *Historická Jazda Pripomenie 80. Výročie Trate Margecany-Červená Skala* (Bratislava: Tlačová Agentúra Slovenskej Republiky, 2016).

Preparations for the construction of this line began even before the fall of Austria-Hungary. In 1920 geological research of the area was carried out under the supervision of Dr. R. Kettner, a professor at the Czech Technical University in Prague. At that time there were already private narrow-gauge railway lines belonging to the concessionaires Gertle M. and Comp., Peter Matuška, Adolf Reich and Ján Aradi. In the preparatory phase of the construction they were nationalised. Among these existing railways was also a technological gem, the first cog railway in Hungary, which connected the mining settlement of Mária Huta with the village of Žakarovce.

In 1931 construction work began on the most difficult section of the construction near Telgárt town. The workers worked under the unsatisfactory financial conditions which resulted into a series of strikes. The difficult working conditions were reminiscent of those from the 19th century, when the first railways were built. One worker, a 26-year-old J. Chlapovic, was even shot dead, when the strike was being suppressed.

In 1933, the first section of the Červená Skala – Telgárt line was opened, followed by other parts in the following years. On July 26, 1936, the entire line was inaugurated in the presence of the politician Juraj Slávik; Minister of Railways Dr. Rudolf Bechyně; Minister of Justice Dr. Dérer and representatives of the highest state; provincial and railway authorities; corporations' representatives and deputies and senators.

At the time, unemployed railway workers of the Košice – Bohumín Railway Company, together with the unemployed youth, worked on the railway. There were about 7,000 workers, and during the period of the greatest intensity of work, up to 9,700 workers, men and women, were participating on building of the railroad. Of these, about 59% were local.

As on most of the Slovak railways, the Second World War and the Slovak National Uprising caused great damage to this line. Altogether, 29 bridges or viaducts and all the tunnels were destroyed during the war. It took almost half a year to repair them, even if all possible working forces from the surrounding villages were engaged in restoration works.

The track is perfectly set in the surrounding countryside and the beauty of the Slovak landscape could be seen in a juxtaposition with a large number of technical works - bridges, tunnels and viaducts. Along the line, there were also stops with the station buildings, but unfortunately they are either dilapidated or have disappeared. Today, the railway is mainly used by tourists, with only two regional trains and a few passenger trains a day, mainly in the morning and evening. To this day, however, they still stop at almost all stations.[12]

12. M. Potančok, *Telgártskou Slučkou do Raja* (Margecany: Martin Potančok, 2017).

Building in the Protected Landscape Area

Nature conservation has a rich tradition in Slovakia. The first legal frameworks for the existence of protected areas date back to the period of feudal land ownership. The protection was based on the laws protecting the forests and game (13^{th}-15^{th} centuries), mineral springs (Royal Patent of 1682 and 1715) and, in particular, on the Theresian Forest Order of 1769. The motives for establishing protected areas were originally due to ownership reasons and later for romantic and local-patriotic aspirations. Gradually they expanded to include scientific, cultural, patriotic, aesthetic and recreational purposes.

In the late 19^{th} and early 20^{th} century, thanks to awareness-raising efforts and activities of scientists and various associations, nature protection was gradually secured at the legal level. During this time the first areas with the status of nature reserves or natural monuments were created (the oldest reserves are Ponická dúbrava and Príboj, established in 1895). The first systematic categorisation of the protected areas in the Hungarian kingdom, where at the time Slovakia also belonged, was presented by Karol Kaán in his work, "Preservation of Natural Monuments" in 1909. However, the real development of nature conservation began only after the establishment of Czechoslovakia, when the foundations were laid for today's set of protected areas. The period from the very beginnings of nature protection and the establishment of the first protected areas until the interwar period, or eventually until 1955, is referred to as the "conservation period". The main goal was passive, conservational protection, which aimed to preserve individual species. This period included the conservation of predominantly small-area landmarks and rare natural creations and phenomena.[13] Currently in Slovakia, several inappropriate building activities are taking place, which are not respecting the protected-area status of the landscape they are in. As an example, the construction at Štrbské Pleso lake area in the Tatra Mountains could be mentioned. The locality was developed in pursuit of promoting tourism and making the place attractive with poor-quality tourist attractions.

Results: Proposal for Revitalisation of the Line – New Linear City Margecany - Červená Skala

In this project the thoroughfare is considered as the basic linear element—the backbone around which the new city is composed. For the railway, as a transport infrastructure, the landscape is to a large extent adapted. In the case of the railway, linear shape is key. It is important that the line of the railway is disturbed as little as possible and maintains a smooth passage through the landscape. It forms an imaginary boundary; the line can be understood abstractly or mathematically. Parts of the line are three-dimensional like all of our space, but with the railway line we also cannot forget the fourth dimension, which is time. Time is the only non-

13. M. Škodová and J. Mazurek, *Chránené Územia Slovenska* (Banská Bystrica, Slovakia: Fakulta Prírodných, Univerzita Mateja Bela, 2011).

renewable raw material of our existence. This is why the project completes the railway with the modifications that would not block the smooth movement of the train sets along the "spine" and therefore save time.

The research is devoted to the application of the elements of the theory of linear urbanism to the current design of the site Margecany – Červená Skala, which is losing its life and becoming only an open-air tourist museum. Rural settlements in general are experiencing a crisis as life is disappearing from them. Most of the population is moving to the big cities in search of work and better life standards.

The aim of the proposal is not to fit all the public amenities into one conglomerate, but rather to create a super-organism within the countryside. The super-organism will be composed of several settlements with are currently insufficient as public amenities. Settlements are connected by the already existing railway. The most important modification is in the use of the transport infrastructure and in the addition of the necessary public amenities. The amenities would be located on the linear transport infrastructure and it will be possible to move them along the railway line. Therefore, it would be possible to share them between the dwellings. That means that the proposal makes the most of what the area already contains and complements what it lacks (see Figure 4).

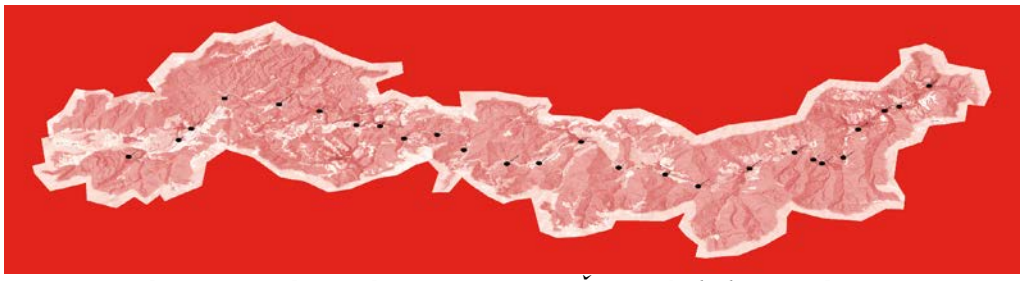

Figure 4. *The City on the Rails, Margecany - Červená skala - Analysis*
Source: Nikoleta Slováková.

The Margecany – Červená Skala line is interesting also because of the extensive transformations of the local landscape since it is crossing a mountainous area. By looking closely, significant changes in the topography of the landscape are visible.

The statistics illustrate the impact in numbers. A total of 3,030,000m^3 of rocks were moved during the excavation works. To build all the bridges, walls and other artificial structures, 110-thousand cubic meters of masonry were consumed in the open track, and another 68-thousand in the tunnels.

In the following part, the structures that were built for the railway and modified the local landscape will be described. An embankment is a formation that is added to the topography where necessary to support the railway. Some embankments are smaller and inconspicuous, but some create mounds between the individual parts of the village. The tunnel creates one of the most prominent encroachments. On the line with a total length of 3,801m, there are nine of them. Also, road crossings occur frequently on the line, many times involving several types of road material. Waterways, car roads, footpaths and railway lines cross here.

Bridges connecting many sections of the railway are to be found as many as 281 times along the line. The train passes through an interesting section through the Mlinky dam, which was built only after the railway was already built. Therefore the line's relocation was necessary in this section. Here the train passes through the middle of the dam, which flows up a narrow canyon. In this case it is difficult to determine how the terrain looked originally. The most interesting part of the railway is the Spiral Tunnel. It is the only such structure in Slovakia that is 2.3 km long and overcomes a 31m height difference.

The non-electrified line which is 92,578 km long, has 26 functional stops (Červená Skala, Telgárt pension, Stratená, Dedinky, Mlynky, Mlynky stop, Rakovec, Sykavka, Hnilec, Nálepkovo-Peklisko, Tretí Hámor, Nálepkovo (formerly Vondrišel), Stará Voda, Švedlár, Švedlár stop, Mníšek nad Hnilcom, Helcmanovce, Prakovce, Prakovce stop, Gelnica stop, Gelnica town, Gelnica, Žakarovce, Jaklovce, Margecany) and some non-functional (e.g., Telgárt station and Vernar station).

The project proposes to repair and supplement the linear network with new stops, which would become stations not only for people, but also for mobile train sets. In these mobile train sets new (currently missing) amenities will be embedded. The train sets can move along the existing railway the only thing that will be added to it will be the new train switches for shunting the trains.

In the new stations, apart from the waiting area for passengers, there will be a dedicated area for car servicing, electricity, water connection and cleaning area. Their architecture will be simple, with the check-in section in front and the technical section in the rear, connected by a rear wall to allow the space to be enlarged. Basically, the structure of the station can be seen as a hybrid between a hangar for the train and a classic waiting station. The new train sets with amenities will move primarily during the day, possibly at dedicated time intervals, so as not to block the path of the passenger trains. Renewed existing stops located on the line must be retained for their cultural value. They will only be supplemented by a train siding and rear hangar, or by new stops where existing stops are no longer adequate. These new stops will be of a simple steel construction to fit in with the unified character of the railway buildings. They will have a modern appearance so that the period of their construction is apparent.

An empirical data analysis (GIS) of the public amenities of the Hnilec Valley revealed a lack of educational facilities in the locality, lack of leisure possibilities for children and young people, lack of medical facilities in some of the villages and lack of complementary education and cultural opportunities.

Therefore, the project proposes to place these functional amenities on the new train sets that will always travel from stop to stop at certain daily set rhythms, so that the localities will come to life. These are, for example, a doctor's surgery, a veterinarian, a library, a small nursery or kindergarten, an art gallery, an exterior space of a convertible train set in for exhibitions, cafés or refreshment places, community clubs for mothers and the elderly, music studios, sleeping shelters, or schools in the open air, located in a carriage set, whose landing point is always the train stop (see Figure 5).

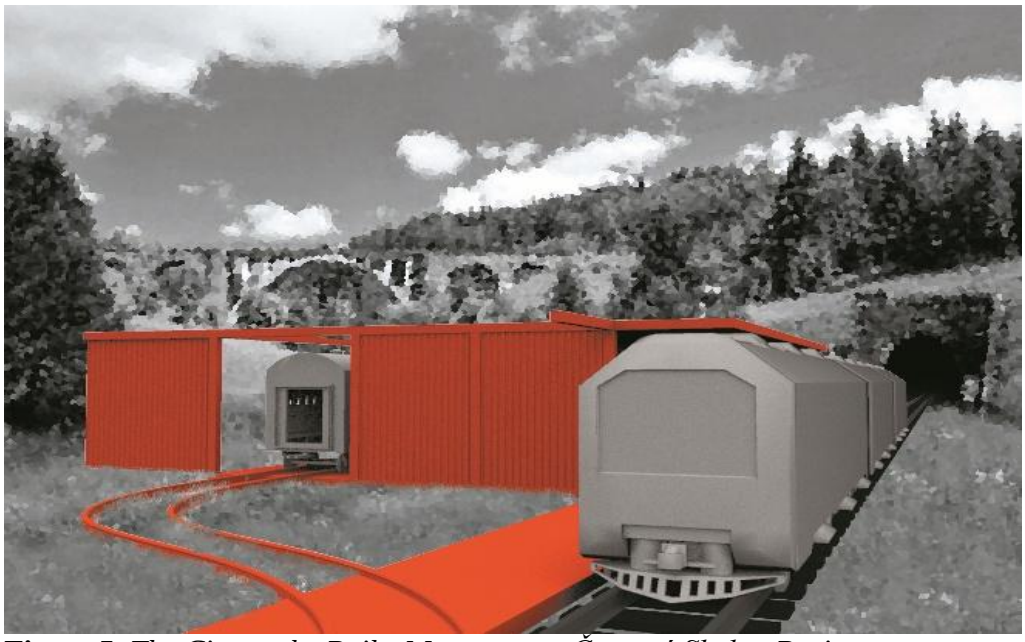

Figure 5. *The City on the Rails, Margecany - Červená Skala - Project*
Source: Nikoleta Slováková.

Discussion: Criticism of the Linear Cities Plans

Because the surface of the earth is three-dimensional, the creation and functionality of a linear city is impossible. As long as we have forces in all directions of the Earth's surface, we cannot have linear cities.[14] Despite the great interest of architects in the concept of linear cities, none of the examples of the designs have ever materialised. The first contributions to the discussion regarding the linear urbanism came from Ch. Bouilhet in 1912, who feared that the idea would mean "the disappearance of city as the nucleus of a human activity."[15]

Organically created linear cities emerge and develop quite differently from the planned projects. The definition of a linear city itself (linear composition of buildings with a thoroughfare running through the middle) is not sufficient, which may also cause misunderstandings.[16]

Why did the linear city concept actually fail? One of the possible answers to this question could be an insufficient definition of the linear city.

The linear city plans are about finding alternative housing and breaking down old boundaries. Humans feel insecure in an unbounded and undefined territory and the linear cities extend into an uncertain space of nature. But is it necessary to have fixed boundaries? Would it not be enough to understand the line itself as a border?

Another possibility why the proposals of linear cities have never been materialised is that the idea was specific to the turn of the 19th and 20th centuries

14. C. A. Doxiadis, "On Linear Cities," *The Town Planning Review* 38, no. 1 (1967).

15. E. Stachura and T. Tufek-Memisevic, *A Linear City Development Under Contemporary Determinants* (Sarajevo: University of Sarajevo, 2015).

16. J. Hrůza, *Teorie Města* (Prague: Nakladatelství Československé Akademie Věd, 1965).

and loses its meaning as time passes. However, many of the problems that the concept of the linear cities addressed are still relevant today such as the rural-urban divide that is widening, or the devastation of the nature by human activities.

Despite the diversity of the projects, there are some common features between them. Almost all of the concepts were developed in response to the poor social and sanitary conditions. The first projects responded to the poor living conditions during the industrial revolution. Today they respond to the demographic crisis.

All the linear-city projects are *alternatives to the central city*. They are using the concept of polycentricity or try to rethink housing that will not be centred around one particular place (city centre).

The projects deal with how innovations in transportation affect the urban fabric and what possibilities speed opens. They are characteristically concerned with the relationship between *landscape and city, transport and housing.* While we have already been rethinking these relationships for a century, the first ideas of linear cities seem radically utopian even today. It is a feature that almost all the projects have in common.

Despite being visionary projects, many of them are very detailed. Often their transport or financial lifespan is calculated.

Projects of the 1920's, such as Roadtown, envisioned endless expansion. They rethought housing itself and offered an alternative that could replace all existing housing options and spread across the country. Later projects, such as those in *Made in Tokyo*, deal with transportation infrastructure as a permanent feature and view housing as fluid and temporary.

The project is questioning not only the definition of a linear city but also the definition of a "city" itself. A city is a settlement or grouping of settlements that differs from the rural communities in the concentration of productive and non-productive activities, building heights, population density, availability of facilities (schools, theatres, libraries, medical facilities, etc.) and social relations.[17] But why can't a line be a city nowadays? It can.

Conclusion

The work combines the theory of the linear city and the garden city for its conceptual coherence and radicalism. The research seeks to learn from their positives and negatives and apply them to the presented project, where it proposes a simplified concept in a similar system.

Through GIS analysis, the project has assessed future potential, explored design options through literature review and draws on their theory. By applying these methods, the presented project suggests ways to bring the site back to life.

With these simple principles of railway revitalisation, the individual communities around the line, or even beyond it, could be revitalised and unified. This is because linear cities have no end point, but can develop infinitely. The project aims to help to make the locations attractive again and bring the people of the valley high quality amenities for their region. These are minimal developments

17. Ibid.

with a big impact. With no disruption to the landscape and with a humble approach, modifications could not only contribute to the settler's life quality, but also to the promotion of tourism. Changes could create opportunities for young people to get involved, for communities of senior citizens, to bring the prospect of new jobs, and the railway itself could become an inspiration for future generations that support a culture and the arts in the region.

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Assimilating Cycle Park as a Part of Urban Living

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Reshmi Manikoth Kollarath[°]

Cycling has a century-old history. Originated as the cheapest and most practical mode of transportation, the evolution and modernity of cycles have led to cycling becoming a popular adventure sport. While the first cycling race was held in 1868, this sport has evolved to various dimensions as a result of innovation and growing interest in sports. This study documents the evolution of cycling from being a mode of transport to recreation to adventure sport, as practised in recent times, as a part of urban living. With the help of a relevant literature review, this study proposes an architectural design of a cycle park in Bengaluru, with the aim to encourage its citizens to make it a part of their urban living. Bengaluru has observed a growing craze of cycling as a sport, over the past decade. Statistical data from cycle dealers and manufacturers reveals these growing trends. In support of the decision from the Forest Department of Bengaluru to allow cycling in Turrahalli forest, this paper proposes a cycle park adjacent to the Peripheral Ring Road amidst Turrahalli forest. The design aims to serve amateurs, professionals, and cyclists of all ages, giving them a safe and natural environment. With the implementation of such a proposal, the authors hope to encourage cyclists and city dwellers to take up cycling on regular basis, in response to the deteriorating global health.

Introduction

Cycling has come a long way since the starting of the 20th century. Beyond just the functional aspects of cycling as a means of transport and a form of recreation, cycling has also had an impact on urban planning. Early on cycles were advocated as a practical and cheaper alternative for a horse, and for this reason, they were introduced in postal and wire services, police and fire departments, and even in the army. The use of motor vehicles, being an expensive means, was mainly for recreation (for example, touring the countryside and enjoying nature) for the wealthier class. After the First World War and the late 1950s, cycling was ubiquitous on streets and public roads all over the world. Later, cycling was replaced by motor vehicles, and cycling headed towards an all-time low demand.[1] However, in the 1970s, the health, environmental and economic benefits of cycling were highlighted by activists, politicians, and later by policymakers, urban

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1. J. Spinney, "Cycling the City: Non-Place and the Sensory Construction of Meaning in a Mobile Practice," in *Cycling and Society* (eds.) D. Horton, P. Rosen, and P. Cox, volume 1 (England, UK: Ashgate Publishing Limited, 2007).

planners, and public health experts.[2] In terms of contributing to urban planning, cycle tourism enhanced rural modernization because it encouraged infrastructural improvements along popular routes and the spread of facilities such as cafes, restaurants, parks, information booths, and repair shops. The image of cycling and its engineering aspect was essentially linked to competitive racing, in support of the enthusiasm from spectacles. The challenges of speed, thrill, performance, time, and distance records made it more exciting for the audiences. The first long-distance race was staged in France, in the late 1860s, shortly after the launch of the velocipede. Cycle racing, on indoor and outdoor tracks, was the first commercialized and media-covered mass spectator sport.[3] Figure 1 photographs a group of bicyclists in the U.S. army taken on 7th October 1896.

Figure 1. "*Bicyclists" Group on Minerva Terrace, U.S. Army on October 7, 1896*
Source: A. Ruggiero, *Little-Known Heroes: All-Black 25th Infantry Bicycle Corps* (Gear Junkie Website, 2016).

This paper examines the phenomenon of cycling in India and the integration of cycling as a means of transport and recreation in urban planning. This paper delves into the evolution of cycling as a major sport and the necessity and relevance of developing sports infrastructure in a city. The paper examines the importance of these structures in the urban fabric and looks at how these structures

2. Civitas, *Enabling Cycling Cities: Ingredients for Success* (Mimosa: Civitas Mimosa, 2013); H. Oosterhuis, "Cycling, Modernity and National Culture," *Social History* 41, no. 3 (2016): 233-248.

3. A. Ritchie, "The Origins of Bicycle Racing in England: Technology, Entertainment, Sponsorship and Advertising in the Early History of the Sport," *Journal of Sport History* 26, no. 3 (1999): 489-520; N. Butler, *The Velocipede Invasion of 1869* (Charleston County Public Library, 2019).

can be integrated into the city through its design. For the purpose of this paper, cycling is viewed both – as a sport and a recreation activity of urban life.

Cycling and Urban Planning

With increasing environmental awareness in cities, people have started recognizing the benefits of active living, sport, and physical activity. There have been many studies that have established the social, environmental, and economic impacts of sports infrastructure on cities. Sports stadiums and related sports infrastructure can also become venues for other non-sport and recreational activities attracting the local community and providing spaces for people to come together. These structures also increase the imageability of the place with the potential to become iconic structures which in turn can provide different forms of capital to the city. Sports stadiums across the world are major landmarks providing visibility to the city at the global level and also major tourist destinations. Well-planned sports infrastructure can contribute to the economy along with increasing the fitness and overall wellbeing of the local community.[4] Cities across the world are increasingly understanding the importance of developing a good sports infrastructure that would merge in the existing urban form, making the infrastructure a part of urban living. Even as cities across Europe have integrated local plans for active living within the broader planning process, many developing countries, such as India, are still working their way to make the urban planning process holistic.[5]

Urban planning should encourage physical activity in the community. This can be done through planning policies and urban design promoting walkability, pedestrianism and activities including cycling by providing biking and walking trails in the master plan. Out of the many forms of physical activity that urban planning of the city can offer to its people, this study emphasizes the importance of cycling as a sport and a recreational activity for urban life. This can offer multiple solutions to our cities, such as, generating thrust for more green spaces, social inclusion, better sports facilities, and building more equal societies and, eventually contribute to the goal of making our cities more sustainable and resilient.[6] At the end of the 20th century, cities looked upon sport as a catalyst to generate an economy. Only industrialized cities invested in sports infrastructure, intending to create more job opportunities and attract tourism. This did not particularly include the local communities. However, since the last two decades, policymakers and planners have become more sensitive towards locals and have created a new image and new opportunities to justify investments in sports infrastructures.[7]

4. G. Dickinson, and Z. J. Jianhui, "Sports and Urban Development: An Introduction," *International Journal of Sports Marketing and Sponsorship* (2020).

5. P. Edwards and A. D. Tsouros, *A Healthy City is an Active City: A Physical Activity Planning Guide* (Europe: World Health Organization, 2008).

6. Olympic Studies Centre, *World Cities Day 2020: The Power of Sport to Build Healthier, More Sustainable Urban Communities* (Tokyo: International Olympic Committee, 2020).

7. C. Gratton, S. Shibli, and R. Coleman, "Sport and Economic Regeneration in Cities," *Urban Studies* 42, no. 5 (2005): 985-999.

Relevance of Cycling in Bangalore City

In the past, India has hosted many national and international tournaments and games, such as the Asian Games. Bangalore, one of the fastest metropolitan cities in India, hosted the Indian National games in 1997[8] and National Youth Games in 2008.[9] Bangalore has regularly been a host of International Premier League (IPL) cricket for the past decade. It is evident, that Bangalore's residents have shown a growing interest in sports. Sports clubs, health centres, gyms, arenas, and stadiums have made a significant contribution to the urban form and lifestyles of people.

One such popular, most sustainable interest among Bangalore's residents is cycling. Cycling serves as the cleanest mode of mobility. It is zero dependence on fossil fuels and zero-emission characteristics, which not only makes it affordable but also positively contributes to deteriorating climate. However, with the knowledge the authors have gained from their experience, cycling in Bengaluru is a sport rather than a mode of travel. After the IT boom in 2000, there has been an average increase in income levels of the working class in Bengaluru. With massive populations migrating from all over the globe, the traditional lifestyles have now become more dynamic. While automobile and public transportation remain the popular modes of travel, cycling is apparently the most popular recreation/leisure sport. There are more than 20 active cycling groups in Bangalore, out of which at least 5 have more than 3000 members.[10] Especially, after the onset of COVID-19, more people have taken up cycling as a mode of primary physical activity. After the first lockdown of COVID-19, wholesalers of cycle shops reported a 30% hike in their sales, and owners of cycle repair shops reported 20 to 30% increases in their customers.[11] In response to this, the comprehensive mobility plan of Bruhat Bengaluru Mahanagar Palika (BBMP), announced the development of 600 kilometres of cycle tracks in the next 10 years around the city.[12] A report by Dutch social enterprise reports a 50% increase in the use of cycles in Bengaluru. Out of which, rides for recreation exceed the number of rides for commute and daily users.[13] From the available data, it can be said that residents of Bengaluru prefer to cycle more for recreation than for work as illustrated in Figure 2.

8. J. Heitzman, "Sports and Conflict in Urban Planning: The Indian National Games in Bangalore," *Jounal of Sport and Social Issues* 23, no. 1 (1999): 5-23.

9. Hindustan Times, *Bangalore to Host First Ever National Youth Games* (Bangalore, Karnataka, India: India News, 2008).

10. N. M., *Get Biking with These Cycling Clubs in Bangalore* (Bangalore, India, 2020).

11. A. S. Mounika, *Cycling the New Normal in Bengaluru, Sales Shoot up After Lockdown. Cycling* (Bangalore, India: The News Minute, 2020).

12. A. Dev, *Number of Pedallers rise in Bengaluru, but not Enough Space for Cycling* (Bengaluru, India: Hindustan Times, 2021).

13. Cycle To Work. *Bangalore Cycling Project* (Bengaluru, India, 2020).

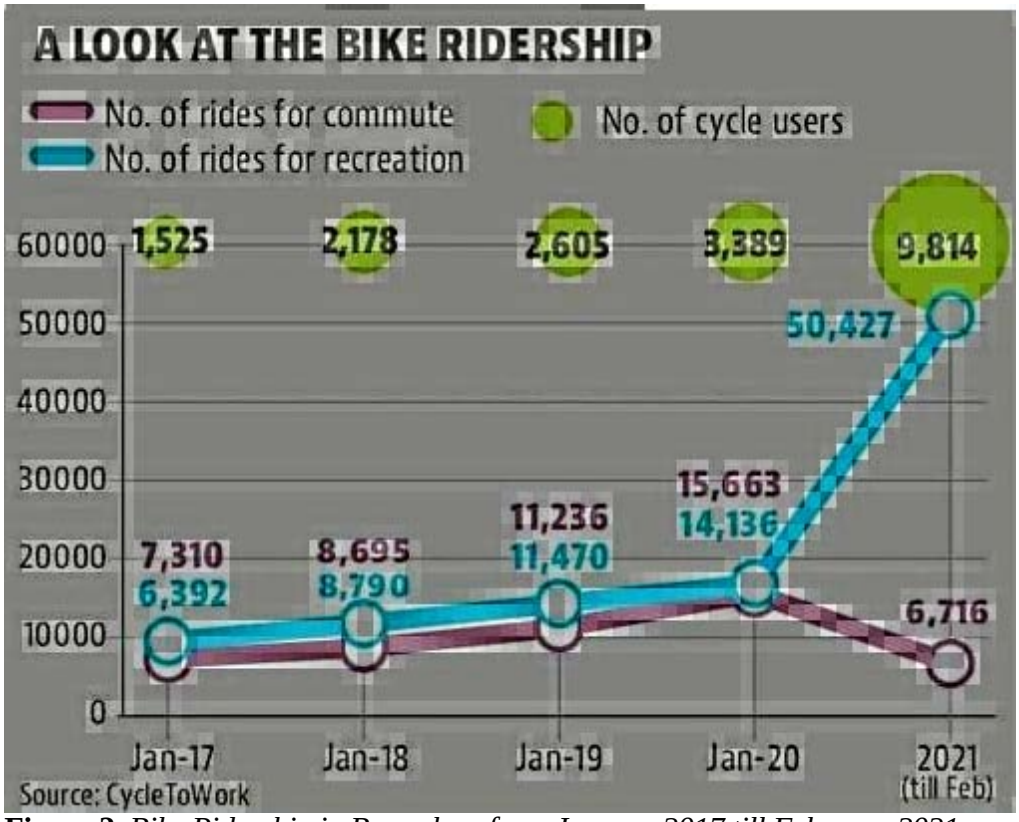


Figure 2. *Bike Ridership in Bangalore from January 2017 till February 2021*
Source: Cycle To Work 2020.

Cycle manufacturers, newspapers, sports communities, local, national, and international organizations sponsor cycle races to promote the sport and diversify economies. Cycling has transformed from a mode of transportation to sports meeting the aspirations of the different populations. To serve such aspiration of Bengaluru citizens, this study proposes a cycle park in Bengaluru, where enthusiasts of all levels can come and practice and/or learn. The proposed cycle park design aims to provide a safe, approachable, affordable and equal atmosphere amidst nature to all cyclists. The proposed architectural project intends to bring out the pure structural effort without artifice thereby enhancing the selected site. Above all, it aims to create a dialogue between the existing urban form and the proposed curved geometry of the structure and display an example of architectural integrity. The proposed design follows global standards employed by reviewing examples around the world.

Context

Bengaluru, the capital city of Karnataka State, is not only the fastest-growing city in terms of population and area but also is one of the (fourth) largest metropolitan hubs in India. The physical growth of the city occurred in four phases: first, (in 1951 – 1961) growth of public sector undertaking creating jobs for millions, second (1960 – 1970) growth of industries and state-run businesses,

third (the 1980s) dramatic growth of the private sector and fourth (1990s) the offshoot growth from establishing IT industry. Only from 1991 – 2001, the area of Bengaluru expanded 92.1% and the population grew by 37.8%.[14] With this huge number of people migrating to the city, the built environment is largely driven by market interests, not by communities, resulting in a diverse cultural system. The lifestyles of people vary due to the influence of distinctive cultures they bring in, individuals' financial capacities, and the localities they reside in. Figure 3 shows the location of Bangalore with respect to the region and the nation.

Figure 3. *Location of Bangalore*
Source: Authors.

Lying in the Southern part of the Indian sub-continent, in the state of Karnataka (Figure 3), Bengaluru hails at 3,113 feet above sea level. The topography makes the climate pleasant throughout the year. Bengaluru enjoys 970 mm rainfall on an average annually.[15] The strategy used for urban planning is orbital development, marked by ring roads (Figure 4). This type of development allows urban centres to decentralize accommodating growth with the addition of each ring road.

14. A. M. Varkey, *Ever-growing Bengaluru and Ineffective Planning* (Bengaluru, India: Deccan Herald, 2018); S. Puttalingaiah, S. Irfan, and A. D. Hanjagi, "Levels of Urbanization in Bangalore Urban District of Karnataka, India," in *Social and Behavioural Sciences*, 70-80 (Bengaluru: International Conference on Humanities, 2020).

15. Bengaluru Online, *Geography of Bangalore*. Bengaluru (India: BengaluruOnline.in, 2021).

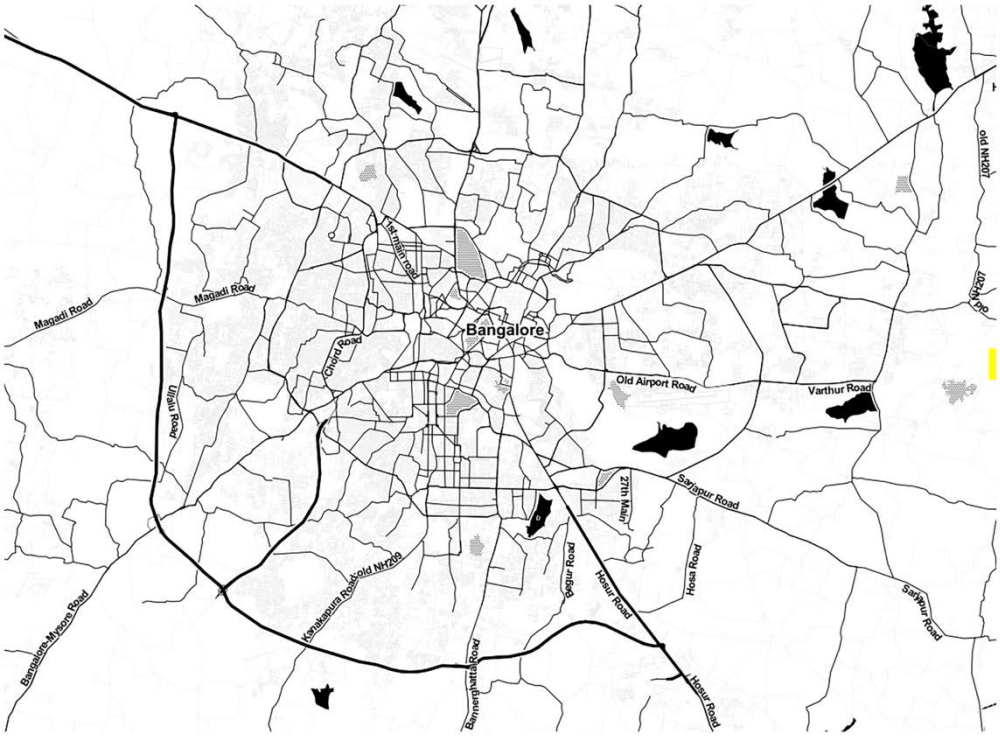


Figure 4. *Orbital Development, Marked by Ring Roads*
Source: Authors.

According to the latest census (2011 – 2021) report, the population growth is consistent with an average of 3.5% annually.[16] The native language of Bengaluru, Kannada, is now spoken by only 38% population, which is the result of mixed culture migration. The population density has also increased by 47% in the past decade (4,000 per square kilometre).[17]

With such dramatic increase in population number and diversity, Bengaluru has found a common sport - cycling, famed by cycling communities. The active cyclist groups in Bengaluru conduct cycling trips throughout the year. Nandi Hills ride, Manchanabele dam, Banyan tree ride, Pipeline ride, back to university ride, and Neelamangala ride are some of the popular cycling trails, visited by cyclists on a daily basis.[18] The location of these cycling tracks is shown in Figure 5.

16. Census 2011, *Bangalore (Bengaluru) City Population 2011 - 2021*. Retrieved from: https://www.census2011.co.in/census/city/448-bangalore.html. [Accessed 6 May 2021.]

17. World Population Review, *Bangalore Population* (Bengalore: World Population Review, 2021).

18. Bangalore Cycling Routes (Bengaluru, India: Bumsonthesaddle.com, 2021).

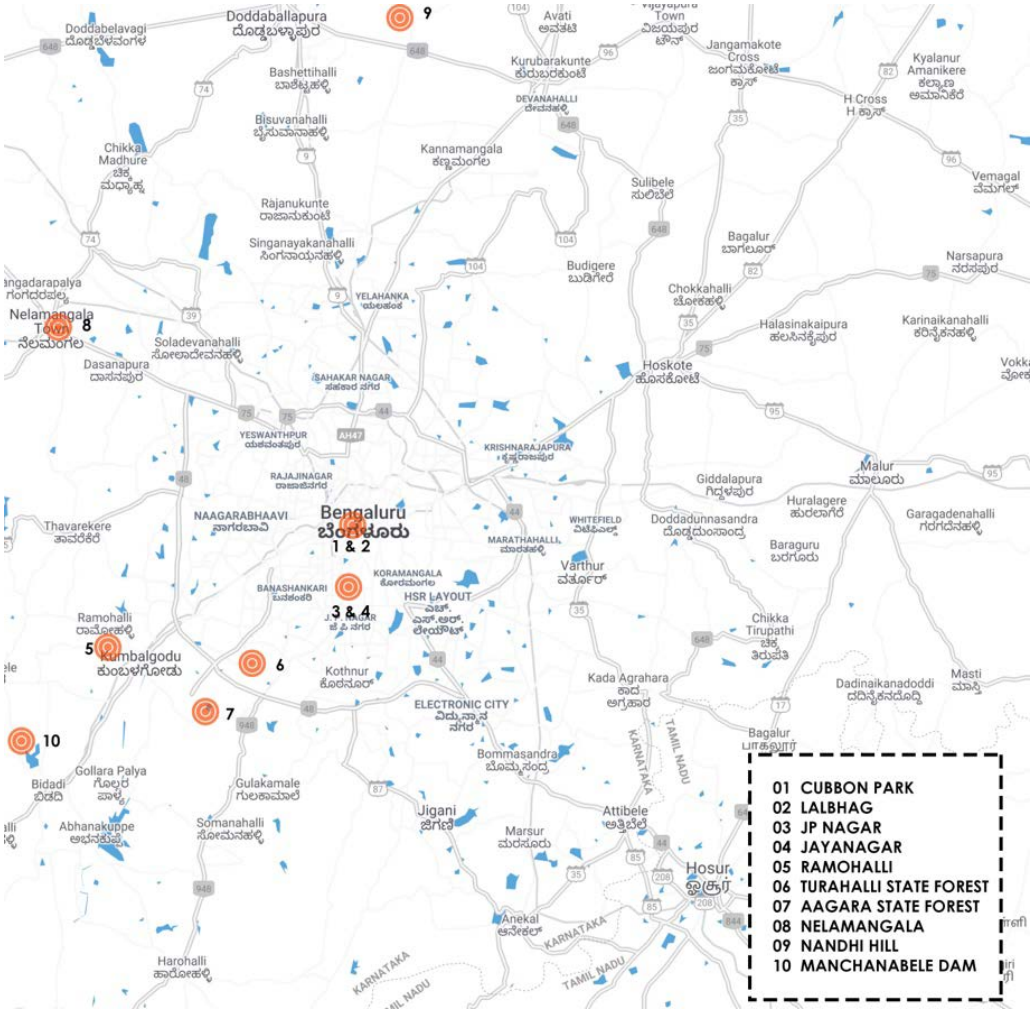


Figure 5. *Map of Popular Cycling Trails*
Source: Authors.

The evidence of active groups of cyclists from social media channels and pages is proof that if given better facilities, people will be more than willing to make use of it. During an informal interview, active cyclists reported that their growing interest in cycling is due to the following reasons:

- No formal training is required for beginners.
- All members of the family (or community) can participate and cycle together.
- The occurrence of long-term injuries and major accidents is relatively less
- The cost of cycling varies based on the level of expertise. Hence, the beginners find it affordable, to begin with.
- One doesn't need a dedicated playground or space to cycle.

In the past (the 1860s and 1870s), when cyclists were replaced by motor vehicle drivers on the road, many motivated cyclists and/ or activists made an effort to revive cycling as a mode of transport. The "velocipede mania" in the

1860s, followed by "cycle boom" or "craze" in the 1890s, in many parts of the west is a piece of evidence that cycling as a mode of transportation has degraded and again revived over centuries.[19]

In 2014, the Directorate of Urban Land Transport (DULT) promoted the "cycle day" campaign once a month, to encourage cycling as a mode of mobility. Community partners and NGOs participated from different neighbourhoods of Bengaluru to carry this campaign.[20] In 2006 - 2007, the government of Karnataka invested Rs. 200 crores to give away free cycles to children aged above 13. In 2020, DULT submitted a 34 kilometres cycle lane project to BBMP (now under construction) on the outer ring road, which would give dedicated lanes for cyclists[21] as part of its "Cycle District Project". Also in 2020, DULT received suggestions of cycling routes, for development, from 109 active cyclists. DULT further developed these suggestions and with the help of Urban Local Bodies (ULB) of various municipalities in Bengaluru. As a result, the "Cycle District" project is now integrated with the "Bengaluru smart city mission". Under this project, the government aims to develop dedicated cycle lanes around the city at various locations.[22]

Design Statement

Acknowledging the importance and need of sports infrastructure in the city, the authors propose a design of a cycle park in Bengaluru. The proposed design examines standards and architectural details accepted and adopted globally. The inspiration of the structure of the cycle park is adopted from the Olympics Games, the velodrome geometry. The velodrome's history dates back to the 19th century when Preston Park, Brighton in England constructed the first cycle track taking on velodrome structure.[23] Of course, the tracks did not display tuned 180 degrees and straight ways until 1896, when the Olympics spared the need to construct a consistent velodrome. Since then, velodromes have been modified in terms of the quality of tracks and sizes. Various sports companies have constructed velodromes for countries to host cycling races and/ or events. The proposed design structure and building materials used creates visual permeability for the user, making the cycle park a part of the existing urban form.

19. M. S. Toohey, *Amateurs, Cash Amateurs and Professionals: Social and Cultural History of Bicycle Racing in New Zealand.* (Lincoln University, 2010).

20. Government of Karnataka, *Cycle Day* (Bengaluru: Directorate of Urban Land Transport, 2014).

21. R. Malagi, *34-km Cycle Lane Coming up on the Outer Ring Road Soon*. *Commute* (Bengaluru, India: Citizens Matters, 2020).

22. J. K. R., *Cycling Districts to Come up Across Bengaluru* (Bengaluru: The Hindu, 2020).

23. M. Nystrom, *What is a Velodrome? Cycling Articles* (Active.com, 2020).

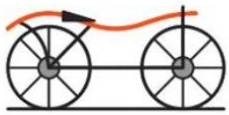
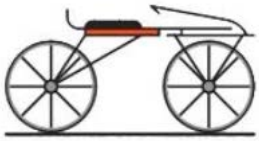
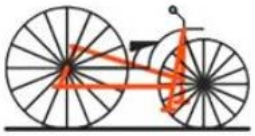
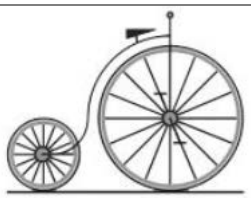
Literature Review

> "Cycling occupies a somewhat unusual position among sports. It is an old sport, originating at the moment of the birth of the modern bicycle in the late 1860s; it is an extraordinarily well-documented sport; it is even a sport about which [much has] been written through the years – and yet...it is not a sport that has been well explored from a critical and academic point of view". - Andrew Ritchie

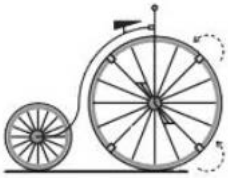
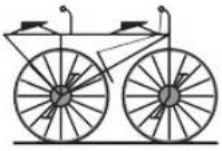
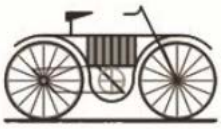
In the past, cycling tracks were constructed to serve the safety and convenience of cyclists. However, considering cycling as a sport, advanced tracks with scientific knowledge on the physics of cycling are a must to understand. Attempts to promote cycling as a daily sport are initiated by governments across the world. For example, the world's longest continuous cycle track (20.4 miles) was achieved by the public works authority in Qatar in the Middle East.[24] This sport requires stamina, perseverance, self-reliance, core strength, balance, and bike handling skills and has inspired many people in India as well. As discussed earlier, the history of the cycle dates back to the late 18th century.

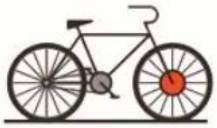
The following section looks at the evolution of the cycle and different types of cycling practised in the current times. Studying the evolution of cycle helps to understand the prerequisites of designing a cycle park. The evolution of cycle is transcribed in the process of designing the cycle park. Table 1 depicts a brief history of the evolution of the cycle.

Table 1. *Evolution of Cycle*

Year	Event	
1790	Celerifere – was invented by Comte Mede de Sivrac. The features include two equal-sized wheels and a seat, but no steering, brakes, or pedals. The rider glides on the celerifere after gaining speed using their feet.	
1817	Steerable Laufmaschine – also known as the running machine, velocipede, Draisine, and the swift-walker. Following the two-wheeler principle, the wooden steerable Laufmaschine has a steerable front wheel.	
1858	Pedals – The steerable laufmaschine has pedals added to it.	
1863	Boneshaker – Blacksmith Ernest Michaux invents the first commercially successful velocipede in 1863, which is now called the boneshaker. The boneshaker was made of stiff materials and straight angles which made it a "boneshaker" to ride on over common	

24. M. Kaddoura, *The Longest Continuous Cycle Path in the World Laid in Qatar* (Doha, Qatar: Guinness World Records, 2020).

	cobblestone roads.	
1866	Penny Farthing – British engineer, James Starley invents the penny-farthing which is commonly known as the high wheeler. The penny-farthing looks pretty silly compared to modern bicycles, and it was pretty difficult to ride. This difficulty limited the popularity of the high wheeler.	
1876	Caliper Brakes – English inventors Browett and Harrison patent an early version of the calliper brake.	
1879	Bicyclette – After many attempts for lever-driven models, Henry J. Lawson patented the first rear-wheel, chain-driven safety bicycle.	
1885	Rover Safety Bicycle – The first model to look like what we now think of as a standard cycle. This model combines a low seat, strong metal for a chain, and two wheels that are similar in size.	
1889	The Pedal-Back Brake – These brakes were patented by Daniel-Stover and William Hance, which later become a standard feature on bicycles.	
1896	Coaster Brakes– These brakes allow the bike to move forward without requiring the pedals to move and the rider can brake by pedalling backwards. These brakes continue to be popular in some areas to this day.	
1898	Pedal-Powered Battery Regenerator – This is a peculiar design in which the pedals spin a generator, which in turn drives a small motor. Known for being the first electric velocipede.	
1938	Electric Hub Motor – Thomas M. McDonald files a patent for an electric hub motor. This may be the earliest of its kind for a front-wheel-mounted version. The patent filing details this bicycle aims to allow the bicycle to be operated by only power, with the option of pedals.	

1979	Mountain Bike – Californian Joe Breeze is credited for creating the mountain bike. The prototypes for these are developed by many early designers including Joe Breeze, Otis Guy, Gary Fisher, and Craig Mitchell. These are the first tough frames built for downhill racing.	
1984	Cogs – It becomes popular for cogs to be added to the rear gear cluster, increasing the number of speeds from 15 to 18, 21, and 24.	
2002	10-Cog Rear Cluster – Italian bicycle component manufacturer Campagnolo develops a 10-cog rear cluster, allowing for 30-speed bicycles.	
2009	Electronic Gears – International manufacturer Shimano develops electronic gears that allow for faster shifting.	
2012	ADAPTRAC – names after the inventor, a system allowing the rider to individually adjust tire pressure while riding. Through a system of carbon dioxide cartridges, allows riders to maintain optimum traction when riding in changing conditions.	
2014	Lithium Nickel Manganese Cobalt Oxide Batteries – Otherwise known as NMC batteries, this is a newer type of lithium battery that starts becoming popular with electric bicycles around 2013-2014. NMC delivers higher power in a smaller package than previous models.	

Source: Adapted from Evelo Electric Bicycles, *The History & Evolution of the Bicycle* (evelo.com, 2021).

Types of Cycling

Cycling as a sport is practised at various difficulty levels. These styles have helped popularize cycling as a sport, by making it physically and mentally challenging for cyclists. The following are the some of the styles that have been translated into the proposed design of the cycle park.

- BMX (Figure 6) – BMX is one of the most popular off-road styles, usually seen and practised in the rural areas or countryside, where the cyclist would naturally get undulated terrain. It originated in the 1970s in California, where one could find youngsters riding and stunting off-road.

Just like motorcycles. BMX cycles are sturdier in make and smaller in dimension. It is made to take abuse and stunts, which would challenge both, the rider and the ride. BMX cycles have frames made of steel (high-tensile) and aluminium, those meant for racing. BMX cycles offer various riding styles, from off-road to urban build-up spaces to ramps designed in BMX parks.[25]

- Road biking (Figure 6) – This is the most commonly performed cycling as it doesn't need professional training. These cycles are used on a variety of roads such as BMX, racing, touring, and utility. It can be used in the velodrome as well as outdoors. The first-ever cycle race (1200 meters) was held on 31st May 1868 at the Parc de Saint-Cloud, Paris, where roading biking cycles were extensively used. As India is gradually turning its attention to adventure sports, road biking has become very popular over the past few decades.

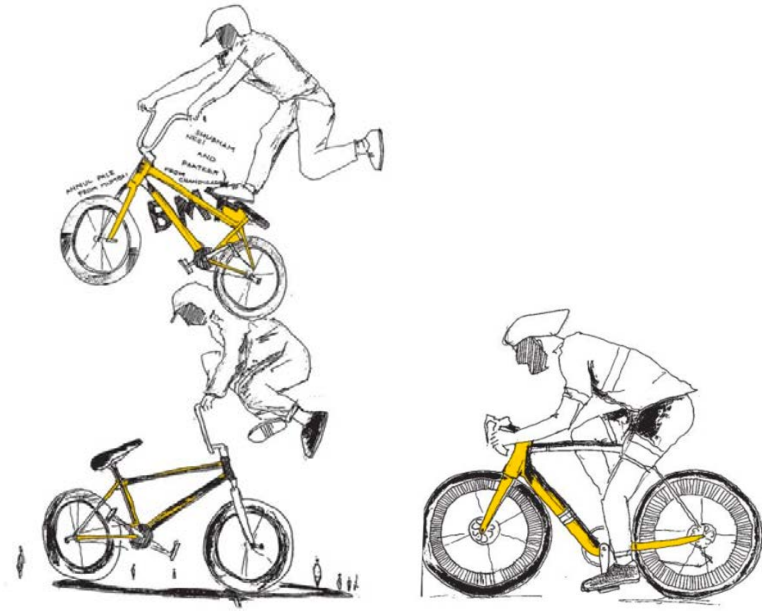


Figure 6. *BMX Stunts and Road Biking*
Source: Authors.

- Mountain biking (Figure 7) – This is an extreme style, where riders build their pumps and trails. Although there are no formal rules to this style, trained mountain bikers are aware of the unwritten rules, such as, be respectful of jumps and trails and being respectful of others. Weather and terrain play an important role in performing this style and conducting challenges. Dirt jumping, slopestyle, cross country, and downhill are some of the categories popularly performed while mountain biking.

25. P. Edwards, *Meet the First Stunt Bicyclist. He Did Tricks in the 1880s and Invented the wheelie* (Trivia Happy, 2016).

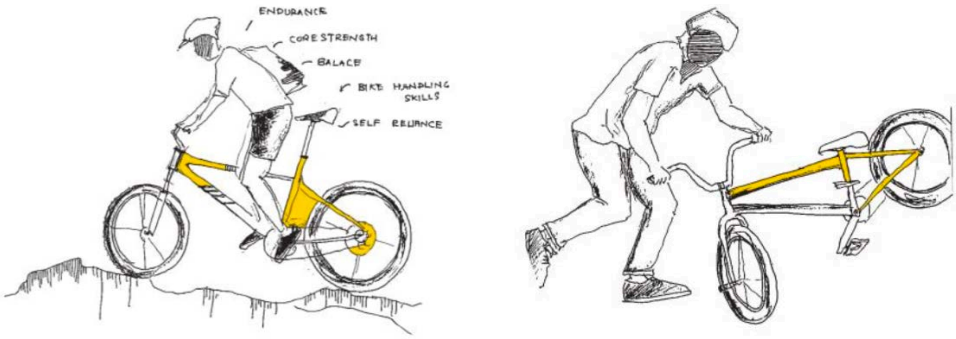


Figure 7. *Mountain Biking Style*
Source: Authors.

- Freestyle – The lightest weighing cycles are made to freestyle. They become popular shortly after BMX cycles and are used for flat trails, vertical skates, and aggressive street riding. Considered one of the safest styles, they come with multiple front and back gears.
- Dirt jumper – These bikes bridge the gap between BMX bikes and freestyles. Also known as jumpers, these cycles are designed to take flight for various ages of cyclists. They usually don't have front brakes and are a great choice for heavier riders.

The two examples below help the authors to understand the standards and architectural details of a velodrome. These examples are selected for desktop study as they have been tested by time and events over the decades. Both the examples have served national, international and local events. This paper suggests integrating such a facility into the city's urban form. Though these examples may not have particularly served the communities they are located in, but the design details and the concept of velodrome are important for this paper. The design developed of the proposed cycle park relies on the standards comprehended from the examples (see Table 2).

Example 1

Anna Meares Velodrome (10,000 m^2) was built in 2016 to serve the Commonwealth games 2018 in Brisbane, Australia. The stadium can accommodate 1,500 spectators and can expand for 4,000 more with temporary seating. Several events throughout the year, such as Track National Championships, Queensland National Championships, and Cycling Queensland Club are hosted at Anna Meares. Cox Rayner from COX Architects was the principal designer, jointly commissioned by Queensland State and the Australian government. With an elliptical footprint, Anna Meares Velodrome is one of the largest column-free arenas in the world. The steel roof makes the structure light weighted and provides a clear roof span of 118 meters. Figure 8 is an interior photograph of Anna Meares Velodrome showing the seating area, cycle tracks and steel truss on the roof. The stadium is water and energy-efficient and uses full LED broadcast lighting, making it one of

its kind in the world.[26] Figure 9 presents the architectural plan and section of the stadium.

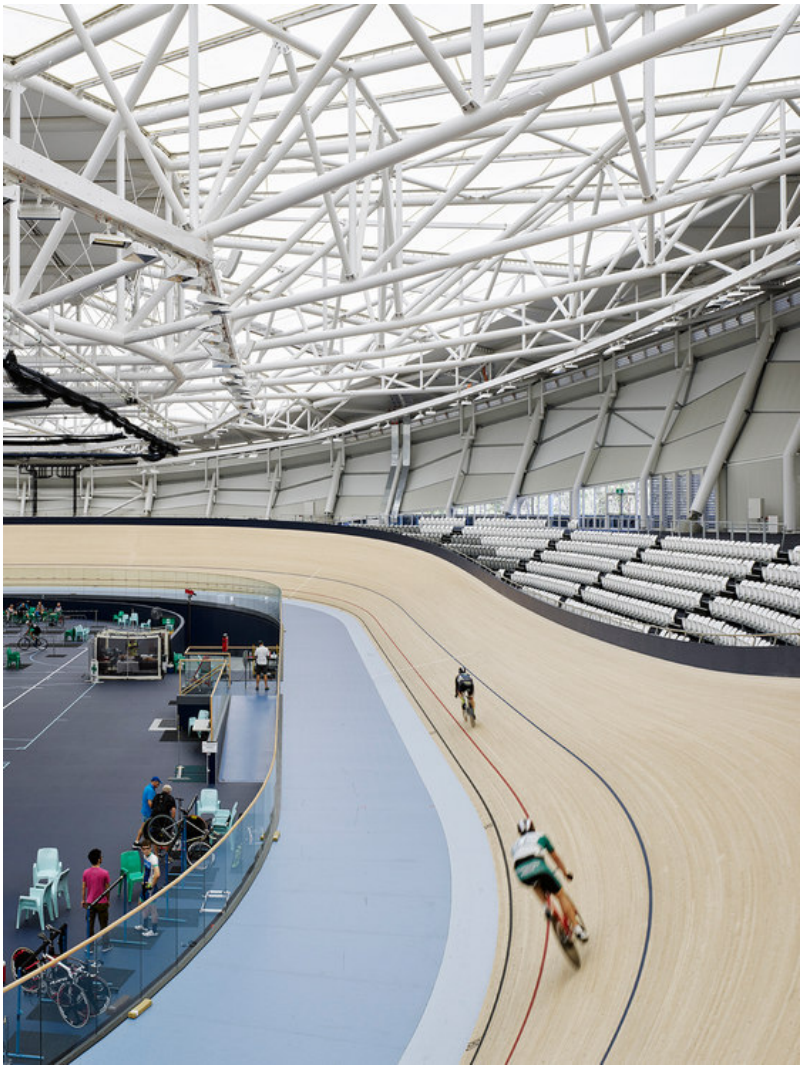


Figure 8. *Anna Meares Velodrome*
Source: C. F. Jones, *Photograph. Anna Meares Velodrome* (Brisbane, Australia: Cox Architects, 2018).

26. Arup, *The Architectural Vision is a Bowl that Grows from the Undulating Landscape. Anna Meares Velodrome* (Brisbane, Australia: ARUP, 2019); Austadiums, *Anna Meares Velodrome* (Brisbane, Australia: Austadiums.com, 2021); Cycling Queensland, *Anna Meares Velodrome* (Brisbane, Australia: cycling.org.au, 2021).

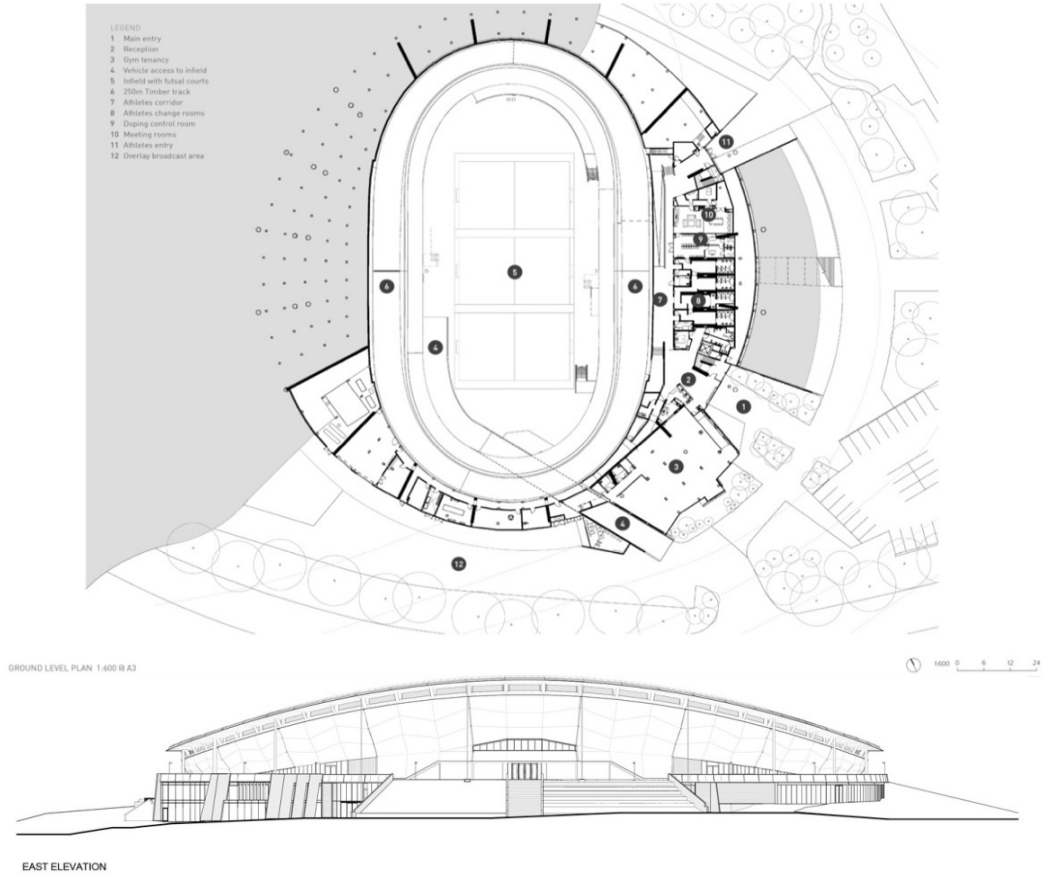


Figure 9. *Top View Plan and East Elevation of Anna Meares Velodrome*
Source: Archdaily, *Anna Meares Velodrome / Cox Architecture* (Brisbane, Australia: archdaily.com, 2021).

Example 2

Lee Valley Velopark in East London was inaugurated in February 2011. The velodrome has served as a permanent venue for Olympic 2012 and Paralympic games. Along with racing tracks, the velodrome has one mile of road tracks and 5 miles of mountain tracks. The design was publicly revealed by Hopkins Architects and Grant Associates in 2008, making it the first Olympic Park venue. The stadium can accommodate 6,000 spectators and provides for all levels of cyclists, amateurs, and champions. Figure 10 was photographed from the outdoor bicycle track of the velodrome followed by Figure 11 presenting its architectural plan and sectional elevation. The design focused on making it sustainable by adopting technologies like rainwater harvesting, harvesting natural light, and energy saving. The velodrome was a built-in way to make the London skyline beautiful, primarily using the traditional western cedar redwood as construction material. The idea was to avoid massive use of steel, in an attempt to not give a contemporary look.[27]

27. Wordpress, *A Work of Perfect Engineering* (London: archvelopark.wordpress.com, 2016).

Figure 10. *Anna Meares Velodrome*
Source: Hopkins Architects, *London 2012 Velodrome* (London: archdaily.com, 2021).

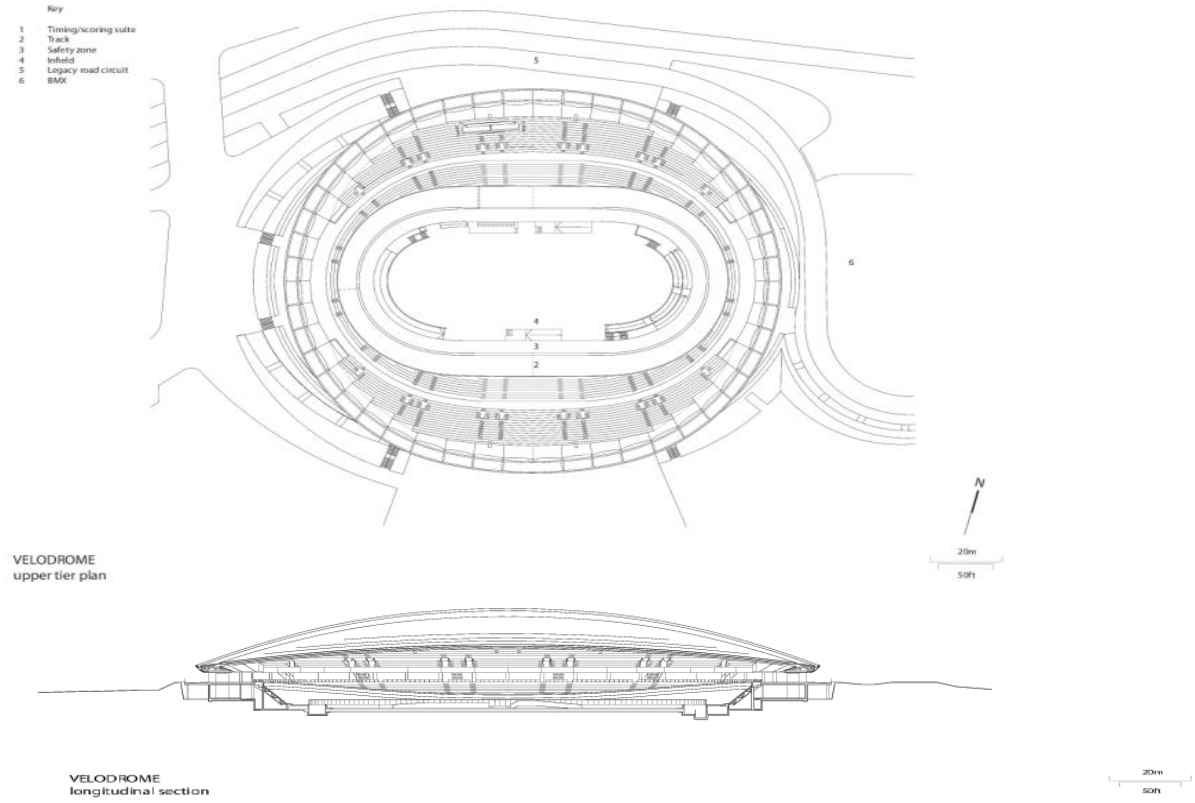


Figure 11. *Upper-tier Plan and Sectional Elevation of Lee Valley Velopark*
Source: Hopkins Architects, *London 2012 Velodrome* (London: archdaily.com, 2021).

The learnings from the case studies helped in the design decision for the cycle park at Bangalore. The comparison and how the learnings were adopted in the final design are presented in Table 2.

Table 2. *Comparative Table of Case Study Learnings*

Features	**Anna Meares Velodrome, Australia**	**Lee Valley Velopark, London**	**Proposal**
Total Area of Velodrome	10,000 m^2	21,700 m^2	11,450 m^2
Capacity	1500 (+4000)	6750	2000
Building Type	Indoor	Indoor	Indoor
Primary Material used	Concrete and Steel	Wood (western cedar redwood)	Concrete and Steel
Clear Roof Span	118 m	136 m	125 m
Sub-structure	Concrete	Concrete	Concrete
Super Structure	Steel	Steel	Concrete and Steel
The material used for tracks	Steel and wood	Steel and wood	Steel and Wood
The total length of the track	250 m	250 m	250 m
180 turning radius			
Innovation	Roof framing is configured to allow the complex hyperbolic paraboloid roof to be formed by simple straight components.	The roof is designed to reflect the geometry of cycling as well as being lightweight and efficient reflecting a bike. There is also a 360-degree concourse level with windows allowing people views of the Olympic Park.	The truss form which connects to the multiple steel support will gain better stability and the orientation has been designed on a contoured site.
Sustainability Target Achieved	Energy, water-efficient. Full LED lighting.	Energy, water-efficient. Use of maximum daylight.	Better daylight and ventilation and no land cut in the contours

Source: Authors.

Methodology

The motivation of proposing a design for the cycle park in Bengaluru was initiated by the author's interest in cycling as a sport. When researched further in Bengaluru's context, the vision was set to serve a rather larger community. In this regard, understanding the context became the first step of the overall design process. A thorough desktop study was carried out to understand the climate, geography, demography, and culture of Bengaluru. Information from municipal authorities confirmed the need for such a project and led the authors to select an appropriate site. As a second step, a literature review was conducted to identify scientific standards which would make the rider's experience safe. Examples from over the globe guided in implementing these standards into the design. The

findings of literature review confirm the need of such a park in Bengaluru, owing to its citizens growing interest in cycling as a sport. Also, the proposed design project is validated by realizing involvement of local authorities in developing such a facility. The third step, which was analyzing the physical and geographical conditions of the selected site, resulted in defining the limitations of structural design. With sustainable architecture as the core theme, a conceptual design was then developed disturbing as little as possible, the existing greens. The final design phase included details of architectural and structural design. The final design of this study is presented in the form of architectural plans, sections, and three-dimensional views. Figure 12 presents the above-mentioned design process.

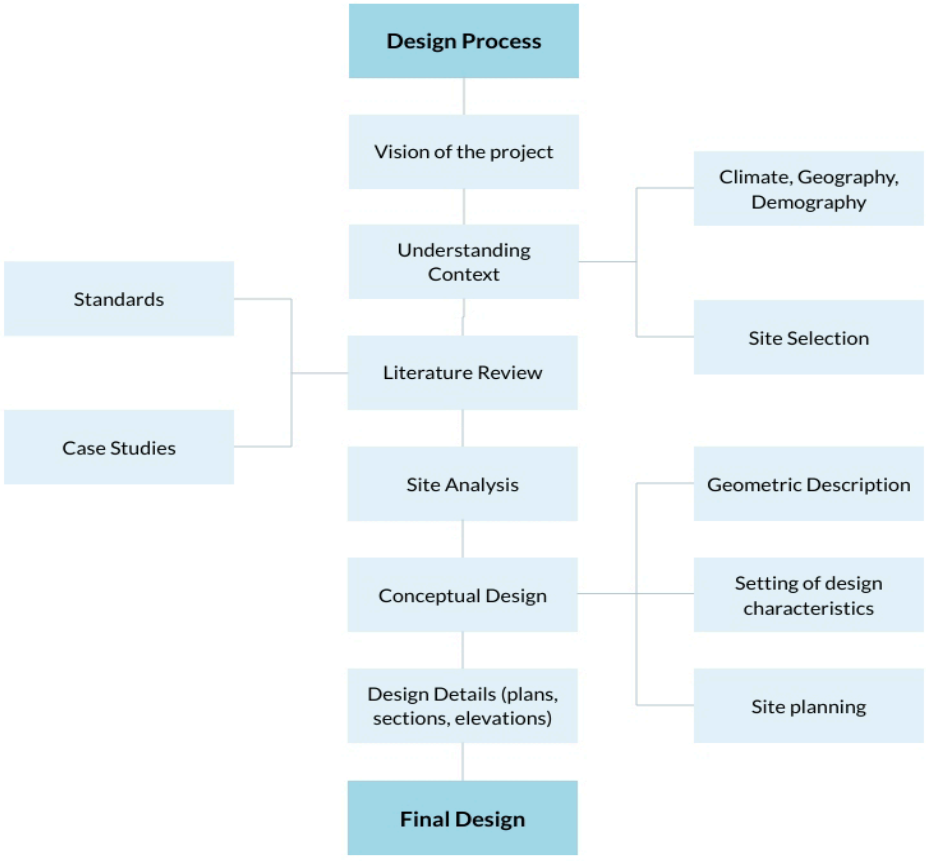


Figure 12. *Design Process*
Source: Authors.

Proposed Design

Site Selection

From Figure 5, it can be inferred that many existing popular trails in Bengaluru are located adjacent to the new ring road, Nice road, soon to become a peripheral road. The proposed design aims to serve all ages and all professional

levels of cyclists. Hence, it is reasonable to choose a naturally levelled landscape between nature to give the cyclists a real experience. On this basis, the site next to Nice road has been selected by the authors. Figure 13 shows the selected site location with the city as a reference. The selected site falls under the zone "park or open space" regulated by Bengaluru Land use development authority, further justifying the selected site by authors. Lying adjacent to the ring road, not only makes the site accessible but also makes the cyclists experience nature as it is surrounded by Turahalli forest's deciduous trees. The Turahalli forest department currently allows enthusiasts and cyclists to practice and ride, which makes it rational to develop a cycle park there. The site is easily accessible by road and the nearest bus stop is 500 meters away. Figure 14 shows the selected site with reference to its surroundings.

Figure 13. *Site Location on Bengaluru Map*
Source: Authors.

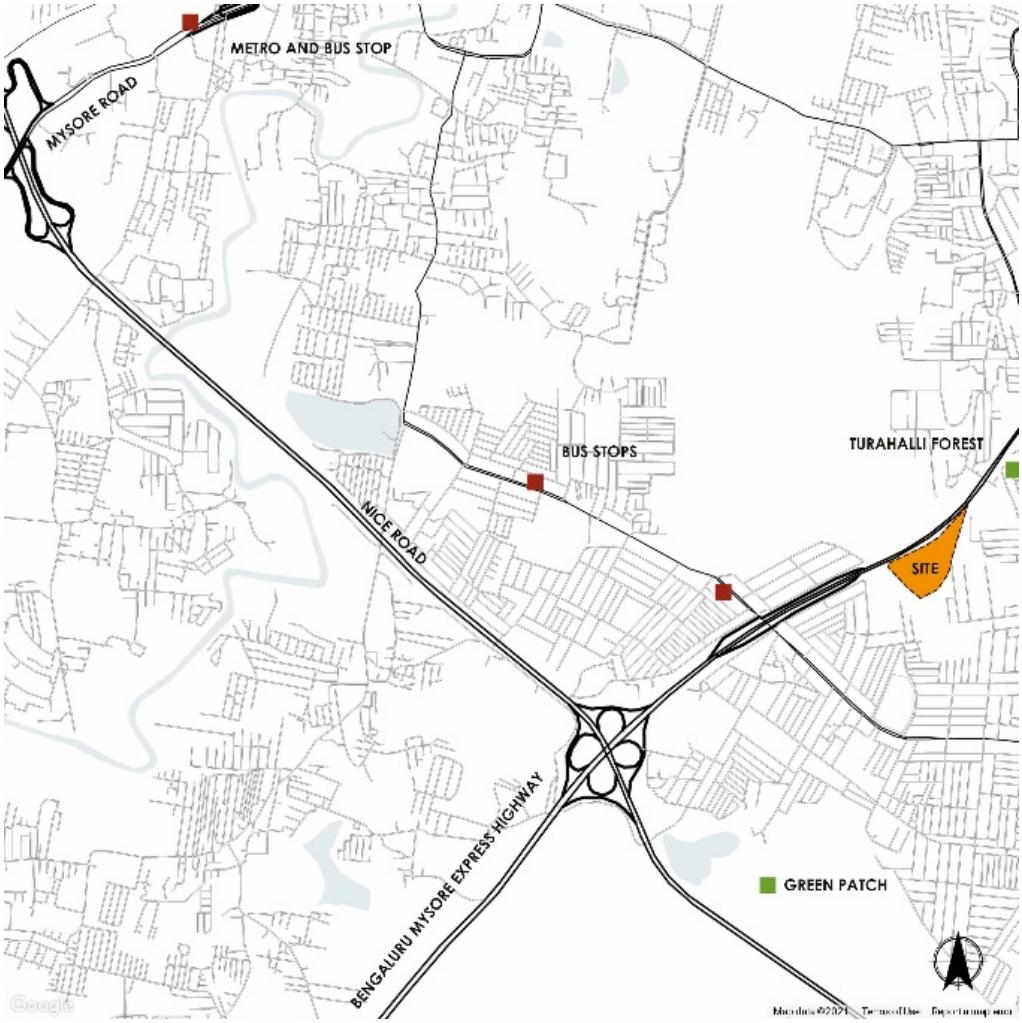


Figure 14. *Site Location*
Source: Authors.

Site Analysis and Setting

Post site selection, the next step is to lay the geometry based on the required functionality of the place. The function of the cycle park is specific and hence, the natural geography of the site is utilized to its best to lay the site layout. The proposed design is developed along the contours of the site, which assists to give natural tracks to BMX and mountain bikers. The maximum and minimum elevation of the contours on the site is 12-14 meters with a total site area of 19.07 acres (77,180 square meters). Figure 15 shows the contours of the selected site. The area surrounding the selected site is still under development and the only built forms found are small tea shops, grocery shops, auto garage–repair shops, and bus stops. As the area is allotted to Forest Department, which is responsible to conserve the forest as a natural resource, constructing permanent buildings and high rise is not a scope, even in the future. The proposed design utilizes all the existing trees, as a response to forest conservation.

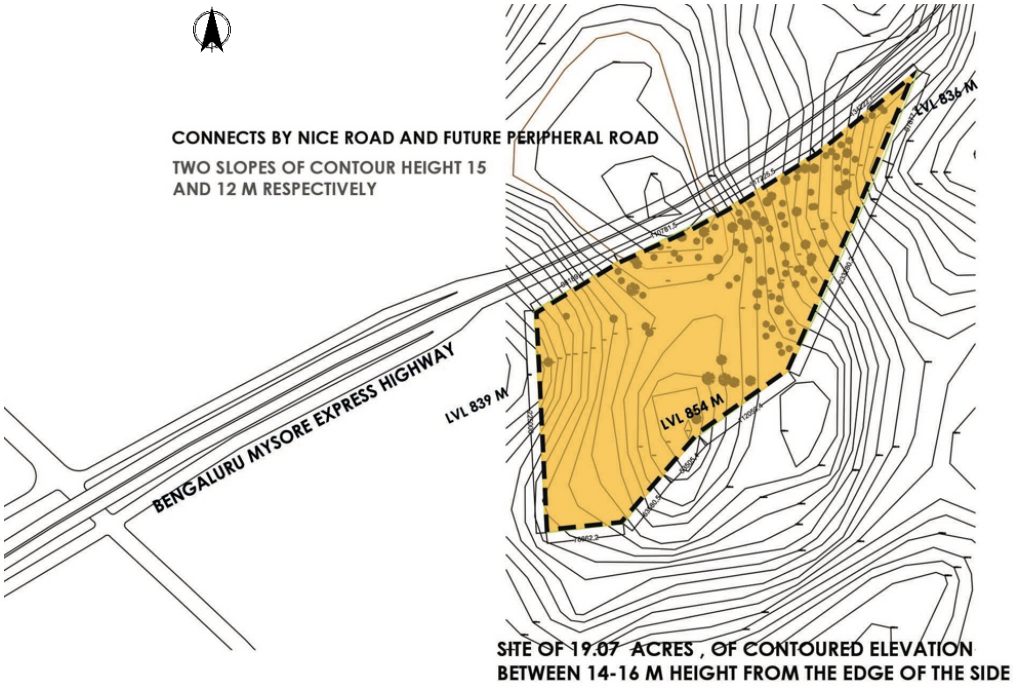


Figure 15. *Proposed Site*
Source: Authors.

The setting of the site and its building structure is inspired by the tension nodes of a cycle. During the ride, the cycle frame transfers the tension, that is the weight applied on the saddle, on the nodal points. The connection of those frames acts as a medium to circulate tension on all nodal points. However, based on the weight on the saddle and the pressure on the peddles, the tension at different nodal points differs from time to time. In the proposed design, these nodal points act as primary spaces, in terms of their function (refer to Figure 16).

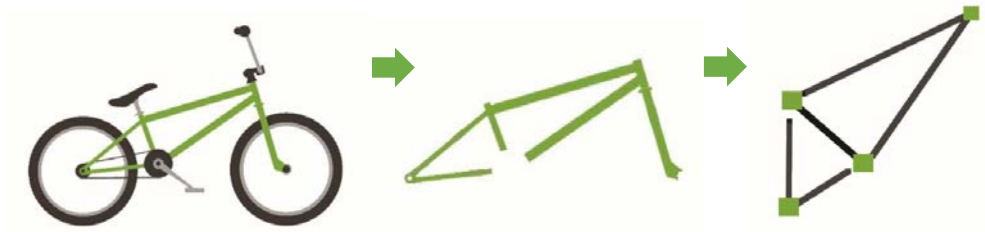


Figure 16. *Concept Inspired by Tension Nodes in a Cycle*
Source: Authors.

The main structure, that is the velodrome occupies the Northwest side of the site, which is adjacent to the peripheral road too. If the structure of the cycle frame is superimposed on the site, the location of the velodrome represents a major nodal point (tension point below the saddle). Laying the site from its northernmost edge, the indoor and outdoor mountain biking (MTB) park represents the topmost nodal point in the cycle frame (the handle of the cycle). The central part of the site comprises BMX park and kids pump park. Figure 17 presents the master plan of

the park followed by site sections in Figure 18. When implemented, this cycle park can serve as an athletic sports centre that can host national events. Housing is provided on the eastern edge as a response to such future events. On the opposite end of housing lies the velodrome with a capacity of 2,000 people, adjacent to an outdoor amphitheater and administration block. In the rear end of the site, the southern side lies the parking for visitors and cyclists. With a clear roof span of 125 meters in the velodrome, the structure is entirely constructed out of concrete and steel. The tracks are made out of wood and steel. The truss which connects to the multiple steel support is designed to gain better stability and orientation on a contoured site (see Figure 17). Figure 18 shows the elevational sections of the site.

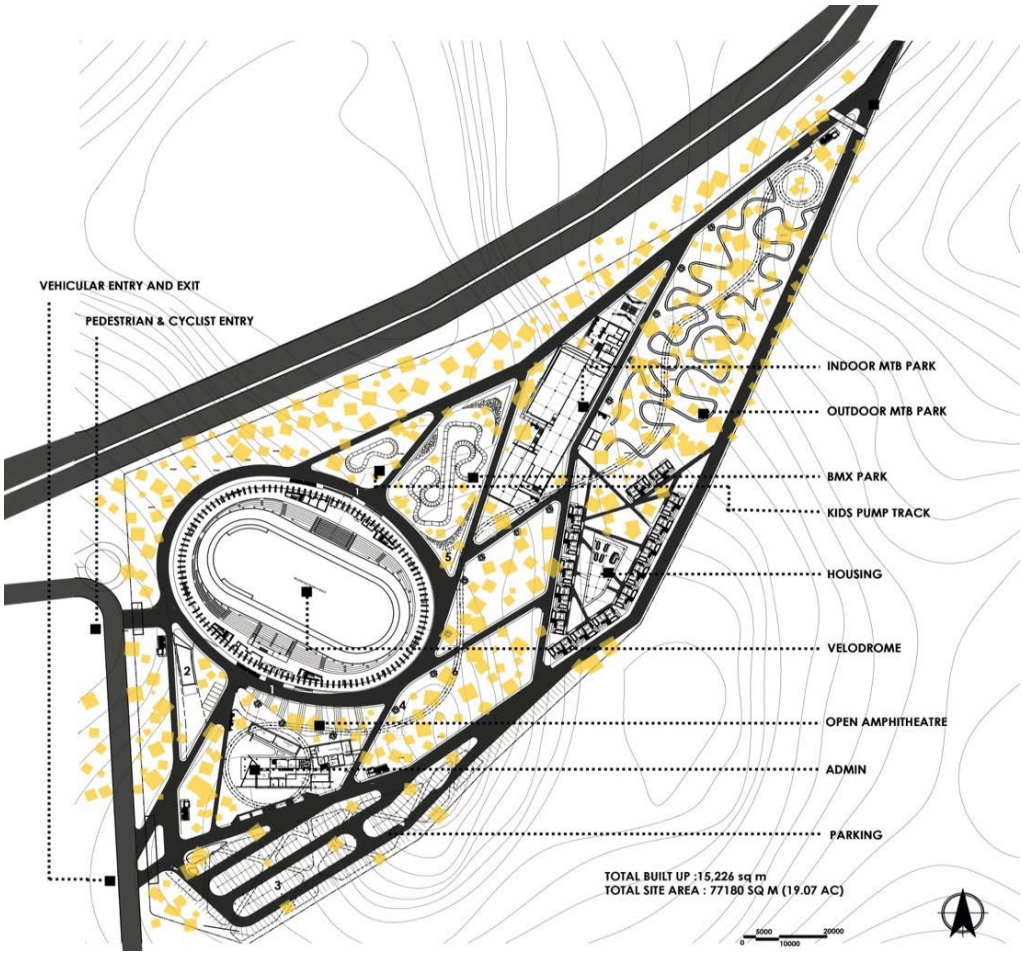


Figure 17. *Site Plan Development*
Source: Authors.

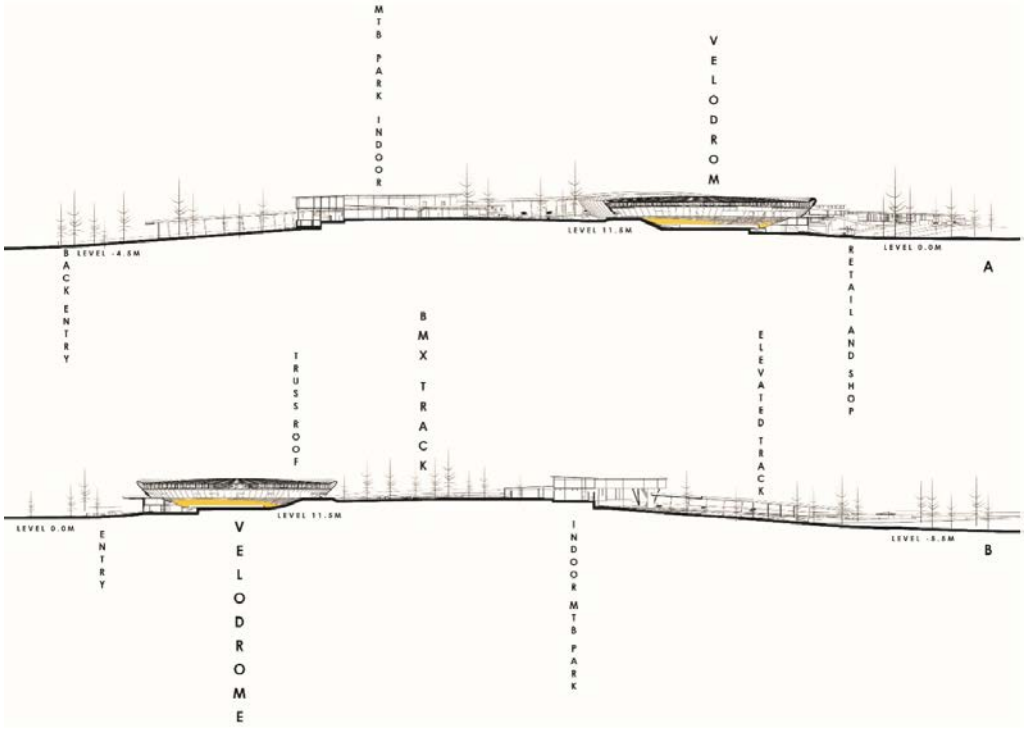


Figure 18. *Site Sections*
Source: Authors.

Design Details

The design of the velodrome is structured into steel and concrete frames supporting a column-free track. Above the ground level (2.5 meters), at 3.5 to 7.5 meters, accommodates the gym, cycle associations, and other services. The entry-level consists of entry/ exit points along with shops and public facilities. This, ground-level public facilities amalgamate the structure into the urban form of the place, not only visually but also by its function. The visual assistant will invite people to use the velodrome as a part of their routine. On the next level, the seating capacity accommodates 2,000 people from 8 meters and 11.5 meters. The wooden Velo track is supported by metal sections forming the outer shell and support for the velodrome. This is enveloped in glass with minimal openings, with the idea to use natural light to its fullest. This will create a feel of porousness in the structure, allowing people to experience nature without being outside. Even the tubular truss, which forms a light roofing structure is combined with metal tubes letting natural light in. The proposed design hopes to thus, coalesce with the existing urban environment that will encourage the users to make it a part of their urban life. Figure 19 shows details of the velodrome and its sectional details. Figure 20 presents an elevational section of the park, while Figures 21 and 22 present various views of the velodrome from the outdoor tracks.

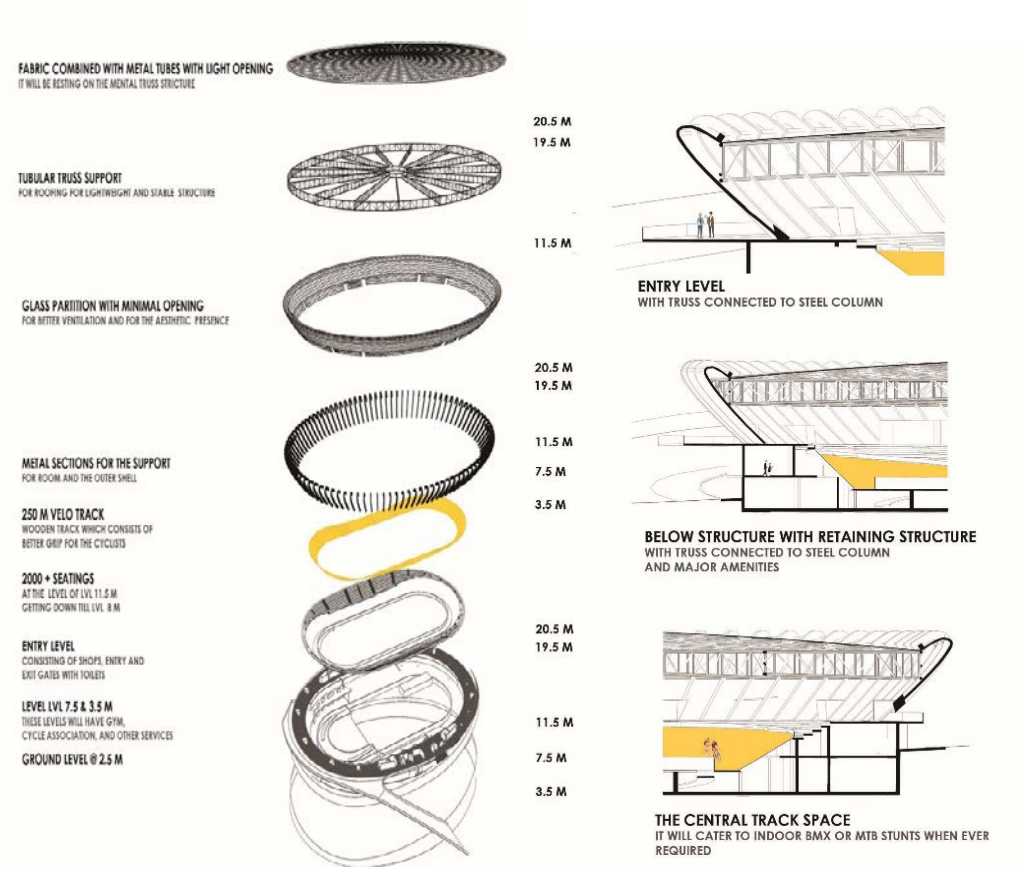


Figure 19. *Design of Velodrome and Sectional Details*
Source: Authors.

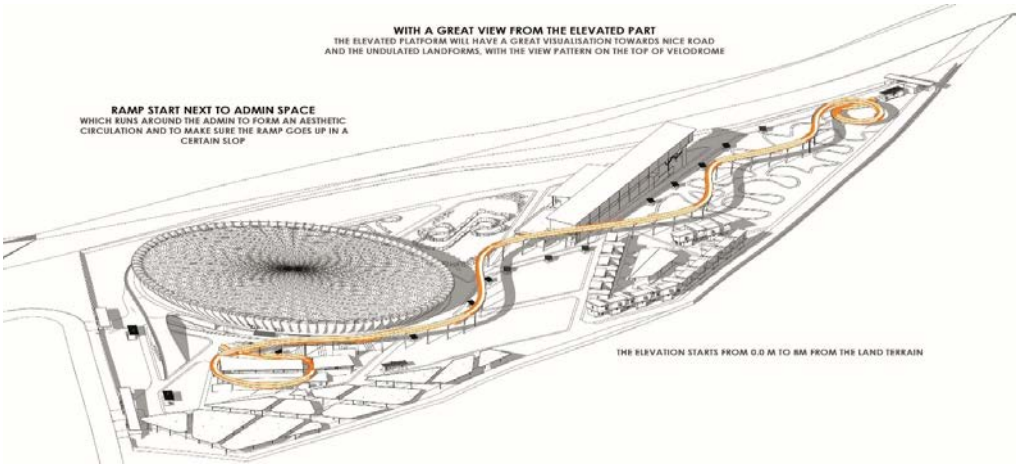


Figure 20. *Elevational View*
Source: Authors.

Figure 21. *Velodrome Top Section*
Source: Authors.

Figure 22. *View of Interlinked Spaces around the Park and View of Elevated Tracks*
Source: Authors.

Discussion

Planners and theorists have defined urban living as life and lifestyles in cities of 20th century.[28] What is expected out of this urban life is a subject of debate based on the geography, culture, and demography of the place. The literature review reveals the growing craze of the people of Bengaluru for the sport of cycling. Owing to the rise of COVID-19 and the subsequent lockdowns, this sport was seen as an escape from lockdown life and bouncing back to being fit. Additionally, the pleasant climate of Bengaluru allows for such a sport to be performed. For an unwalkable metro city like Bengaluru,[29] how can cycling become a part of urban living? With the aim to answer this question through architectural design, the paper presents a pilot cycle park design adjacent to the peripheral ring road. However, this would serve only a part of the population. More research is needed to develop such cycle parks around Bengaluru to really make it a part of citizens' urban living. As the key finding of this paper, focuses on the design of the cycle park, more research needs to be done on the social cohesion of such a facility. Will creating such an atmosphere invite more people to cycle? Does Bengaluru offer other sites between nature to practice the sport? What about the people living in the city centre who experience urban life to its maximum? How to bring the people to continue their pandemic lifestyle after the pandemic as this sport was initiated as an escape from lockdown? To answer these questions, and throw more light on the subject, more research is needed.

Conclusions

The study included a literature review exploring people's growing interest in cycling, especially during pandemic times (COVID-19). The influence of the mixed culture population and immigrants from all over the country and globe has given new light to the potential of cycling as a sport in Bengaluru, in the recent decade. Several cyclist groups have explored cycling trails in and around Bengaluru. However, many cyclists still do not get a chance to practice stunts due to no dedicated infrastructure. The amateurs also lose motivation due to the little infrastructure provided and for safety reasons. With this notion as a starting point, this study has documented international standards and case studies, to propose a cycle park for amateurs and professionals where they can practice cycling as a leisure activity as well as a sport. The idea is to give the infrastructure of an international cycling stadium within the city limits but also with natural textures, such as uneven terrain which is needed for mountain biking. The design provides BMX track cycling, road biking, mountain biking, freestyle and dirt jumper facilities. Concepts such as natural lighting, water and energy-efficient systems make the design relevant to the time. If implemented, this study aims to provide the place with appropriate infrastructure for all cyclists and for national and international cycling events to take place.

28. L. Bettencourt, and G. West, "A Unified Theory of Urban Living," *Nature* 467 (2010): 3, 21.
29. P. MV, *Bangalore Scores Low on Walkability Score* (Bengaluru, India: Bengaluru News, 2014).

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The Rediscovery of Japan: The Critical Reception of Japanese Architecture in Portugal after the Opening of Japan to the West

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The opening of Japanese ports to the West in 1854 enabled the rediscovery by the rest of the world of Japan as a country, which, until then and throughout the more than two centuries of the Sakoku *or closed country period, had maintained an isolationist policy in relation to the outside world. This opening up allowed for contact with Japanese art, including architecture, which was progressively absorbed by Western art, giving rise to* Japonisme. *Portugal was receptive to* Japonisme, *even if that receptiveness was motivated more by a taste for the exotic than genuine interest in the values of Japanese art. Even though its influence on Portuguese architecture was practically zero, Japanese architecture was divulged in Portugal. The aim of this paper is to determine an initial understanding of the reception of Japanese architecture in Portuguese books and architecture-related magazines published in the late nineteenth and early twentieth centuries. The investigation is sustained in interpretative-historical research, and seeks to assess how the contact with Japanese architecture unfolded and also examine the reasons behind its dissemination in Portuguese publications. This assessment is preceded by a contextualisation that sets out to clarify the reception given to* Japonisme *in the Portuguese art scene.*

Initial Considerations

The aim of this paper is to provide an initial understanding of the reception given to Japanese architecture in Portuguese books and architecture-related magazines published in the late nineteenth and early twentieth centuries. Two separate periods in said reception can be considered: that of the first encounter, which is directly connected to the re-establishment of ties between Portugal and Japan after the latter's re-opening to the West in 1854, which anticipated the Portuguese adherence to *Japonisme*; and that of the second encounter, now in the early twentieth century, which took place against the background of discussions around progress and the affirmation of an own cultural identity in Portugal. Despite this reception, the actual influence of Japanese architecture on Portuguese works of architecture built in the period was practically zero, reflecting a certain difficulty of understanding and absorbing *Japonisme* on the part of the Portuguese art scene. An influence can be found only in a small number of interior designs and the design of a sales pavilion for a faience factory.

The assessment of the reception given to Japanese architecture is based on interpretative-historical research, as defined by David Wang: "We define

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interpretative research specifically as *investigations into social-physical phenomena within complex contexts, with a view toward explaining those phenomena in narrative form and in a holistic fashion.*"[1] The publications mentioned form the fundamental research documentation. The understanding of Japanese architecture in the two aforementioned periods is preceded by a contextualisation which clarifies the reception of *Japonisme* in the Portuguese art scene. Proceeding from the observations of David Wang, this paper seeks to form a narrative that can explain the circumstances and reasoning that determined both the understanding – or lack thereof – of Japanese architecture in Portugal and its divulgation in Portuguese publications.

This matter is currently not the object of any other research project, giving this study a trailblazing character. The reception given to *Japonisme* by the Portuguese art scene is still in need of systematic research.

The Encounter with Japan

The opening of Japanese ports to American ships brought about by Commodore Matthew C. Perry (1794-1858) in 1854 enabled the world to rediscover Japan. This ended the *Sakoku*, or closed country, period, which spanned more than two centuries, during which Japan maintained an isolationist policy, withdrawing into itself, and refusing almost all contact with the outside world.[2] The United States interest in Japan reflected the expansionist appetite of the West, and was marked by a desire for hegemony over the world's main trade routes. As early as 1858 the initial agreements between the United States and Japan were to be consolidated, and to be followed by similar agreements with Holland, Russia, Great Britain, and France that same year. These became known as the Ansei Treaties. The European powers strengthened their dominance over Asia, and the United States guaranteed control over the Pacific crossing. The cultural and political affirmation of the West was given a continuity that was considered both natural and necessary for the exploitation of the economic benefits provided by the territories under its control.[3]

1. David Wang, "Interpretive-Historical Research," in *Architectural Research Methods*, ed. Linda Groat and David Wang (New York: Wiley, 2002), 136.

2. This isolation of Japan was determined by Tokugawa Iemitsu (1604-1651) through several policies and edicts successively implemented in the 1630s. Iemitsu was the third *shogun* of the Tokugawa period. The aim was to annul the European religious and colonial presence in Japan. Christianity was banned and access to the country was severely limited for foreigners. The Dutch were the only Westerners allowed to trade with Japan, even if they were only allowed to dock on the island of Dejima in Nagasaki Bay. Trading was also maintained with China and Korea. Despite this self-imposed isolation, Japan experienced a period of considerable peace and prosperity. The opening to the West was to bring about the end of the shogunate period. For further discussion of this period in Japanese history and the period following its opening to the world, see Brett L. Walker, *A Concise History of Japan* (Cambridge, MA: Cambridge University Press, 2015).

3. For further discussion of the significance of the treaties signed by Japan and the Western powers, as well as the conflicting interests in the East Asia and Pacific Region of the day, see Michael Auslin, *Negotiating with Imperialism: The Unequal Treaties and the Culture of Japanese Diplomacy* (Cambridge, MA: Cambridge University Press, 2006).

This encounter with Japan soon led to contact with the country's artistic production, which rapidly became an obsession for, and indeed began to be absorbed by, Western art.[4] The increasing presence of Japanese objects in Europe and the USA formed the basis for widespread interest in Japan. In 1872, Philippe Burty (1830-1890), a French art critic, coined the term *Japonisme*, adopting it in a series of texts published in the magazine *La Renaissance littéraire et artistique* [The Literary and Artistic Renaissance].[5] Burty used the term *Japonisme* to refer to the Japanese prints and objects that met with such enchantment within his own circle of artistic friends. *Japonisme* came to be used to identify the influence of Japanese art on Western art. In the late nineteenth and early twentieth centuries, Japanese influence was reflected in painting, printmaking, graphic design, textiles, costumes, jewellery, furniture, ceramics, but also in literature, theatre and opera. Less immediate, but no less important, was the impact of Japan on architecture.

The absorption of Japanese architecture by Western architecture was more expressive in the USA, especially on the West Coast, to which contributed the presence of Japanese architecture at the Centennial International Exhibition held in Philadelphia in 1876 and the World's Columbian Exposition held in Chicago in 1893; the geographical proximity to Japan; and the presence of North American architects and researchers in Japan. This absorption was more common in residential architecture. In Europe, *Japonisme* spread to architecture only at a later date, even though contact with Japanese art took place earlier there and the adoption of Japanese references in interior decoration was also more common.[6] Clay Lancaster clarifies the origins of the distinct European and North American approach to Japanese art and architecture:

4. During the *Sakoku* period, Europe continued to import Japanese goods, first and foremost porcelain and lacquer work that was frequently manufactured specifically for the Western market. Such pieces nourished the European taste for the exotic, and often ended up in cabinets of curiosities and collections. The taste for things Japanese came to be reflected in the European porcelain and furniture manufacture, as well as in the creation of architectural environments. A clear distinction between Chinese and Japanese pieces was not always made, and this was reflected in the fact that all pieces became known as *chinoiseries*. For further discussion of the impact of Japanese art on European art before the opening of Japan, see Oliver Impey, "Japanese Export Art of the Edo Period and Its Influence on European Art," *Modern Asian Studies* 18, no. 4 (October 1984): 685-697, http://www.jstor.org/stable/312344.

5. The terms *japonaiseries*, *japoniaiseries* and *japoneries* were already commonly used, but most of them had a depreciative connotation. As an aesthetic current in the arts, *Japonisme* was referenced by the French art historian and critic Ernest Chesneau (1833-1890) in 1873 in the magazine *Musée universel* [Universal Museum]. See "L'invention du japonisme," Gallica, Bibliothèque Nationale de France, accessed December 27, 2021, https://gallica.bnf.fr/html/und/asie/linvention-du-japonisme?mode=desktop.

6. Japan's impact on European architecture before the Modernist period has been the subject of some, albeit limited research. Of the research work carried out, one should mention the work of Jean-Sébastien Cluzel, who served as editor for *Le japonisme architectural en France 1550-1930*. See Jean-Sébastien Cluzel, ed., *Le japonisme architectural en France 1550-1930* (Dijon: Éditions Faton, 2018). For further discussion of the impact of Japanese architecture in the USA in that period, see Clay Lancaster, *The Japanese Influence in America* (New York, NY: W. H. Rawls, 1963).

> The cultural climate of the United States and the circumstances under which Japanese art was introduced here were quite different from those of Europe. […] [T]he first taste of things Japanese in Europe was in incidental discoveries – Hokusai's *Manga*, *ukiyoe* prints and decorative articles – and the influences from these imports were felt mostly in Impressionist and related paintings, posters and Art Nouveau designs. In the United States the art of Japan made a big splash at the first important international fair in two authentic buildings filled with bronzes, ceramics, carvings and lacquer wares. It is not surprising, therefore, that in practical-minded America the imprint of Japan should become more prominent in the three-dimensional domestic setting, and should figure only slightly in the specialized two-dimensional field of painting and printmaking.[7]

Treaty of Peace, Friendship and Commerce between His Majesty the Emperor of Japan and His Majesty the King of Portugal

The West's encounter with Japan naturally had an impact in Portugal. The Portuguese had been the first documented Westerners to arrive in Japan, in 1543, in Tanegashima Island, and Portugal had been the first European country to be visited by Japanese, in 1553, in this case by Bernardo the Japanese (?-1557), an early Japanese Christian.[8] In 1860, just two years after the signing of the Ansei Treaties, the "*Tratado de Paz, Amizade e Comércio entre Sua Magestade o Imperador do Japão e sua Magestade o Rei de Portugal*" [Treaty of Peace, Friendship and Commerce between His Majesty the Emperor of Japan and His Majesty the King of Portugal] was signed.[9] The relations between the two countries were confirmed with the visit of a Japanese mission to Portugal in 1862. A second visit was planned for 1864, although it was cancelled by Japan shortly before it was to take place.[10] Several gifts of manifest artistic value have remained from the 1862 mission – a saddle and harness set, two ornamentally-cut swords, paintings, ten folding screens, one display cabinet, one paper box and inkstand and assorted silk pieces.[11] In 1864 more gifts were received, which were probably sent because of the planned Japanese mission – five swords, rolls of velvet and of

7. Lancaster, *The Japanese Influence in America*, 51. Lancaster refers to the Japanese dwelling and to the Japanese Bazaar and Garden presented at the Philadelphia exposition. The workers who built the two structures and the materials used came from Japan.

8. For further discussion of the beginning of relations between Portugal and Japan, see Xavier de Castro, ed., *La découverte du Japon: 1543-1552* (Paris: Chandeigne, 2017).

9. Ana Fernandes Pinto, "The Reunion (1854-1900)," in *A Striking Story: Portugal - Japan, 16th-20th Centuries*, eds., Ana Fernandes Pinto, Alexandra Curvelo and Maria José Gaivão de Tavares (Lisbon: Galeria de Pintura do Rei D. Luís – Palácio Nacional da Ajuda, 2018), 91.

10. The visit of the Japanese diplomatic mission to Portugal in 1862 was part of a wider tour of Europe, taking in France, the United Kingdom, the Netherlands, Prussia and Russia. The aim of the mission was to renegotiate the treaties of 1858 and take knowledge of European technological advances that could help to modernise Japan. The diplomatic mission of 1864 visited France only, and its fundamental objective was to close the port of Yokohama to foreign trade. The mission was not successful, which may have led to the cancellation of the visit to Portugal. For more on the Japanese diplomatic missions to the West, see Auslin, *Negotiating with Imperialism*.

11. Maria José Gaivão de Tavares, "Japan in the Ajuda Palace," in *A Striking Story: Portugal - Japan, 16th-20th Centuries*, eds. Ana Fernandes Pinto, Alexandra Curvelo and Maria José Gaivão de Tavares (Lisbon: Galeria de Pintura do Rei D. Luís – Palácio Nacional da Ajuda, 2018), 115.

delicate fabric, pieces of white and red silk, two card game boxes, a lacquered shelf, an office shelf, a writing desk, two pairs of porcelain vases, one porcelain punch bowl and one porcelain jar, one crystal figure representing a man, one writing table and two boxes of assorted games.[12] The interest in Japan that was established at then was confirmed by the existence of a Japanese section at the Porto International Exhibition in 1865. It was, however, an unofficial and small-scale representation, made up of objects chosen by Edward Clarke, the Portuguese consul in Kanagawa who was responsible for negotiating the coming of the first Japanese mission to Portugal in 1862.[13] The taste for pieces related with Japan spread progressively, thus confirming Portugal's adherence to the *Japonisme* then en vogue. The Retrospective Exhibition of Spanish and Portuguese Ornamental Art that was held in Lisbon in 1882 featured a section dedicated to Japan that presented a few dozen Japanese and Japan-inspired porcelain pieces.[14]

The agreements with Japan offered Portugal similar conditions to those achieved by other Western nations. However, application thereof was not very consistent, mainly because of Portugal's political and economic incapacity. The absence of a resident Portuguese diplomatic mission in Japan until 1903, a fact that greatly displeased Japan, confirmed said incapacity. To quote Ana Pinto:

> the political consensus around Portugal's imperial vocation was not matched by the administrative and political reforms or the economic investment necessary for a modern imperial sovereignty. […] In time, the lack of interest by the Portuguese on this trade opening would become increasingly evident, alongside a series of other obstacles to diplomatic relations.[15]

Diametrically opposed to what happened in France, the United Kingdom and the USA, Portugal's difficulty in sustaining well-defined relations with Japan was reflected in a certain disaffection of the Portuguese artistic milieu from Japanese

12. Tavares, "Japan in the Ajuda Palace," 116. A number of these gifts, together with other Japanese pieces and European pieces of Japanese inspiration acquired by the Portuguese royal family around Europe are today on display at the National Palace of Ajuda in Lisbon and at the National Palace of Pena in Sintra. The taste for such pieces spread to the aristocracy and collectors.

13. *Catalogo official da exposição internacional do Porto em 1865* (Porto, Typographia do Commercio, 1865), 162. The objects featured at the show included a book on silk farming and examples of painted paper. The painted paper objects are now part of the Porto Public Library collection. The existence of a Japanese section at the Porto exhibition followed Japan's presence at the London International Exposition in 1862, where, for the first time, Japan was represented on the circuit of major international expositions. The second time was in Porto. As was the case in Porto, the Japanese participation in London was not official. It was organised by a European official, Rutherford Alcock (1809-1897), the first British diplomatic representative to Japan. The collection of pieces on exhibition was significantly larger and more diverse than the representation at Porto. See Rutherford Alcock, *Catalogue of Works of Industry and Art, Sent from Japan* (London: William Clowes and Sons, 1862). Japan's first official participation in a large international exposition was at the Exposition Internationale de Paris in 1867, where a Japanese pavilion was built, most likely by Japanese craftsmen. See Jean-Sébastien Cluzel, "Les pavillons japonais de 1867, édifices authentiques?" in *Le japonisme architectural en France 1550-1930*, ed. Jean-Sebétien Cluzel (Dijon: Éditions Faton, 2018), 121. The international expositions played a decisive role in consolidating and spreading the taste for all things Japanese in the West.

14. See *Catalogo illustrado da Exposição retrospectiva de arte ornamental portugueza e hespanhola* (Lisbon: Imprensa Nacional, 1882), 1: 290-293.

15. Pinto, "The Reunion," 90-91.

art. This disaffection was even greater when one took architecture into consideration. The ambience of a possible Japanese influence that resulted from the application of the silks and other pieces gifted by the Japanese mission of 1862 in one of the rooms of the Palace of Ajuda, in Lisbon, is significant for being unusual, not so much for reflecting a general adherence to *Japonisme*. The sales pavilion of the Caldas da Rainha Faience Factory, with its clear references to Japanese architecture, was an exception (Figure 1). It was most likely designed by Raphael Bordallo Pinheiro (1846-1905), an illustrator, sculptor and ceramicist, who was the owner of the factory. The pavilion was completed in 1885.[16]

Figure 1. *Raphael Bordallo Pinheiro, Sales Pavilion of the Caldas da Rainha Faience Factory, Caldas da Rainha, Portugal, 1885* (photograph by unknown author, c. 1889)
Source: © Courtesy Museu Bordalo Pinheiro, Lisbon. MRBP.FOT.0693.

Some of the Bordallo Pinheiro objects reveal the influence of Japanese values. The comments in the press on the pavilion were typical of the confusion that characterised the reception given to *Japonisme* – Japanese architecture was "a very good choice, as this is a faience factory, an industry in which China is a leading manufacture."[17] The pavilion was demolished in the 1980s. The few references to Japan in Portuguese art of the late nineteenth century are more the

16. José-Augusto França, *Rafael Bordalo Pinheiro: O Português Tal e Qual*, 3rd ed. (Lisbon: Livros Horizonte, 2007), 104.

17. Anonymous, "Fabrica de Faianças das Caldas da Rainha." *O Occidente*, November 21, 1887, 262, http://hemerotecadigital.cm-lisboa.pt/OBRAS/Ocidente/1887/N321/N321_item1/P6.html. Translation by the author. Original text: "muito bem escolhida, tratando-se de uma fabrica de faianças, industria de que a China é produtora por excellencia."

result of a circumstantial taste for the exotic than of a conscious absorption of the values of Japanese artistic culture. Significantly, the room in the Palace of Ajuda eventually became known as the "Chinese Room". Literature was the only exception in this context of alienation, with the figure and work of Wenceslau de Moraes (1854-1929) taking on particular importance.[18] Wenceslau de Moraes gave up his career as a Navy officer to settle in Japan in 1898. He was consul in Kobe and Osaka. He became a writer and maintained a long-standing fascination for Japan.

> His personal discovery of the Land of the Rising Sun, with its landscapes, legends, history, art, literature and religions and the way of life of the Japanese people became the central theme of his works. The many years he lived in Japan, first as Portuguese Consul, and later simply as one who was fascinated by this land, his marriage with Ó-Yoné, his attempt to "become Japanese", are the most striking aspects of his biography.[19]

José-Augusto França helps us understand the distaste for Japan when he criticises the ambience in which the realist writer Abel Botelho (1854-1917) appears in a portrait painted by António Ramalho (1859-1916) in 1889 (Figure 2). According to França:

> António Ramalho [...] depicts him dressed in a kebaya surrounded by Japanese objects of the bric-a-brac type that Barão de Lavos [one of Botelho's characters] would appreciate, totally unaware of the modern values that *Japonisme* represented.[20]

18. For further discussion on the presence of Japan in Portuguese literature at the time, see José Carvalho Vanzelli, "Entre o passado e o presente: um estudo do orientalismo literário português na segunda metade do século XIX," (PhD. diss., University of São Paulo, 2020), https://www.teses.usp. br/teses/disponiveis/8/8156/tde-02062020-135310/pt-br.php.

19. Natália Vital, "Japan in the works of Pierre Loti and Wenceslau de Moraes," *Bulletin of Portuguese - Japanese Studies*, no. 9 (December 2004): 47, https://www.redalyc.org/pdf/361/3610 0903.pdf.

20. José-Augusto França, *A Arte em Portugal no Século XIX*, 3rd ed. (Lisbon: Bertrand Editora, 1990), 2:104. Translation by the author. Original text: "António Ramalho […] figurando-o de cabaia, entre objectos japoneses dum bricabraque que o seu «Barão de Lavos» apreciaria, e bem inconsciente dos valores modernos que o japonesismo trazia em si." Abel Botelho is, in fact, wearing a kimono, and not a kebaya, as França writes, although this fact does not affect the accuracy of his observations. António Ramalho also painted several paintings of Japanese influence in one of the rooms of a chalet belonging to Queen Maria Pia (1847-1911) in Estoril, a seaside resort town just outside Lisbon. See António Cota Fevereiro, "A iluminação no chalet do Estoril ao tempo da Rainha D. Maria Pia," *Herança – Revista de História, Património e Cultura* 3, no. 1 (2020): 56, https://doi. org/10.29073/heranca.v3i1.

Figure 2. *António Ramalho, Retrato de Abel Botelho, 1889, Oil on Canvas, 59 x 44 cm. Museu Nacional de Arte Contemporânea – Museu do Chiado, Lisbon* (photograph by Carlos Monteiro, 1993)
Source: © DGPC/ADF. 06288 TC.

The First Portuguese Encounter with Japanese Architecture

The first Portuguese texts examining Japanese architecture after Japan's opening to the West coincided with the beginning of the interest in Japan that was

generated in Portugal. They are also indicative of the important role literature was to play in the reception of *Japonisme*. The texts have to do with the Portuguese diplomatic missions to Japan in 1860 and 1873. They are *Viagem da corveta Dom João I á capital do Japão no anno de 1860* [Voyage of the Corvette Dom João I to the Capital of Japan in the Year 1860] by Feliciano Marques Pereira[21] (1802-1864), which was completed in Macao in 1861 and published in Lisbon in 1863, and *O Japão: Estudos e Impressões de Viagem* [Japan: Studies and Travel Impressions] by Pedro Gastão Mesnier[22] (1846-1886), written and published in Macao in 1874. These are the first two Portuguese accounts, among the first in the West, of Japanese society and the changes it underwent because of its opening to the West. The year 1878 saw the publication in the *Boletim da Real Associação dos Architectos Civis e Archeologos Portuguezes* [Bulletin of the Royal Association of Portuguese Civil Architects and Archaeologists], of a short text titled "Architectura Japoneza" [Japanese Architecture] by Januário Correia de Almeida (1829-1901), the Viscount São Januário.[23] The Bulletin was the first Portuguese periodical dedicated to architecture.

Voyage of the Corvette Dom João I to the Capital of Japan in the Year 1860

1863's *Voyage of the Corvette Dom João I to the Capital of Japan in the Year 1860* by Feliciano Marques Pereira was based on the voyage to Japan in 1860 by Isidoro Francisco Guimarães (1808-1893), the Viscount of Praia Grande and Portuguese Minister Plenipotentiary, to sign the treaty negotiated with Japan that year (Figure 3). Marques Pereira was the commanding officer on the Corvette that carried the diplomatic mission to Edo, the current Tokyo. The Japan he found was still very much untouched by its recent opening to the West. The book contains a general reflection on the country, delving into the political structure, its customs, literature and its arts, but also its history and geography. Marques Pereira drew on the account of Commodore Perry's expedition to Japan written by Francis Hawks[24] (1798-1866), thus confirming access to more recent sources.

21. Feliciano Antonio Marques Pereira, *Viagem da corveta Dom João I á capital do Japão no anno de 1860* (Lisbon: Imprensa Nacional, 1863).

22. Pedro Gastão Mesnier, *O Japão: Estudos e Impressões de Viagem* (Macao: Typographia Mercantil, 1874).

23. Visconde de São Januário, "Architectura Japoneza," *Boletim da Real Associação dos Architectos Civis e Archeologos Portuguezes* 2, no. 5 (1878): 67-69, https://www.museuarqueologicodocarmo.pt/publicacoes/arqueologia_historia/serie_2/Tomo_II/s2_tomo_II_Bol5.pdf.

24. Francis L. Hawks, *Narrative of the Expedition of an American Squadron to the China Seas and Japan: Performed in the Years 1852, 1853 and 1854 under the Command of Commodore M. C. Perry*, 3 vols. (Washington, DC: Congress of Unites States, 1856).

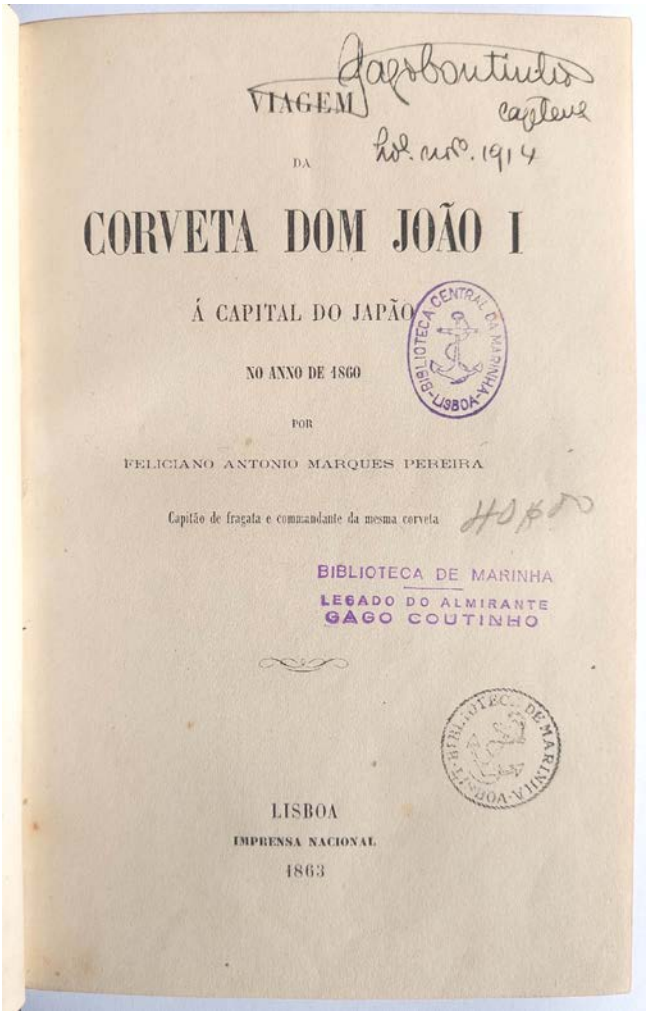

Figure 3. *First Page of the 1863 Edition of Feliciano Antonio Marques Pereira's "Viagem da corveta Dom João I á capital do Japão no anno de 1860"* (photograph by João Duarte, 2022)
Source: © Biblioteca Central de Marinha, Lisbon. 3F2-45.

Despite the wealth of information provided by Hawks, Marques Pereira's comments on the Japanese cities and architecture were the result of direct experience. He went to Edo, Kanagawa and Yokohama. On Edo he writes: "seen from close-up or from afar, there is nothing agreeable or admirable about it; and it does not enable any comparison with European cities, nor with any others in the Christian world."[25] He also writes that the city centre is marked by two concentric sites, and that the innermost one, where the Emperor lives, is surrounded by a thick, high stone wall and a moat connected to the port. The streets are wide, and

25. Pereira, *Viagem da corveta Dom João I*, 22. Translation by the author. Original text: "vista de perto ou de longe não tem nada de aprazivel, nem de admirável; e não admitte mesmo comparação alguma com as cidades da Europa, nem com quaesquer outras do mundo christão." For further discussion on Edo in the period following the opening of Japan to the West, see Hiroo Ichikawa, "The Evolutionary Process of Urban Form in Edo/Tokyo to 1900," *The Town Planning Review* 65, no. 2 (1994): 179-196, http://www.jstor.org/stable/40113289.

the blocks are very long; the squares are irregular in shape and informal but spacious. Marques Pereira confirms that the city is dissected by many water channels. Most of the buildings seem insignificant to him – "ordinarily, they are no more that street-level huts, even if they are covered with well-built roofs that feature thick roof tiles."[26] From the outside, the houses of the daimyos and the pagodas distinguish themselves from common buildings by being higher. However, on the interior, the pagodas stand out for the parks and gardens that surround them and the majestic arches – the *Torii* – that punctuate the latter, and that the more refined houses reveal an unexpected generosity of space that is provided by their courtyards. Marques Pereira goes into greater detail on such houses. He observes their spatial organisation and their building system; how the spaces, which are devoid of furniture, can be easily transformed; and the singular relationship the spaces establish with the gardens, particularly in the larger and wealthier houses.

> It is clear that similar residences may present few aspects of beauty on the exterior; but the same is not true of the interior, or the garden side; ordinarily, they have gardens, which one accesses by going down a few steps. Seen from there, from amongst the trees and flowers, the half-open walls, the completely open veranda, which normally goes the whole way around the house, the cleanliness and the attractive painted paper objects – all unite to give them a very original and agreeable aspect, a certain kiosk-like character, or that of pavilions, making them appear beautiful and ideal for a hot climate. [27]

Marques Pereira's observations reflect the understandable feeling of discomfort Edo and its architecture provoked in someone from Europe in 1860. Images of Japanese buildings were not so common in the West at the time and not very precise, making it more difficult to understand Japanese architecture. The descriptions that were available were not very favourable. Hawks writes that, with the exception of one or the other temple or gateway that stood out from the low houses, "there were no buildings seen which impressed the Americans with a high idea of Japanese architecture."[28] However Marques Pereira's observations are also characterised by a free openness that was capable of appreciating the architecture without necessarily subjecting it to comparison with European models and without lingering only on the decorative elements. Descriptions of the interiors of more refined houses are the most evident expression of this.

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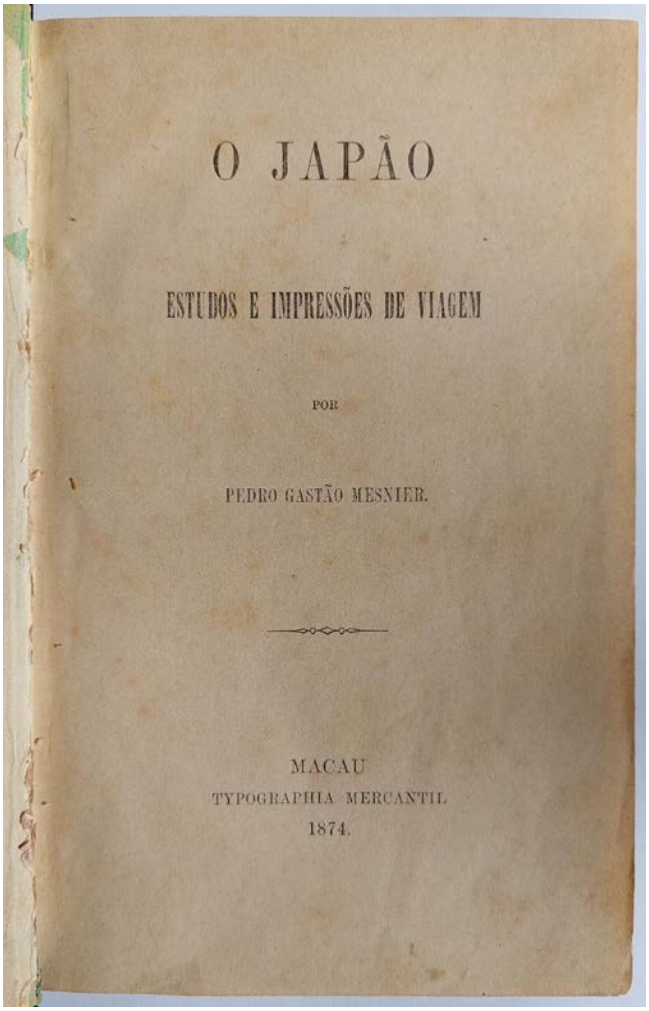
26. Pereira, *Viagem da corveta Dom João I*, 22. Translation by the author. Original text: "ordinariamente não passam de barracas ao rez da rua; bem que cobertas com bem construidos telhados de grossas telhas."

27. Pereira, *Viagem da corveta Dom João I*, 22. Translation by the author. Original text: "Bem se deixa ver que similhantes habitações pouca perspectiva de beleza poderão apresentar no exterior; mas não acontece outro tanto no interior, ou do lado dos jardins, que ordinariamente têem, e para os queaes se desce por poucos degraus. Vistas d'ahi, por entre as arvores e flores, essas paredes meia rotas, essa varanda toda aberta que as cerca ordinariamente em roda, o aceio e o vistoso dos papeis pintados, tudo isto lhes dá um aspecto muito original e agradavel, certo caracter de quioskes, ou pavilhões, que as faz parecerem bellas e muito proprias para um clima quente."

28. Hawks, *Narrative of the Expedition*, 1:463.

Japan: Studies and Travel Impressions

Japan: Studies and Travel Impressions, published in 1874 by Pedro Gastão Mesnier, presents an in-depth description of Japan that was compiled with the express purpose of introducing the country in Portugal.[29] It is based on the journey to Japan in 1873 by Viscount São Januário, Portugal's Minister Plenipotentiary to Japan from 1872 to 1874, to whom Mesnier was the private secretary (Figure 4). Just a few years after the visit of Marques Pereira, Japan was now in a clear process of westernisation.


O JAPÃO

ESTUDOS E IMPRESSÕES DE VIAGEM

POR

PEDRO GASTÃO MESNIER.

MACAU
TYPOGRAPHIA MERCANTIL
1874.

Figure 4. *First Page of the 1874 edition of Pedro Gastão Mesnier's "O Japão estudos e impressões de viagem"* (photograph by João Duarte, 2022)
Source: © Biblioteca Central de Marinha, Lisbon. 2P6-27.

Mesnier goes into the history of Japan and also deals with the Portuguese presence; he describes the cities, populations and their customs, while also providing a glossary of Far-East terms and tables containing geographic, historical

29. Mesnier lost part of the book's original manuscript in a typhoon that hit Macao, thus restricting the final size of the work. See Mesnier, *O Japão*, IX.

and demographic data. The country's literature and arts are described as part of the characterisation of Japanese society and culture. The book relies on wide-ranging sources, works on Japan – both books and periodicals – some of them preceding the re-opening to the West.[30] Of those works, one should mention, on account of its size, the at the time recently published *Le Japon Ilustre* [The Japan Illustrated] by Aimé Humbert[31] (1819-1900), a Swiss born diplomat who became the envoy plenipotentiary of the Swiss federal government to Japan. Mesnier does not mention Marques Pereira's book, but it is very plausible that he was acquainted with it.

Mesnier visited several Japanese cities – Nagasaki, Kobe, Osaka, Yokohama and Edo. He evaluates the emergence of new cities that were Western in aspect and frequently grew up out of the already existing ones. Mesnier describes a few castles, highlighting that the lower level was built of stone and the upper levels of wood. He notes that the palaces of the former daimyos differ from normal housing merely through their size. As for the former residences, which, he emphasises, are made of wood only, he notes the singularity of the joints between the constituent pieces and the care taken in selecting and finishing the various woods used in the floors. He also appreciates the lightness of and the silence with which the room panels are moved. "Houses built like this have the effect of a huge chest that is full of drawers of all sizes, but the orderliness in even the poorest houses is admirable."[32] Mesnier devotes a significant part of his book to Edo and its architecture. He remarks on how wide the streets are and the erection of buildings of a European aspect amongst the rubble caused by a recent fire[33]. Here he finds renewed order. The palaces of the former daimyos are regarded as examples of primitive architecture. Like the castles, their lower floors are made of stone and the upper floors are in wood. They are characterised by their extensive horizontality. Only the high volumes that mark the respective entrances give them some special flair. "There is nothing sadder or more monotonous than the aspect of these buildings, in which the most uniform regularity has nothing that surprises or delights the sight."[34] The temples are more appreciated, but they do not match the majesty and grandeur of the architecture of India and Europe. "Ultimately, the Japanese seek to conserve in their architecture as little symmetry as possible, and in many of their works of art, they seem to intentionally flee from all and any

30. Mesnier, *O Japão*, XI-XIII.

31. Aimé Humbert, *Le Japon Ilustre*, 2 vols. (Paris: L. Hachette, 1870). As with Marques Pereira the works referred to by Mesnier confirm ease of access to updated sources on Japan.

32. Mesnier, *O Japão*, 113. Translation by the author. Original text: "Casas construídas por essa fórma produzem o effeito de uma enorme commoda, cheias de gavetas de todos os tamanhos, mas é admirável a limpeza que reina mesmo nas mais pobres."

33. This was a fire that spread in 5 May 1873 and destroyed the Emperor's residence in Edo castle. See Donald Keene, *Emperor of Japan: Meiji and His World, 1852-1912* (New York, NY: Columbia University Press, 2002), 236.

34. Mesnier, *O Japão*, 189. Translation by the author. Original text: "Nada mais triste e monotono do que o aspecto d'estes edifícios, onde a mais uniforme regularidade não tem cousa alguma que surprehenda ou deleite a vista."

symmetric arrangement."[35] Mesnier believed that superiority in architectural matters, which came from the Greeks, was determined by the principle of symmetry. In relation to the gardens, Mesnier finds that they limit themselves to being free imitations of nature. In terms of layout, they come close to English gardens. He concludes that "they do not have the geometric regularity that was so valued by the French at the time of Le Nôtre."[36] They are, nevertheless, impressive. "The walker feels transported to an enchanted world."[37]

Mesnier's impressions reveal an understandable interest in the cities and architecture of Japan; this interest often serves to frame the more mundane episodes he relates. Traditional houses and, above all, the parks and gardens, seem to have had a particular impact on him, that was perhaps unexpected given the descriptions he was working on. Nevertheless, his gaze is that of someone convinced of the referential and civilising role of Europe in relation to the rest of the world. Mesnier´s observations are marked by a constant desire to compare to European models, in relation to which Japanese architecture always emerges as inferior. There is no openness to looking at the architecture beyond the differences that distinguish it from European architecture. And there is also no nostalgia whatsoever for traditional Japan at a time when the country was beginning to undergo transformations.

"Japanese Architecture"

"Japanese Architecture" by Viscount São Januário, published in 1878, also originated from the Portuguese diplomatic mission to Japan headed by the former in 1873[38].

Viscount São Januário's comments reflect the alienation caused by the radical difference between Japanese and Western architecture. The first gaze is one of rejection. "We are forced to recognise that Japanese architecture is much inferior in taste and grandeur to the styles that civilised peoples most cultivate and practise."[39] The diplomat's models were classical – Greek and Roman – and Gothic architecture. However, the strangeness eventually gives way to progressive recognition. "Japanese [architecture] is good, from an artistic point of view; in

35. Mesnier, *O Japão*, 196. Translation by the author. Original text: "Emfim os japonezes procuram conservar na sua arquitectura o menos que é possível de symetria, e em muitas das suas obras d'arte, parecem fugir adrede de qualquer disposição symetrica."

36. Mesnier, *O Japão*, 200. Translation by the author. Original text: "Não possuem a regularidade geometrica tão apreciada pelos francezes no tempo de Le Nôtre."

37. Mesnier, *O Japão*, 201. Translation by the author. Original text: "O passeante julga-se transportado n'um mundo encantado."

38. Viscount São Januário had amassed quite a collection of objects from Japan, as well as a few others from China, India, Ceylon, Korea, Siam and Egypt. He displayed them in his house in Lisbon. Part of the collection was auctioned off in 1877. See João Luís Cardoso, "O General Conde de S. Januário (1827-1901) Um português de excepção," *Estudos Arqueológicos de Oeiras* special issue (2018): 88, https://eao.oeiras.pt/index.php/DOC/article/view/327.

39. Visconde de São Januário, "Architectura Japoneza," 67, https://www.museuarqueologicodocarmo.pt/publicacoes/arqueologia_historia/serie_2/Tomo_II/s2_tomo_II_Bol5.pdf. Translation by the author. Original text: "somos forçados a reconhecer que a architectura japoneza é muito inferior, em gosto e em grandeza, aos generos que os povos civilisados mais cultivam e exercitam."

relation to its style and the surrounding environment, it satisfies the requirements that awaken the idea of beauty."[40] The reflection is focused on the temple of Kamakura, in the region of Yokohama, with the Viscount relying on *Le Japon Illustré*, by Humbert[41]. Viscount São Januário was struck by the magnificence and the shape of the roofs and the decoration of the buildings, as well as by the leafy presence of nature and the landscape. Japan captivated him through its picturesqueness. The buildings were like pictures framed by nature.

The First Encounter

It is difficult to assess the impact the observations on Japanese architecture made by Marques Pereira, Mesnier and Viscount São Januário had in Portuguese intellectual circles, particularly amongst architects, even when one accepts that Viscount São Januário's account was naturally divulged amongst the ranks of the profession. The poet and writer Antero de Quental (1842-1891) commented on Mesnier's book in a review published in *Revista Occidental* [Western Magazine] in 1875[42]. Quental praises the work's usefulness in understanding Japan but makes no reference to Mesnier's observations on Japanese architecture.

The observations made by Marques Pereira, Mesnier and Viscount São Januário were isolated cases in the Portuguese critical landscape of the nineteenth century. They are attributed more to the fact that all three visited Japan than to a specific interest in Japanese architecture, which at the time was non-existent in Portugal. Portuguese architecture of this period was motivated by a romantic ideal of affirmation of the national identity and found in revivalisms – the Neo-Arab and, above all the Neo-Manueline styles – its preferred form of expression.[43] Japan had nothing to do with the roots of that identify, even if it could help to revive the nineteenth century affirmation of an imperial Portugal. And they were the observations of people who were not closely involved with architecture,

40. Visconde de São Januário, "Architectura Japoneza," 68, https://www.museuarqueologicodocarmo.pt/publicacoes/arqueologia_historia/serie_2/Tomo_II/s2_tomo_II_Bol5.pdf. Translation by the author. Original text: "A architectura [japonesa] é boa, debaixo do ponto de vista artístico, quando em relação ao seu estylo e ao meio que a circunda, reúne condições que despertam a idéa do bello."

41. It is not clear which temple Viscount São Januário visited. Humbert devotes several pages to the temples at Kamakura, which he complements with images. Humbert, *Le Japon Ilustre*, 1870, 1:234-244.

42. [Antero de Quental], "O Japão: estudos e impressões de viagem, por Pedro Gastão Mesnier. Macau, Typographia mercantil," *Revista Occidental*, May 31, 1875, 254-256, http://hemerotecadigital.cm-lisboa.pt/Periodicos/AnuariodaSociedadedosArquitectosPortugueses/AnoII/AnoII_item1/index.html.

43. For further discussion on Portuguese architecture in the late nineteenth century, see Maria Helena Barreiros, "Arquitecturas do século XIX português, entre o fim do Absolutismo e a abertura da Avenida da Liberdade," in *Da expressão romântica à estética naturalista*, eds. José Luís Porfírio and Maria Helena Barreiros, vol. 15 of *Arte Portuguesa: da Pré-história ao século XX*, ed. Dalila Rodrigues (Lisbon: Fubu Editores, 2009), 99-140.

although Viscount São Januário was very much interested in heritage issues, as his pioneering visit to Angkor in Siam (now in present-day Cambodia) confirmed.[44]

The Second Portuguese Encounter with Japanese Architecture

Despite the pioneering nature of these three texts, interest in Japanese architecture in Portugal only returned in the early twentieth century. The *Annuario da Sociedade dos Architectos Portuguezes* [Yearbook of the Society of Portuguese Architects], an architecture-related magazine, even had a Japanese correspondent from 1906 to 1910, the year it ceased publication. That correspondent was Chujo Seiichiro[45] (1868-1936). The architectural firm he founded in Tokyo together with Sone Tatsuzo (1853-1937) gained prominence for adopting Western architectural models. Seiichiro was the first representative of the Institute of Japanese Architects at the Seventh International Congress of Architects, held in London in 1906[46]. Seiichiro's appointment as a correspondent was the result of contacts with the Portuguese delegation to the congress, which included José Alexandre Soares (1873-1930), the President of the Society of Portuguese Architects. It is not clear what role Seiichiro may have played within the *Annuario*.

Modern Construction

The periodical *A Construção Moderna* [Modern Construction], which was published from 1900 to 1919, featured several articles on Japan, some of which focused on the country's architecture. *Modern Construction* was the first Portuguese magazine specifically dedicated to architecture and construction. Heritage was not a particularly important issue, contrary to what was the case at the previously

44. Viscount São Januário was one of the first Europeans to visit the ruins of Angkor in what is now Cambodia, where he went in 1875. He wrote about the Angkor ruins. See Visconde de São Januário, "A Architectura Khmer – Ruinas de Angkor Wat no Reino de Cambodge (Parte 1/2)," *Boletim da Real Associação dos Architectos Civis e Archeologos Portuguezes* 1, no. 12 (1878): 67, https://www.museuarqueologicodocarmo.pt/publicacoes/arqueologia_historia/serie_2/Tomo_I/s2_tomo_I_Bol12.pdf; Visconde de São Januário, "A Architectura Khmer – Ruinas de Angkor Wat no Reino de Cambodge (Parte 2/2)," *Boletim da Real Associação dos Architectos Civis e Archeologos Portuguezes* 2, no. 2 (1878): 17-21, https://www.museuarqueologicodocarmo.pt/publicacoes/arqueologia_historia/serie_2/Tomo_II/s2_tomo_II_Bol2.pdf; Visconde de São Januário, "A Architectura Khmer – Ruinas de Angkor Wat no Reino de Cambodge (Parte III)," *Boletim da Real Associação dos Architectos Civis e Archeologos Portuguezes* 2, no. 3 (1878): 33-37, https://www.museuarqueologicodocarmo.pt/publicacoes/arqueologia_historia/serie_2/Tomo_II/s2_tomo_II_Bol3.pdf.

45. Sociedade dos Architectos Portuguezes. "Socios Honorarios e Correspondentes" (Annuario da Sociedade dos Architectos Portuguezes, 1906), s.p, http://hemerotecadigital.cm-lisboa.pt/Periodicos/AnuariodaSociedadedosArquitectosPortugueses/AnoII/AnoII_item1/index.html.

46. Royal Institute of British Architects, *International Congress of Architects: seventh session, held in London 16-21 July 1906: under the auspices of the Royal Institute of British Architects: transactions* (London: Royal Institute of British Architects, 1908), 17, https://archive.org/details/cu31924015677812.

mentioned two periodicals[47]. The magazine had as its mentors, José Mello de Mattos (1856-1915), an engineer and mathematician, and Rosendo Carvalheira (1864-1919), an architect with a Romantic spirit dedicated to the cause of Portuguese culture.

Japan was examined in a variety of ways, the first time being referenced in an article on the railway in 1900.[48] The articles looked at transport systems, mining, shipbuilding, metalworking and electricity generation, amongst other things. Most of these articles were sourced in foreign publications, reflecting a regularly updated network of contacts and publications which encompassed Spain, France, Britain, Italy and, perhaps more unexpectedly, the USA. The Japan portrayed in the *Modern Construction*'s articles was a nation undergoing a huge transformation, characterised by progress and modernisation, seeking to assert itself in the context of world powers. The technical articles, with those dedicated to the railways and mining standing out, highlighted Japanese industrial and infrastructure construction capacity. The recognition of Japan's progress served to point out the delay in development which continued to mark Portugal. The remarks that precede the introduction to the article "Trinta annos de desenvolvimento dos caminhos de ferro japonêses"[49] [Thirty Years of Japanese Railway Development], published in 1903 in three parts and translated from *Bulletin De La Commission Internationale Du Congrès Des Chemins De Fer*, [Bulletin of the International Commission of the Railroads Congress] state: "news [of this development] is of great interest, as it shows how, in countries we consider uncivilised, economic issues are being confronted that we dare not even consider."[50] Although the railways in Portugal predated those in Japan, the Japanese railway network had long since outgrown the Portuguese network.

Japanese architecture is looked at in three articles: "No Japão"[51] [In Japan], published in 1908; "As cidades arruinadas: alguns problemas de reconstrucção"[52]

47. For further discussion of the significance of magazines and periodicals in the renewal of architectural scene in Portugal, see Paulo Simões Nunes, "A cultura arquitectónica em Portugal na dobra do século XIX para o século XX: sinais da influência estrangeira nas páginas *d'A Construcção Moderna* (1900-1919)," in *Revistas de Arquitectura: Arquivo(s) da Modernidade*, ed. Marieta Dá Mesquita (Casal de Cambra: Caleidoscópio, 2011).

48. Anonymous, "Os Caminhos de Ferro no Mundo," *A Construção Moderna*, September 16, 1900, 4, http://ric.slhi.pt/A_Construcao_Moderna/visualizador/?id=11214.001.016&pag=4.

49. Anonymous, "Trinta annos de desenvolvimento dos caminhos de ferro japonêses (Parte 1/3)," *A Construção Moderna*, July 1, 1903, 128, http://ric.slhi.pt/A_Construcao_Moderna/visualizador?id=11214.004.016&pag=8; Anonymous, "Trinta annos de desenvolvimento dos caminhos de ferro japonêses (Parte 2/3)," *A Construção Moderna*, July 10, 1903, 136, http://ric.slhi.pt/A_Construcao_Moderna/visualizador?id=11214.004.017&pag=8; Anonymous, "Trinta annos de desenvolvimento dos caminhos de ferro japonêses (Parte 3/3)," *A Construção Moderna*, August 1, 1903, 151-152, http://ric.slhi.pt/A_Construcao_Moderna/visualizador?id=11214.004.017&pag=8.

50. Anonymous, "Trinta annos (Parte 1/3)," 128, http://ric.slhi.pt/ A_Construcao_Moderna/ visualizador?id=11214.004.016&pag=8. Translation by the author. Original text: "a notícia é deveras interessante para mostrar como é que em países que reputamos pouco civilizados se encaram questões económicas com que não nos atrevemos sequer a arcar."

51. Anonymous, "No Japão," *A Construção Moderna*, January 1, 1908, 135, http://ric.slhi.pt/A _Construcao_Moderna/visualizador/?id=11214.008.017&pag=7.

[Ruined Cities: Some Reconstruction Issues] written by Mello de Mattos and published in 1909; and "Arquitectura doméstica japoneza"[53] [Japanese Domestic Architecture], published in 1916 in five parts.

The first two pieces deal with technical construction questions. The first one highlights the recent appearance of a fireproof house building, called the *kura*. It was likely based on another article from outside Portugal, although that is not mentioned. One should point out that the structure of the building, whether it was made of steel or timber, was covered in several layers of damp clay, thus ensuring fire protection. The article manifests its own belatedness in relation to the issue at hand, given that the protection system was already in use in Japan for quite some time and had already been the subject of other pieces by Western writers. And the *kura* was not a new type of building, but the name given to traditional Japanese storehouses. Of greater relevance is the reference to the "invasion of European civilisation when it comes to improving building methods"[54], confirming the ongoing process of Westernisation in Japanese architecture. The second article mentions the architecture of Japan in the context of a discussion on anti-seismic construction. It is the translation to Portuguese of an article in the British periodical *The Illustrated Carpenter and Builder*, as Mello de Mattos points out.[55] It registers the Japanese choice of wooden structures reinforced with iron and resting on solid foundations, although it reaches the conclusion that the system would be inviable in European cities, as it would increase the risk of fire. Mello de Mattos notes that the wooden building system based on the triangle used in Japan, which the British magazine presents as a new development, had already been used in the reconstruction of Lisbon following the earthquake of November 1, 1755.[56]

The third article delves much deeper into Japanese architecture, and more specifically, traditional Japanese housing. The time lapse of almost 40 years between the text published by Viscount São Januário and this article confirms that practically no attention was paid to this matter. Although no reference is made to the fact, the article is an adaptation of "Japanese Domestic Interiors" by Ralph

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52. Mello de Mattos, "As cidades arruinadas: alguns problemas de reconstrucção," *A Construção Moderna*, April 1, 1909, 202-204, http://ric.slhi.pt/A_Construcao_Moderna/visualiza dor/? id=1121 4.009.026&pag=2.

53. Anonymous, "Architectura domestica japoneza (Parte 1/5)," *A Construção Moderna*, June 10, 1916, 84, http://ric.slhi.pt/A_Construcao_Moderna/visualizador/?id=11214.017.011&pag=4; Anonymous, "Architectura domestica japoneza (Parte 2/5)," *A Construção Moderna*, June 25, 1916, 92, http://ric.slhi.pt/A_Construcao_Moderna/visualizador?id=11214.017.012&pag=4; Anonymous, "Architectura domestica japoneza (Parte 3/5)," *A Construção Moderna*, July 10, 1916, 110, http://ric.slhi.pt/A_Construcao_Moderna/visualizador?id=11214.017.013&pag=4; Anonymous, "Architectura domestica japoneza (Parte 4/5)," *A Construção Moderna*, July 25, 1916, 108, http://ric.slhi.pt/A_Construcao_Moderna/visualizador?id=11214.017.014&pag=4; Anonymous, "Architectura domestica japoneza (Parte 5/5)," *A Construção Moderna*, August 10, 1916, 116, http://ric.slhi.pt/A_Construcao_Moderna/visualizador?id=11214.017.015&pag=4.

54. Anonymous, "No Japão," 135, http://ric.slhi.pt/A_Construcao_Moderna/visualizador/?id =11214.008.017&pag=7. Translation by the author. Original text: "invasão da civilização europeia no aperfeiçoamento dos methodos de construir."

55. Mello de Mattos, "As cidades arruinadas," 203, http://ric.slhi.pt/A_Construcao_Moderna/ visualizador/?id=11214.009.026&pag=2.

56. Mello de Mattos, "As cidades arruinadas," 203, http://ric.slhi.pt/A_Construcao_Moderna/ visualizador/?id=11214.009.026&pag=2.

Adams Cram[57] (1863-1942), published in the British periodical *The Architectural Review* in 1900. The author of the adaptation is unknown, but it was most likely Mello de Mattos. The adaptation does not include any of the images that accompanied the original text. Cram was an American architect who designed one of the first American houses to reveal an influence of Japanese architecture, in the late 1890s[58]. He visited Japan in 1898. Cram's article had the peculiarity of devoting itself to residential architecture, continuing the pioneering work of Edward Morse[59] (1838-1925) and his *Japanese Homes and Their Surroundings*, published in 1885. In line with Cram's text, the Portuguese adaptation praises traditional Japanese houses, noting the vitality they showed in comparison to housing designed by Western architects for the wealthier classes. The majority of these dwellings failed to adapt to the Japanese customs and environment. "This kind of construction hurts the eye, making an unpleasant impression."[60]

The article presents a detailed description of Japanese residential architecture, benefitting from the rigour of Cram's text. It lists the principles and main characteristics of Japanese houses, which always have to do with the customs of the Japanese people. And it underlines the importance of wood and the sophistication of the houses, despite their apparent simplicity. "At first sight, the construction might appear poor and sad, but in reality it is not, for each detail, form and colour is so infinitely studied, that the dwelling, still empty, is sufficient for itself."[61] Despite its criticism of the importing of foreign models, publication of the article seems to have been more motivated by the curiosity that Japanese residential architecture aroused in Portugal than by any contribution it could make to the then ongoing debate on the definition of a national style[62], which was also marked by criticism of the adoption of foreign architectural models.

The Second Encounter

The diverse Japan-related articles published in *Modern Construction* do not reflect a consolidated and widespread interest in that country; much less so in its

57. Ralph Adams Cram, "Japanese Domestic Interiors," *The Architectural Review: for the Artist & Craftsman*, January-June 1900, 9-15, https://archive.org/details/sim_architectural-review_january-june-1900_7/page/8/mode/2up. The article would later appear as one of the chapters of Cram's book *Impressions of Japanese Architecture and the Allied Arts*, published in 1905. See Ralph Adams Cram, *Impressions of Japanese Architecture and the Allied Arts* (New York: Baker & Taylor Co, 1905): 115-142, https://archive.org/details/impressionsofjap00cram/mode/2up.

58. Lancaster, *The Japanese Influence in America*, 70-71.

59. Edward S. Morse, *Japanese Homes and Their Surroundings* (New York, NY: Harper & Brothers, 1885), https://babel.hathitrust.org/cgi/pt?id=mdp.39015031800371&view=1up&seq=10.

60. Anonymous, "Architectura domestica japoneza (Parte 1/5)," 84, http://ric.slhi.pt/A_Construcao_Moderna/visualizador/?id=11214.017.011&pag=4. Translation by the author. Original text: "Este género de construção fere a vista, causando uma impressão desagradável."

61. Anonymous, "Architectura domestica japoneza (Parte 2/5)," 92, http://ric.slhi.pt/A_Construcao_Moderna/visualizador?id=11214.017.012&pag=4. Translation by the author. Original text: "Á primeira vista parecerá este conjunto pobre e triste, porém, realmente, não é assim, pois cada detalhe, forma e côr, estão tão exquisitamente estudados que a habitação, ainda vazia, basta a si mesma."

62. See Nunes, "A cultura arquitectónica em Portugal", 236.

architecture. They constitute a loose collection of materials that does not establish a line of continuity. They are, above all, connected by the idea of progress associated with Japanese society and, accordingly, the backwardness that continued to persist in Portugal. Publication of the article "Japanese Domestic Architecture", an adaptation of a text made available by *The Architectural Review*, as pointed out above, is important for the rigour of its observations and for affirming the bond between traditional Japanese residential architecture and the identity of the Japanese people and, therefore, with Japan itself. It is, however, an isolated article that makes the scarce interest in Japan and its architecture, even more evident, when one considers the fact that other articles on the subject matter existed in other magazines that were equally accessible to the publishers of *Modern Construction*, such as the British periodical *The Illustrated Carpenter and Builder* and *Architectural Review* from the USA. The absorption of Japanese architecture that was experimented with in Europe and the US, was ignored in the contents of *Modern Construction*. This explains the ridiculing tone with which a house built in California with an obvious oriental appearance is described in an article published in 1916 (Figure 5):

> we are not repelled by the idea that the owner [be he Chinese or Japanese], while now living in America, wanted a remembrance of his native country, and recommended that the architect add a little of his country's characteristics to the construction.[63]

63. Anonymous, "Arquitectura na California (Estados Unidos da America)," *A Construcção Moderna*, November 25, 1916, 172, http://ric.slhi.pt/A_Construcao_Moderna/visualizador/?id=11214.017.022&pag=4. Translation by the author. Original text: "não nos repugna a ideia que o seu proprietário [seja chinês ou japonês], embora na América, quisesse recordar o seu país natal, recomendando ao arquitecto que lhe desse um pouco da feição do seu país na construção."

172 A CONSTRUÇÃO MODERNA

ARQUITECTURA ESTRANGEIRA

A arquitectura na California

(Estados Unidos da America)

E' um outro modêlo de arquitectura californiana o que hoje publicamos.

Destôa este um pouco, exteriormente, dos que temos publicado, dando a sua forma de telhado e cobertura de alpendre, a idéa de que se trata de uma construcção chinêsa ou japonêsa, não nos repugnando a idéa de que o seu proprietario, seja de qualquer destas nacionalidades, e, embora na America, quizesse recordar o seu paiz natal, recomendando ao arquitecto que lhe désse um pouco da feição do seu país na construcção.

ESTATUA MONUMENTAL DE CIMENTO ARMADO

Erigida em Espaly, proximo de Puy (Alto-Loire)

SEM que tenhamos de nos referir ás estatuas monumentais da antiguidade, das quais existem, no emtanto, numerosos exemplos celebres (esfinges, colossos dos templos do Egito, etc.), podem-se citar outras que datam dos tempos modernos, mais interessantes pelo seu método de construcção que esses gigantescos monolitos.

Poder-se-iam aproximar a estes monumentos antigos uma grande quantidade de esboços de estatuas colossais ou de torres nas quais se adotaram figuras monumentais em alto relêvo. Nem sob o ponto de vista da construcção, nem do artistico, poderiam estas massas de pedra talhada, algumas vezes aperias desbastadas, qualificar-se de estatuas monumentais.

Recordaremos aqui algumas das mais conhecidas:

1.ª A estatua de Buda de Nara, no Japão, executada por Rochana, em 740. E' de bronze e tem 16m,20 de altura.

2.ª Outra estatua em bronze, de Buda, tambem no Japão, a de Kamakura. Tem 15m,20 de altura e foi executada em 1252 por Ono Goroemon.

3.ª A estatua de S. Carlos Borromeu, em Arona, que desde 1697 domina o Lago Mayor do alto da colina onde se eleva sobre um pedestal de 12 metros; a sua altura propria é de 22 metros e é constituida por um macisso interior de alvenaria, no qual estão fixas umas armaduras de ferro que sustentam a envolvente de cobre forjado, principalmente o braço direito.

(*Continúa*).

SIhi

Figure 5. *Article "A Arquitectura na California (Estados Unidos da America)" Published in "A Construcção Moderna" in November 25, 1916.*
Source: © http://ric.slhi.pt/.

A Disencounter – Final Considerations

The reception given to Japanese architecture in Portugal in the period between Japan's opening to the West and the 1920s was very restricted, superficial, inconsistent and inconsequential. In the first encounter, which took place in the 1860s and 1870s and was a result of Portuguese diplomatic missions to Edo, understanding Japan was always marked by the omnipresence of European models, in relation to which Japanese architecture was considered inferior. Even so, said understanding had the peculiarity of being based, at least in part, on direct contact with the architecture of Japan, with this fact being reflected in the astonishment at Japanese residential architecture and the genuineness of the assessment thereof. In the second encounter, in the 1910s and 1920s, comprehension of Japan is marked by an interest in its development, much in line with the recognition of the backwardness of Portugal. The information on Japanese architecture was sourced from foreign publications, as very little

relevance was given to the subject matter in the Portuguese publishing scene. The publication of the adaptation of a foreign article on Japanese residential architecture in Japan is not enough proof of a widespread interest in the subject matter, even though it did confirm the fascination in the West for said architecture. The Far Eastern flavour noticeable in some Portuguese architecture from late nineteenth and early twentieth centuries does not mean that the architectural culture of the time had internalised or even consciously contemplated the values of Japanese architecture, even if said values were accessible and provoked a certain amount of fascination in the artistic culture of Portugal.

Eduardo Lourenço Throughout this whole period, Portugal was coming to terms with its own identity, while registering the profound time-lag that the country had in relation to the industrialised West, of which it was a part. The first reflections on a Japan that only shortly before had re-opened to the West focused on a country that was backward and primitive, even if certain aspects of it were surprising. Compared to Japan, Portugal saw itself as superior. Four decades later, the second wave of reflections gave an inkling of the Portuguese discontent with the progress Japan was showing. Any direct comparison with Japan now highlighted Portuguese weakness. The inability to understand the modern values of *Japonisme*, as revealed by José-Augusto França in his critique of how António Ramalho painted Abel Botelho[64] was also typical of Portuguese architecture.

(1923-2020) was a philosopher who dealt with the Portuguese identity in his work. His synthesis of the encounter between nineteenth-century Portugal and Japan clarifies the impossibility of the Portuguese cultural scene fully understanding Japanese architecture. It was, in the end, modernity itself that Portuguese architecture showed itself to be incapable of understanding. Lourenço writes:

> [a] Portugal timidly open to industrialisation and open, a little, as if we were the Japan of Europe, at the same time violated by *Uncle Sam* without him giving it a second thought [...] sees itself at a pinnacle confounded with a cultural avalanche which it can by no means deal with in terms that are, shall we say, acceptable.[65]

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64. França, *A Arte em Portugal no Século XIX*, 2: 104.

65. Eduardo Lourenço, *O labirinto da saudade*, 6th ed. (Lisbon: Gradiva, 2009), 90. Translation by the author. Original text: "Um Portugal timidamente aberto à industrialização e aberto um pouco como se fôssemos o Japão da Europa no mesmo momento violado sem contemplações pelo *Uncle Sam* [...] vê-se num ápice confundido com uma avalancha cultural que de modo algum pode digerir em termos, digamos, aceitáveis."

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Innovative Building Technologies for Sustainable Architecture in Heritage Sites: Detailed Design of Two Full-scale Prototypes in the Ancient Greek Colony of Megara Hyblaea in Sicily

By Vincenzo Sapienza[*], *Gianluca Rodonò*[±], *Simona Calvagna*[°], *Lorenzo Guzzardi*[•] *& Marianna Figuera*[♦]

The present research shows some results obtained by the PON project entitled "An early warning system for cultural heritage / EWAS". In this national funded project, Sicilian research institutions, universities and companies work together with the common goal of developing new technologies for the protection and enhancement of historical and cultural heritage and also aim to improve its strategic management and protect it from risks. With a view to pursuing the primary objectives of the EWAS project, it was planned to realize two full-scale prototypes. The first one is a lightweight shelter, the second one is a micro-architecture for facilities. They are able to reduce the environmental impact, they are responsive and they are designed to protect the sensitive areas of the excavations and at the same time to facilitate the use of the archaeological site. In order to test these prototypes, the archaeological area of Megara Hyblaea has been chosen, the most ancient Greek colony in Sicily. It is immersed in an industrial landscape that stretches along the coast of eastern Sicily from Augusta to Syracuse. The sense of the original place has been erased by an indiscriminate occupation of the land by industries which has left, here and there, an archipelago of "heritage relics" of various kinds, which are equally close to the smelly chimneys and the horizon of the sea. This landscape of contrasts, dominated by petrochemical industries, has over time hindered a cultural tourism appropriate to the representativeness and importance of the findings, despite the efforts made by the authorities responsible for its protection.

Introduction

The EWAS (an Early WArning System for cultural heritage) project aims to promote and stimulate a policy of protection from degradation and prevention at the level of historic settlements which are conceived, in their morphological and functional whole, as a vital component of urban centers in line with the strategies defined by the recent UNESCO (United Nations Educational, Scientific and

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Cultural Organization) Recommendation on "Historic Urban Landscape" and "urban conservation".[1]

Environmental Safety and Structural Safety are among the essential requirements that historic settlements and historic buildings, containers of cultural assets and activities, must ensure for their protection and preservation. However, meeting these needs, it takes a combination of different knowledge and techniques that pose a number of significant technological challenges.

Therefore, the aim of the EWAS project is to obtain an innovative platform for the monitoring of cultural heritage based on the latest technological solutions, capable of fast and on-demand diagnostics following critical situations through the implementation of a continuous monitoring system over time, multisensory, multi-scale (control of the structure and surrounding area and detailed diagnostics), multiresolution, with low or no invasiveness on monuments and surrounding areas. This is achieved through advanced systems based on wireless networks and sensors supported by the most modern diagnostic methodologies, allowing to produce in a Smart City actions on issues related to natural and man-made hazards and to security (Smart Environment and Smart Living) for the protection and the valorization of cultural heritage at the urban scale.[2]

In order to pursue these objectives, the project makes use of the following studies, investigations, technological and industrial developments and technical tools.

1) Evaluation and diagnosis of the state of deterioration and safety (danger, vulnerability and risk) of heritage buildings and artifacts in archaeological test-site areas.
2) Development, realization and production of a new low-cost Smart Wireless urban environmental monitoring system and of a telecommunication network realized ad hoc for the continuous and multiparametric environmental control of structures and artifacts.
3) Verifications and evaluations on vibrating table of the characteristics and performances of the devices that will be used for the SHM (Structural Health Monitoring).
4) Installation at the selected test sites of an innovative wireless hybrid monitoring system (static and dynamic) with the purpose of verification of structural safety (SHM) and identification of crisis conditions such as to generate preventive alarms.
5) Installation in the selected study cases of a prototype of a low cost Smart, deformation and seismic-accelerometric monitoring network, integrated with a satellite monitoring system.
6) Design and implementation of a continuous monitoring system on a limited number of museum objects (statues, works of art of high cultural value).

1. The UNESCO Recommendation on the Historic Urban Landscape. Report of the Second Consultation on its Implementation by Member States, 2019, UNESCO World Heritage Centre. Available at: https://whc.unesco.org/en/hul/

2. Available at: https://www.ewas.eu/en/home-english.

7) Design of an innovative protection system for findings in archaeological areas, consisting of a lightweight shelter controlled by a sensor network.
8) Design of an innovative system for the enhancement of archaeological sites, based on a multifunctional and sustainable architectural module for the reception of visitors and the support to the visit of the site.
9) Realization of a prototype "Early Warning" system for the mitigation of environmental risks.
10) Realization of an information system, based on GIS (Geographic Information System) logic, which will contain the geometries and all the data acquired during the project.

EWAS has important implications in the enhancement of the cultural heritage of historical centers, especially those falling within the UNESCO heritage. In fact, the project aims to strengthen the specific skills in an approach of "structured collaboration" on issues of protection, security and enhancement of historical buildings. Moreover, the definition of standards, methodologies and tools for data acquisition, analysis and sharing favors the optimization of building interventions of redevelopment, restoration and renovation.

As to the protection and the support of archaeological areas, the traditional systems are invasive and not very flexible. In order to respond to these problems, EWAS plans to experiment with innovative architectural components that are highly performing thanks to their integration with a monitoring system. The aim is to reduce the disturbance on the site and to adapt the behavior of the components to the needs of users. For this goal, the area of Megara Hyblaea has been chosen as test-site for studies and technological developments of the lightweight shelter (objective 7) and of a multifunctional and sustainable architectural module to support the visit of the site (objective 8).

In this paper, the authors will show part of the result of this study. For the valorisation of the areas, EWAS proposes an innovative architectural module, called Experience Pavilion (EP) and developed as a prototype of the experimental technology called ICARO (Innovative Cardboard Architectural Object). For the protection of the archaeological findings, EWAS develops a kinetic responsive envelope, based on the origami art, called KREO (Kinetic Responsive Envelope by Origami). Both of them will be prototyped in full-scale and tested in the archaeological site of Megara Hyblaea, one of the most important of the southern part of Italy.

State of the Art: Value of Archaeological Sites and Project Issues

The enhancement of an archaeological area responds, according with Militello, to the following needs:[3]

3. P. M. Militello, "Archaeologists and Archaeological Cover," in M. Vanore (ed.), *Archaeology's Places and Contemporary Uses*, 49-65 (Venezia: IUAV, 2010).

- the preservation of the material remains;
- the arrangement of the site for users;
- the valorisation and promotion of the site.

The realization of a protective shelter for archaeological findings is often one of the main responses to the first requirement.[4] This element is, in some cases, necessary for the protection from material decay, due to weathering.

The use of a removable shelter could solve the problem of invasiveness that protective shelters made in the past have often shown. In some cases, they can also be harmful, profoundly altering the visual spatial perception of places.[5]

To realize this kind of shelter, in the EWAS project it has been decided to create an easily controllable material, such as a sheet of paper. It could be easily moved by folding it. The fold would also make the surface corrugated, giving it an extra strength by shape.[6]

The valorisation of the site could be achieved by introducing in it some architectural multipurpose modules, which can useful to illustrate the site and to introduce other facilities for the visitors (i.e., ticket office, kids laboratory, coffee-corner, multimedia information boxes, etc.). In the traditional layout of the sites, these services are concentrated in one point, generally near the entrance. The use of this innovative modules, make possible to spread them in the area and introduce a new concept of visit, in which the visitors are accompanied along their walk.

There are several examples in which this approach has led to very appreciated solutions.[7] Generally, the modules are less invasive and easily removable.

The layout design must be driven by a reconfiguration of the area. The final goal is to improve the comfort of the places for touristic purposes and to facilitate the interpretation of the remains by users (through the creation of new spatiality, paths, lighting and so on). In the lack of this step, the introduction of architectonic elements could be a risk, because it could introduce a relevant disturbance in the site.

This is not the case if the architectural design is put in tension with a landscape approach. As Jean Nouvel recently stated in his *Manifesto* inaugurating his year as guest editor of the historic Italian journal *Domus*, architecture has to foster characterisation and belonging, bearing in mind the depth of recollection, the milestone of the time, the geography, the natural landscape, the materialisation of responses to the climate.[8] In resonance with this approach, architectural

4. Z. Aslan, S. Court, J. M. Teutonico, and J. Thompson, *Protective Shelters for Archaeological Sites: Proceedings of a Symposium, Herculaneum, Italy, 23-27 September 2013* (Roma: The British School at Rome, 2018).

5. G. Rizzi, "Considerations on Archaeological Shelters: A Practitioner's Viewpoint," in Z. Aslan, S. Court, J. M.Teutonico, and J. Thompson (eds.), *Protective Shelters for Archaeological Sites: Proceedings of a Symposium, Herculaneum, Italy, 23-27 September 2013 – Roma* (The British School at Rome, 2018).

6. V. Sapienza, and G. Rodonò, "Architecture and Foldable Surface," *Athens Journal of Architecture* 2 (2016): 223-236.

7. V. P. Bagnato, *Nuovi interventi sul patrimonio archeologico* (Universidad Politécnica de Cataluña, 2013); M. Vaudetti, V. Minucciani, and S. Canepa, *The Archaeological Musealization* (Italy: Umberto Allemandi & C., 2012).

8. J. Nouvel, "Spirit, Are you There?" *Domus* 1063 (2021): supplement.

interventions was conceived in relation to topographical aspects (relationship between ruins and landscape) and visual aspects (relationship between the aesthetics of the ruins and the morphology of the landscape), and not only to the control of the architectural elements themselves.[9]

So, the architectural project was carried out in parallel with an inter-scale strategic landscape design, inspired by the principles of European Landscape Convention[10] and the idea of *territorial heritage* developed in the research of the Italian *Scuola Territorialista* founded by Alberto Magnaghi.[11]

From the technological point of view, some important measures can be put in relation whit this cultural posture, even at the design level of the individual building, to reduce the impact not only on archaeological assets but also on the general environmental context. The main ones are as follows:

- use building materials with high levels of environmental sustainability;
- use building components that can be dry-assembled;
- use of lightweight structure, without foundations.

Starting from these considerations, have been designed two mentioned innovative technologies, that will be discussed in the following.

Research Methodology

Responsive Shelter

In recent time, the use of the so-called textile architecture[12] or fabric structure[13] has improved. Generally, the base material is a composite with a reinforcement in natural or synthetic woven and the matrix is a polymeric material that increase mechanical properties and durability, as shown by Houtman.[14]

By folding the composite, it is possible to strength it, thanks to the form resistance.[15] It is also possible to move the sheet, because each fold is a hinge. This configuration can be achieved through a thermoforming process using a mould with the assigned pattern. So, the folded composite material could be used to realize a lightweight kinematic shelter (Figure 1).

9. S. Calvagna, P. M. Militello, F. A. Reale, G. Rodonò, and A. Tornabene, "From the Landscape of Contrasts to the Landscape of Invisible Cities: A Strategic Landscape Design for the Revitalization of the Ancient Greek Colony of Megara Hyblaea in Sicily," *Athens Journal of Architecture* 8 (2022): 1-33.

10. Council of Europe, *European Landscape Convention* (2000).

11. A. Magnaghi, *Il progetto locale. Verso la coscienza di luogo* (Torino: Bollati Boringhieri, 2010).

12. B. Maurin, and R. Motro. "Textile Architecture," in R. Motro (ed.), *Flexible Compososite Matererials in Architecture Construction and Interior*s, 26-38 (Germany: Birkhauser, 2013).

13. J. Llorens, *Fabric Structures in Architecture* (England: Elsevier, 2015).

14. R. Houtman, "Materials Used for Architectural Fabric Structures," In J. Llorens (ed.), *Fabric Structures in Architecture*, 101-121 (England: Elsevier, 2015).

15. A. S. Muljadinata, and S. Darmawan, "Redefining Folded Plate Structure as a Form-resistant Structure," *Journal of Engineering and Applied Sciences* 11 (2016): 4782-4792.

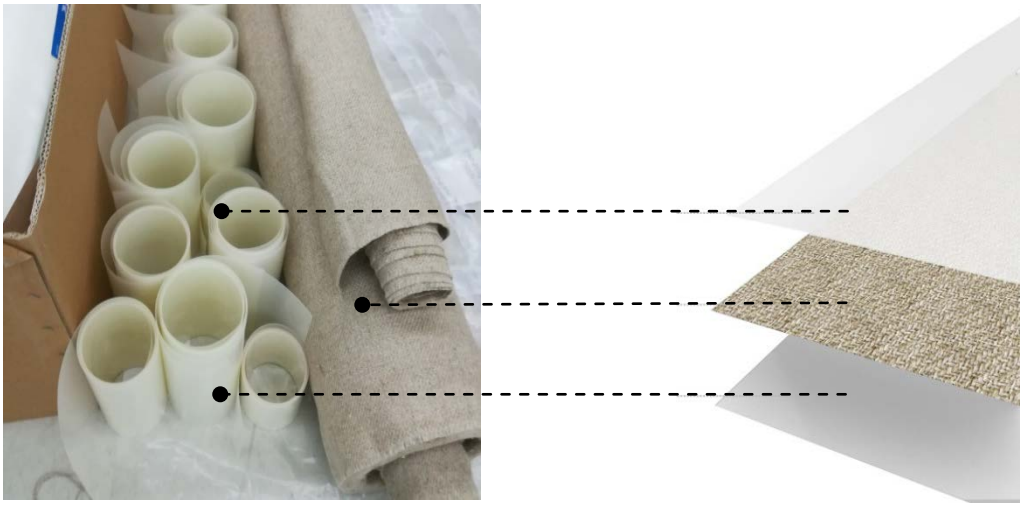


Figure 1. *Composed Material Used for EWAS Project*

The EWAS project has been focussed on the optimization of this innovative material, i.e., choice of the raw materials, stratification, mechanical characterization and post-production thermoforming process[16] (Figure 2). Through the numeric modelling, it has been fixed a suitable workflow to optimize the physical parameters of the shelter.[17]

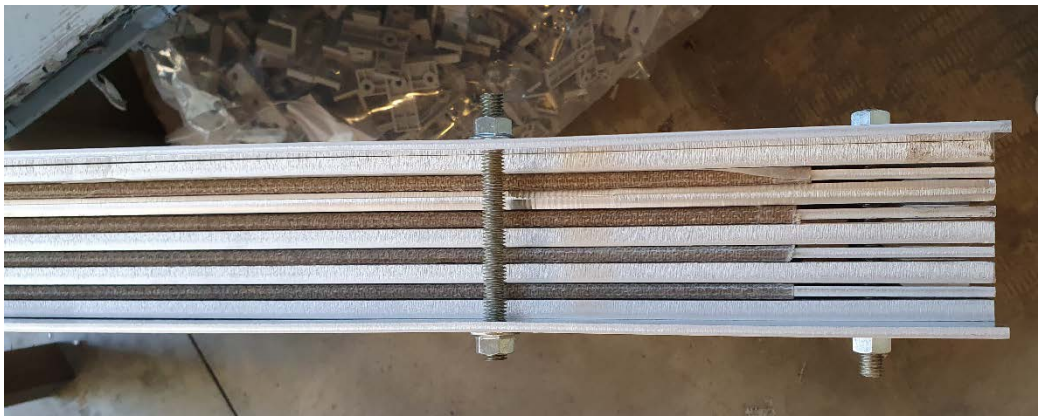


Figure 2. *Post-production Thermoforming Process*

The design of the shelter is based on the analysis of the folding geometries, for which the reference is the Japanese art of Origami and the folding patterns already used in the engineering and architectural field, as discussed by Casale and

16. A. Astuti, F. Giusa, A. Monteleone, G. Rodonò, V. Sapienza, and M. Voica, *Componenti innovativi per involucri architettonici smart* (Catania – Italy: New Horizons for Sustainable Architecture - Colloqui.AT.e 2020, 2020); V. Sapienza, and G. Rodonò, "KREO - Kinetic Responsive Envelope by Origami," *TEMA* 2 (2016): 42-52.

17. G. Rodonò, E. Naboni, V. Sapienza, F. Cucchi, and G. Macrelli, "Simulation Workflow for Parametric Optimization of Outdoor Comfort-based Origami Shelter," *Journal of Architectural Engineering* 26 (2020).

Valenti.[18] For this reason, the authors called the experimented technology KREO; in fact, in this acronym the "O" represents the word origami.

To test this innovative technology, it has been developed a full-scale prototyping phase. Before this, it has been realized a virtual model to analyse the thermophysic and the mechanical behaviour. The simulations have been addressed to several focus, i.e., to define of a mechanical system to move the folded sheet and to automatize the prototype, with a suitable script. The full-scale testing phase will be also finalized to fix the climatic parameters for the opening and the closing of the shelter.

Multipurpose Architectural Module: The Experience Pavillion

According to the project requirements, the building materials for the construction of the architectural module must have the following features: easy availability, low economic price, lightness, low environmental impact. They must also come from recycled and recyclable raw materials. Moreover, in order to reduce the activity in the building site, and so the risks for the archaeological finds, prefabrication has been adopted as the main construction technology, by focusing on the realization of a modular panel for the vertical building envelope. According to these purposes, it has been chosen multilayer fir wood and corrugated cardboard as building materials. The first one is used to realize the frame of the modular panel; corrugated cardboard is arranged in box shape to infill space between the frame components. In this way the panel assumes both the role of structural element to support the roof and the role of main component of the envelope, which is then completed with a second outer skin. To increase the panel's structural performance, a pre-stress procedure is adopted. So, the cardboard boxes are not only complementary elements, but their presence makes stronger the panel. This innovative technology is called ICARO.

The gap inside the boxes can be fill in different materials to improve the thermo-acoustic comfort.[19] The panel is completed with a ventilated façade, to improve the indoor comfort conditions and also to improve the protection of the cardboard from the rainwater. A number of materials has been tested as finishing, both for their technological features and their compatibility with the high assets value of the context. *Shou Sugi Ban* wood (burned wood) has been chosen for its high durability[20] and visual and sensory qualities. The southern façade will be used to fix a set of photovoltaic cells to assure the off-grid operation of the module. They have been embodied in a composite fabric, the same tested in KREO, to have lightness and flexibility and to mitigate the visual impact by removing the reflective effect of ordinary photovoltaic panels.

18. A. Casale, and G. M. Valenti, *Architettura delle superfici piegate: Le geometrie che muovono gli origami* (Italy: Kappa, 2013).

19. D. L. Distefano, A. Gagliano, E. Naboni, V. Sapienza, and N. Timpanaro, "Thermophysical Characterization of a Cardboard Emergency Kit-house," *Mathematical Modelling of Engineering Problems* 5 (2018).

20. T. Kilian, "Shou-Sugi-Ban," *Wood Des. Build*. 66 (2014): 42-44.

The base of the module is a grating in steel element. They are settled with telescopic legs, in plastic material, to arrange the horizontal layout; a sheet of nunwoven fabric has been set below, as interposition with the archaeological ground.

The prototyping of ICARO technology has been carried out in two phases.

In the first one, some panels have been realized, in reduced scale, with different modality of pre-stress. By analyzing them, the best solution has been chosen and it has been realized a full-scale panel. This is called Panel Zero.

In the second phase of the research, the suitable number of panels and the other elements will be the realized, in order to build the full-scale architectural module, called Experience Pavillion (EP) in the test-site. The test phase will conclude the experimentation.

Valorisation Project of the Archaeological Site

The archaeological site of Megara Hyblaea has been chosen as test-site for the testing phase of ICARO and KREO, for a series of conditions that make it suitabole for this aim.

Megara Hyblaea is one of the sites the highest historical and archaeological significance in Sicily. A part from the oldest traces of an entrenched Neolithic village, in it the remains of a Greek colony dating back to the 8^{th}-7^{th} century BC (founded in the 727 BC from colonists coming from Megara Nisea) are conserved. The city of Archaic period (end 8^{th} - early 5^{th} century BC) and that of smaller dimensions of Hellenistic period (end of 4^{th}-3^{th} century BC) are then superimposed on it. After its final destruction in 214 BC, at the hands of the Romans, the city was not rebuilt. For these characteristics is therefore configured as one of the most important centers of Sicily and Southern Italy.[21]

In spite of this, Megara is practically neglected by tourist routes. The reason of this, perhaps stays in the location of the site, that is very closed with the industrial complex of Augusta-Priolo, from whose expansion it was saved thanks to the intercession of the Superintendence in the early 1960s.

The architectural and technological project has been framed in a wide-ranging and inter-scalar strategic landscape design. Starting with the analysis of the landscape features of the site, the purpose was to rediscover a new narrative centered on the system of local values, as to put the experimentation of innovative construction technologies in harmony with the archaeological landscape.

The Strategic Landscape Design process was intertwined with a dialogue with stakeholders (local authorities, superintendence, association of the touristic guides, cultural associations, associations for the environmental protection, and so on), in order to understand if the local community identifies with its territorial

21. M. Gras, H. Tréziny, and H. Broise, *Megara Hyblaea 5, Le ville archaïque. L'espace urbain d'une cité grecque de Sicile orientale* (Roma: École Française de Rome, 2004); M. Gras, "La colonizzazione greca e la Sicilia, Megara Hyblaea e la nascita dell'urbanistica in Sicilia orientale," in C. Ciurcina (ed.), *La colonizzazione greca la fondazione di Siracusa e sviluppo della città antica* (Regione Siciliana, 2006).

heritage,[22] and re-weave a network of physical and immaterial relations between archaeological heritage, place and community.

After this phase, it has been defined a masterplan of the site, in order to define:

- the new viability, both pedestrian and vehicular;
- the most fragile areas, to protect them with the responsive shelters;
- the most sensible areas, to equip them with multipurpose architectural module.

Discussion and Results

The Test-site of Megara

Megara Hyblaea was a prosperous city, especially in the Archaic period, and was full of rich monuments. Mostly of them are located near the large *Agora*, in which the main axes of the city cross each other. A *Stoa* closes the north side of the *Agora*. In the north west corner, there was the *Heeron* (a sacred area). The *Zeus Temple* was along the north side, it remains several entablatures and other decorated elements of it; in the south part of the city it was the *Prytaneum*, a public building for the distinguished guests. The *South Temple* of the Archaic period had a central line of columns, in Doric style; it is overlapped by the Hellenistic structures. Near the corner south west there is a *Hellenistic Bath*, which is very unusual for its circular plan. A part of these monuments, there are many other interesting buildings, as the *House 13,22* (Figure 3), which its marvelous pavement in *opus signinum* (mosaic), or the *Metal Workshop.*[23] Due to the subsequent destruction, it survives only foundations and masonry bases of mostly of them (Figure 4).

22. A. Magnaghi, *Il progetto locale. Verso la coscienza di luogo* (Torino: Bollati Boringhieri, 2010).

23. G. Vallet, F. Villard, and P. Auberson. *Mégara Hyblaea 3. Guide des fouilles* (Italy: Ecole Française De Rome, 1983).

Figure 3. *The House 13,22 Pavement*

Figure 4. *The Metal Workshop Foundation*

To set the prototypes of ICARO and of KREO, a new layout of the site has been designed (Figure 5). In it, the entrance of the archaeological area is located near the west gate of the Archaic city. So, the visitors have the opportunity of a walk troughs the large area surrounding the historical city in which it will be recovered the autochthonous agricultural crops. Through this path people reach up to the coast line. Here there is the *Faro Cantera*, a lighthouse, and a *masseria*, that is partly nineteenth-century but the building of the *baglio* dates from the eighteenth century. The first one is a guesthouse for the archaeologists, the second one is the *Antiquarium*. The new gate is just outside the archaeological area, thanks to this, it is possible to realize there a parking and other facilities. The current entrance of the site, maintains its functionality only for the workers and for people with disabilities.

Figure 5. *The Layout of the Archaeological Site*

When the path arrives in the ancient city, it is overlapped on its main axes, west-east; it crosses the second axes of the city, with north-south direction, in the *Agora*. They are highlighted with an elevated walkway and form the main visit route. Along these two axes some protection and valorization structures are dislocated.

There are three protection shelters:

A. on the area on the *North Temple*;
B. on the *Hellenistic Bath*;
C. on the *House 13,22*.

There are also nine multipurpose architectonic modules, three in strategical paths point and seven located as following:

1. near the touristic entrance;
2. near the *North Temple*;
3. near the *Heeron*;
4. near the *Metal Workshop*;
5. near the *Hellenistic Bath*;
6. between the *Prytaneum* and the *South Temple*.

The project EWAS finances the realization of the responsive shelter C (on the House 13,22 - Figure 6) and the module number 6 (between the *Prytaneum* and the *South Temple* - Figure 5 b) named Experience Pavilion (EP), as already said (Figure 7).

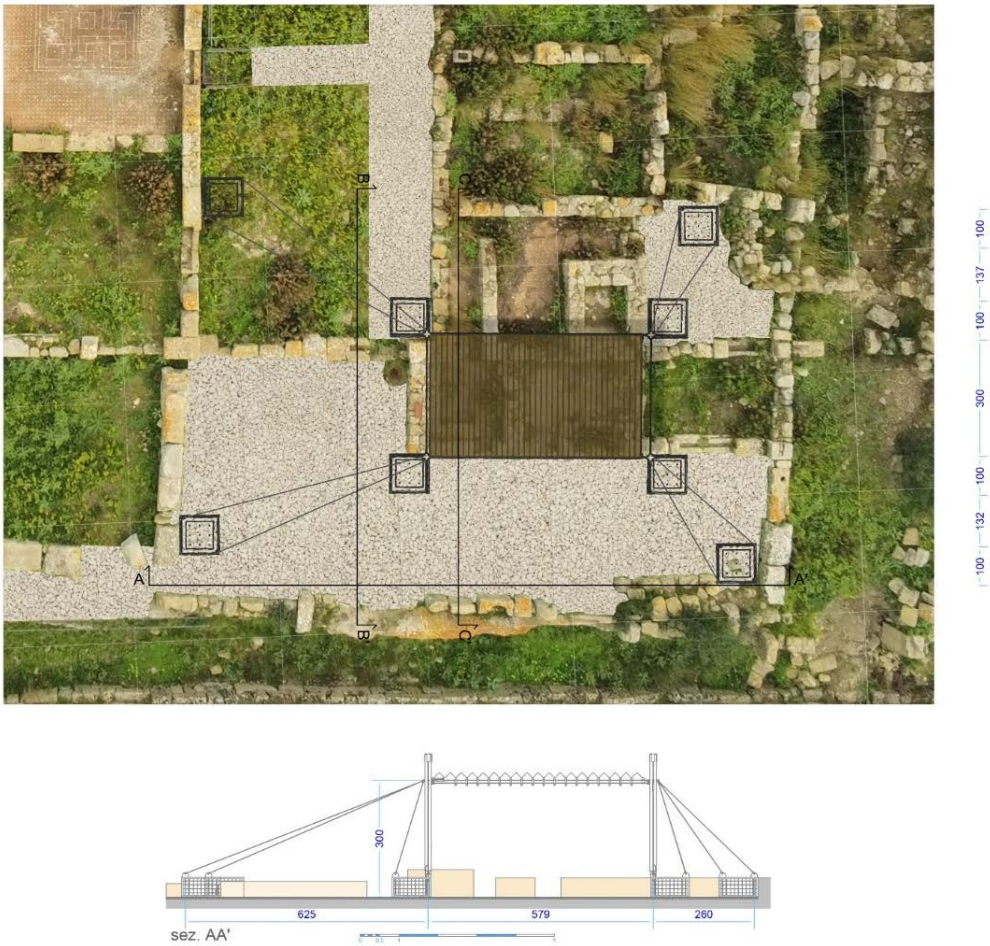


Figure 6. *Responsive Shelter C on the House 13,22*

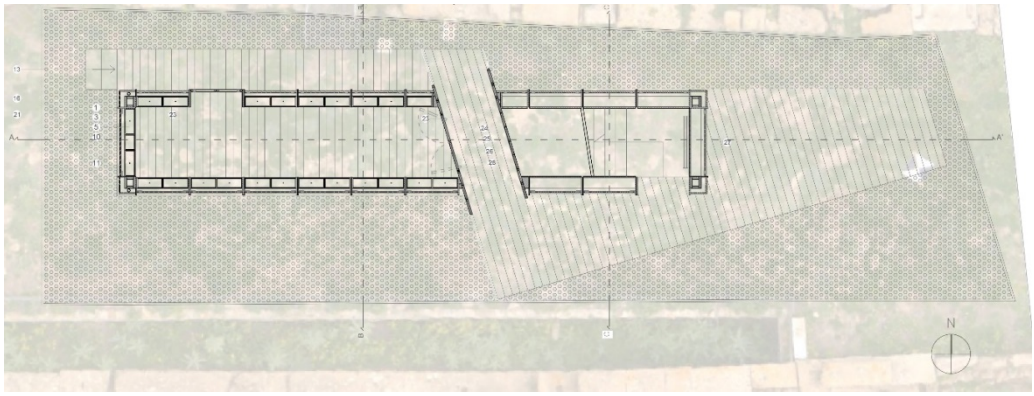


Figure 7. *Plan of the Module Number 6 (EP)*

Design of the Responsive Shelter Prototype KREO

In order to test KREO technology a full-scale prototype has been realized, which measures 4.00 × 5.00 m (Figure 8). The loadbearing structure is in steel and it is made up by four cruciform pillars (Figure 9). The concept of the design is to reduce the disturbance in the site. To get this achievement, the structure is lack of beams and foundations.

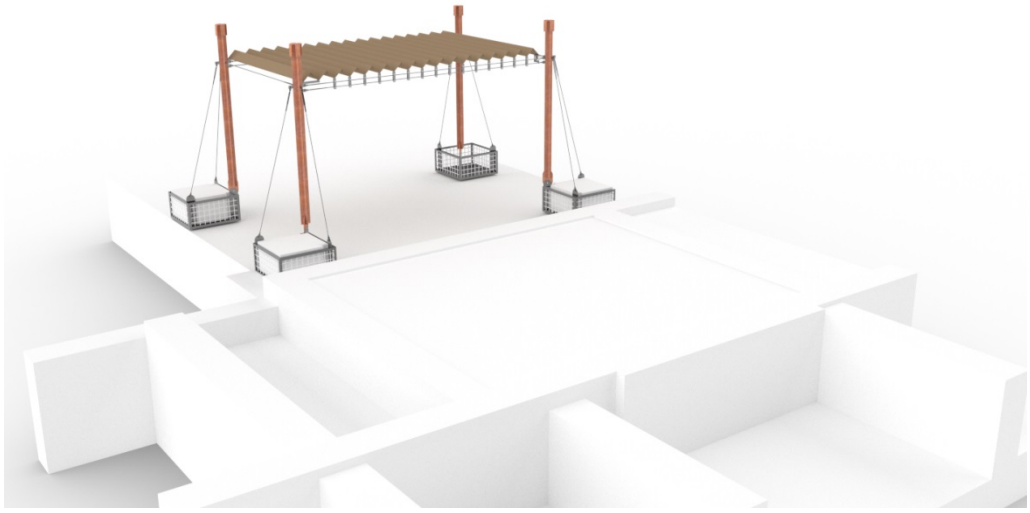


Figure 8. *The Model of KREO Shelter*

Figure 9. *The Cruciform Pillar*

The pillars are connected at the top by a series of steel tie rods. The horizontal ones are used for the movement of the covering surface, using a trolley system with triple pulleys (Figure 10). Trolleys are able to slide in both directions, allowing to open and close the shelter.

Figure 10. *The Connection Between Pillar and Steel Tie Rods*

At the base of each pillar there is a welded mesh boxes that is full of concrete bricks, to form a ballast to stabilize the pillar (Figure 11). Other six ballasts, with similar shape, are located in the corners, along the diagonals of the shelter, to get the necessary weight for the stability. In this way, it is not necessary to provide foundations and so it avoids excavation works or other invasive actions on the archaeological site. To link the pillars to the ballast boxes, stay steel cables are used.

Figure 11. *The Connection Between Pillar and the Welded Mesh Box*

The shelter has been designed as a flexible, componible building component. It is flexible because it is suitable for many uses and many types of sites. It is componible because, by replicating it, you can cover large area with very low invasiveness.

The realization of the prototype of the shelter KREO has shown several criticalities. They will be correct in view of the realization in the site.

The steel structure has two functions: on one hand it is the load bearing structure, on the other hand, it is the guide for trolleys. It means that in the assembling it is necessary the perfect alignment of the pillars to allow the sliding of the trolleys. It is also necessary to control the mid-span deflection for the movement of the pulleys. So, the ballast boxes must be improved. According with the high dimensions, the foldable material must be stiffened and strong stucked to the trolley.

The composite material for the covering surface is formed with the following stratification (from the top to the bottom): EVA (Ethylene Vinyl Acetate), PTF

(polyvinyl fluorideused as back sheet), EVA, Biotex Flax and EVA. The flax tissue is the reinforcement; the back sheet improves the rigidity of the material; the EVA is the matrix and it sticks the various layers. The folds are obtained with a secondary working process of thermoforming. The chosen folding pattern consists in an accordion with rectangular tassels. Thanks to its simplicity, the mold consists in plates of aluminum. In the first step the composite is stratified; all components are arranged in flat in a laminator, in the correct order. In the second step the composite is folded; the semi-finished product is wrapped around the plates and tight and put in an oven for fifteen minutes, at 120°.

The control system of the shelter is still under development. It will be realized by a series of sensors (for rain, wind, solar radiation and so on) connected with Arduino. According with the climatic conditions, the control system will open the shelter, making it smart. The engines are equipped with encoders and a limit switch sensor will allow the automatic shutdown of the system.

Design of the Multipurpose Module Prototype EP Whit ICARO Technology

The Panel Zero of ICARO technology (Figure 12) is formed by ten modules and it is 2.80 m high, 1 m large ad 0.30 m deep. It has been realized by using the following materials:

- the triple wave cardboard, type of the "Cartonificio Fiorentino" (called Euro 22-24/14);
- spruce laminated panel, 20 mm tick, technical class SWP/2 S L3

Figure 12. *The Panel Zero of ICARO Technology*

The finishing is realized by five panels of composite material, supported by a wooden frame. They realize a sort of ventilated façade, thanks to the air gap between them and the cardboard.

The pre-stress system is realized by using two threaded rods that run median in the boxes. They are tightened at the ends with bolts. The type of carboard has been chosen according to its strengthening. The double-wave one has a not sufficient strengthen and it tends to collapse during the pre-stress. so, the triple-wave one is more preferable, even if it has higher costs.

After the construction of Panel Zero the design of the multipurpose module EP has been defined in detail.

EP is a mini-architecture located within the archaeological excavation site. It aims to allow a deeper reading of the remains. Its shape is generated by the projections of the footprints of some representative buildings along the main routes of the ancient colony.[24]

EP is a parallelepiped 12.00 m long, 2.00 m wide and 4.50 m high. It has two doors, to make easy a linear flow of visitors, from one part to the other one and it has two levels. The ground floor is a closed rectangular space where informative materials about the place's monument is displayed. Two doors are located near both of the shorter sides, to make easy a linear flow of visitors, from one side to the other one. The upper floor of EP is a terrace that is accessible with an external stair, to have a panoramic view of the archaeological site (Figure 13).

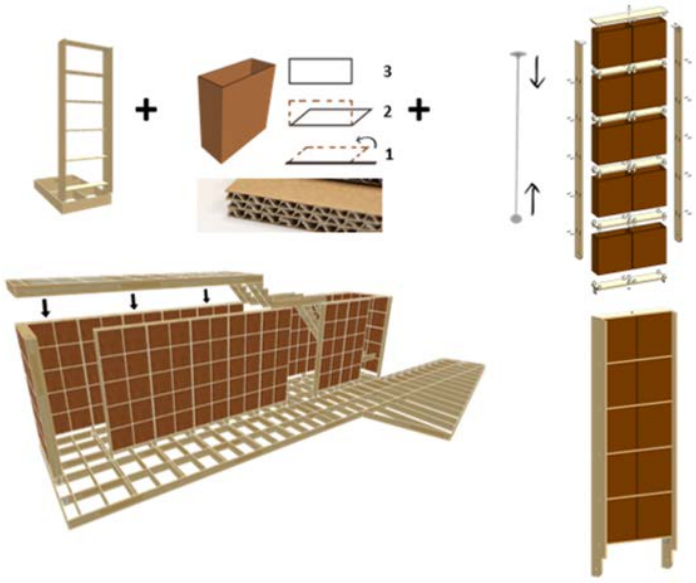
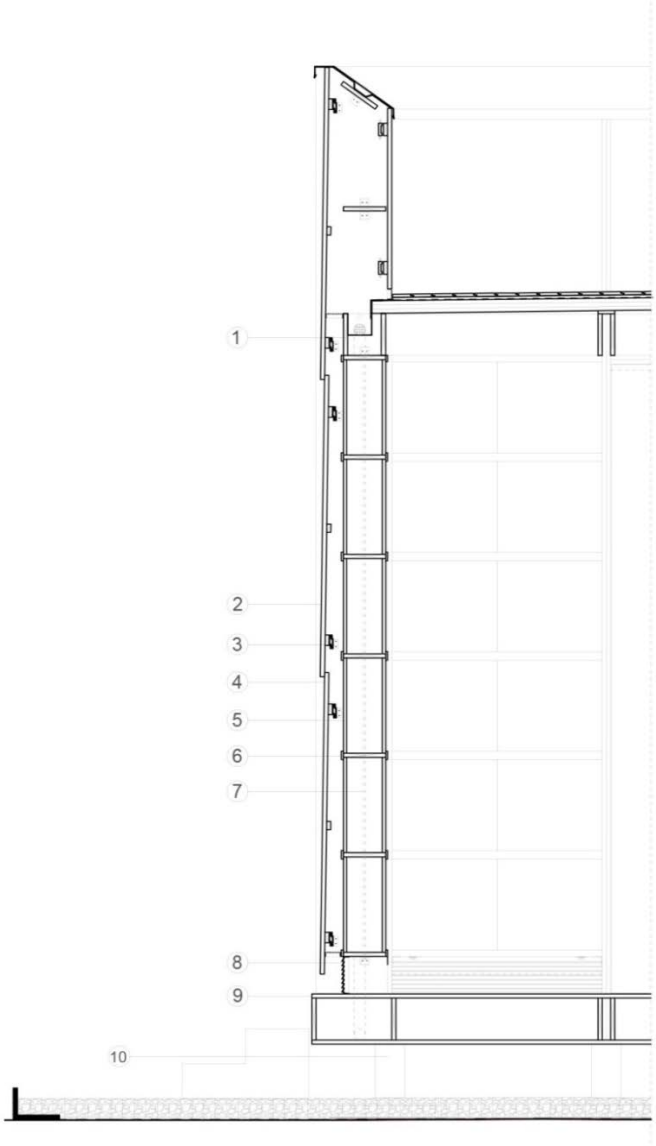


Figure 13. *The Model of ICARO Pavilion*

Considering the feedback of the structural analysis, 42 mm thick wooden elements were adopted. The depth of the wooden uprights is 40 cm, while the

24. For further details about the architectural project see the already mentioned article: Calvagna, Militello, Reale, Rodonò, and Tornabene, "From the landscape of contrasts to the landscape of invisible cities: a strategic landscape design for the revitalization of the Ancient Greek colony of Megara Hyblaea in Sicily," 2022.

depth of the transoms is 24 cm, to leave sufficient gap for the ventilation, between them and the finishing. The fixing between uprights and transoms is realized through slotted holes, to allow shifting during the pre-stress phase (Figure 14).



LEGEND

1 Phenolic plywood double-beam curb 2x20cm
2 Phenolic plywood stud 2x34 cm
3 Coupling system for prefabricated finishing panels with ventilated façade system
4 Prefabricated finishing panels with wooden frame and matchboarding in acetylated radiata pine, burnt with impregnating oil finish, 2 cm thick
5 Triple corrugated cardboard tubes (1.4cm thick) 20x50x45.5 cm
6 Phenolic plywood noggings 2x20 cm
7 Threaded steel tie rod Ø1 cm
8 Metal ventilation grid
9 Acetylated burnt radiata pine plank deking with impregnating oil finish 2 cm thick
10 Adjustable pedestals for decking wood

Figure 14. *The EP Constructive Section*

The base of the module is a grid in steel, each element is a couple of C profiles in galvanized steel S275. The profiles will be bolted in site to reduce the weight of the beams, because the transportation inside the archaeological site will be manual. In the gap between them, the uprights of the panels are fixed, with a steel plate to improve the contact area. Their weight is not sufficient to contrast the action of the wind, so the basement will be ballasted with concrete brick. According with the usage of the module and the short permanence in it, the filling in insulating material can be avoided.

The covering is formed by a wooden grid of beams, connected to the uprights. The connection is guarantee by nine through bolts M10 strength class 8.8. On the top, there is an x-lam floor. The thrust of the wind, which is the highest horizontal stress, is countered by the knee beams of the stair, that are fixed on each wooden upright, with a steel element.

In the internal side, the finishing is missed and cardboard and wood are exposed. In the external side, the finishing is formed by burned wooden slats, which has been preferred over composite for its high durability. For fire protection of the cardboard, the use of a treatment with a two-component, water-based, transparent and colourless fireproof bottom coat has been planned.

As to the external finishing, slats are connected with steel elements, to realize a matchboarded panel. It is fixed to the structure with the so called Fitlock system.[25] The high of the panel is covered by three elements, which leave free an air gap, for the ventilation of the façade in the bottom.

The module will be equipped with digital and analogical informative materials. For the first type, there is a multimedia device with the virtual reconstruction of the *Stoa*, which is the most important monument of Megara. For the second type, there is a tridimensional model of the area of Megara, obtained from a cellular lightweight concrete block thanks a subtractive prototyping procedure.

The electricity for the devices and for the lighting will be supplied by the photovoltaic panels embodied in the finishing of the south façade. Each panel is realized with 15 solar cells in monocrystalline silicon with high efficiency (realized by SunPower Maxeon) 125 mm x 125 mm (Figure 15). The system is patented.[26]

According to the hypothesized scenario of use, it is necessary to use three couples of photovoltaic panels. It is also necessary to provide the module with a backup battery, for the cloudy days.

25. Available at: https://www.fitlock.it/.

26. V. Sapienza, G. Rodonò, A. Monteleone, and F. Giusa, *Adaptive Kinetic Device for Architecture* (Patent Request no. 102019000025819, 2019).

Figure 15. *The Photovoltaic Panels Embodied in the Finishing Layer of the South Elevation*

Conclusions

In the valorisation of the archaeological site, there are three actions that are showed in the literature as efficient: the preservation of the remains; the communication to promote the site; the arrangement of the site. In the EWAS project these three actions are implemented with the KREO and ICARO technologies.

The realization of a shelter is one of the most efficient systems for the preservation of the archaeological areas; the possibility to remove it, when it is unnecessary, could be a good strategy to reduce the disturbance on the site. This achievement can be reached by using a pre-folded composite material. To be sure about its performance, a campaign test on full-scale prototype is useful.

As to the communication for promotion, a relevant strategy is to introduce in the area some architectural multipurpose modules, which can be useful to illustrate the site and to provide facilities for the visitors. This aim could be obtained through lightweight material, as corrugated cardboard and wood. The prefabrication of the envelope can reduce the disturbance on the site. A campaign test on full-scale prototype is useful to verify technology issue and comfort performance.

The experimented technologies show a high innovation level in comparison with the current solutions, for similar aims. This goal has been obtained thanks to the use of building materials with high levels of environmental sustainability; the use of building components that can be dry-assembled; the use of lightweight structure, without foundations.

Shelters and architectural modules can contribute, together with the study of a system of paths, to redefine the arrangement of an archaeological site with the aim of improving the reading of the complex system of stratifications that characterizes it. The set of linear and small punctual elements can promote an approach of widespread and non-invasive reception to the archaeological heritage.

The realization of the prototypes, scheduled for the next months, will show the real effectiveness of the designed technologies and also the possible future implementations. Thanks to their flexibility, the designed technologies are useful for the applications in other archaeological sites and also in other fragile sites (in order to revitalize the historical centres or to improve the accessibility of the naturalistic areas, etc.). The design team is working on these subjects to implement the studies already carried on.

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Author Contributions

Conceptualization, V.S.; methodology, V.S., G.R. and S.C.; technological investigation G.R.; architectural investigation S.C. and G.R.; writing-original draft, V.S. and G.R.; writing-review, V.S.; drawings and graphic elaboration G.R. and S.C.; archaeological supervision M.F. and L.G.; funding acquisition, V.S.

All images showed in the paper are elaborations of the members of the research group.

All authors have read and agreed to the published version of the manuscript.

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Role of Cognition in Pedestrian-Level Universal Mobility: Case of Central Kolkata, India

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In this research, the role of cognition in Universal Mobility at the pedestrian-level has been investigated. A stretch of approximately 850 m in the core of Kolkata Municipal Corporation (in India) has been delineated as the case area for this research. The 02 data sets considered for this research are: 1) Physical data: Pedestrian Count and Vehicular Traffic Volume, and 2) Cognitive data: Light Intensity, Noise, and Thermal Comfort. The authors collected the data from the case area in the years 2020 and 2021. This paper initially involves determining the pedestrian "Level of Service" (LOS) based on the pedestrian count. Furthermore, the authors co-relate (Pearson's Correlation with a 95% confidence interval) the LOS data with the light intensity, sound intensity, and temperature data; to establish a relationship between them. The result of this research indicates that there is a gap in realizing the potential of walkability in the case area. The authors conclude that the improvement of cognition in pedestrian-level Universal Mobility can lead to a better physical environment for the specially-abled and elderly.

Introduction

There are 26.8 million specially-abled people in India as per the last census in 2011. Additionally, there are 103.8 million elderly people.[1] Along similar lines, the "United Nations Sustainable Development Goals" (UN-SDG) number 11 (Sustainable Cities and Communities) becomes more significant than ever in the Indian context. Universal Mobility is a fundamental component of "Sustainable Cities and Communities", which suggests equal mobility preferences for all,

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1. Social Statistics Division, Ministry of Statistics and Programme Implementation, *Disabled Persons in India - A Statistical Profile 2016* (New Delhi: Government of India, 2016).

devoid of the users' physical conditions.[2] Pedestrian (including wheelchair-bound users) level use of urban areas is a relatively challenging domain of Universal Mobility in India. Specifically, in the old urban areas of India, the Universal Mobility scenario is more complicated due to organic urban development, low temporal changes, and high density. Amongst the numerous factors of pedestrian-level Urban Mobility, "Cognition" is significantly important. Cognition is important for specially-abled and elderly people alike since it (Cognition) ensures legibility, orientation, and a sense of place. Despite multiple international, national, and state-level guidelines related to Universal Mobility in India, the aspect of cognition has been disregarded in these guidelines. Although there has been immense research on accessibility and Universal Design in India, the impact of cognition on Universal Mobility at the pedestrian level of old Indian cities is a relatively new research topic.

Universal Mobility incorporates the needs of varied users, including the elderly and specially-abled within a designated spatial boundary. On an urban scale, Universal Mobility serves the function of an infrastructural bridge between buildings having Universal Design/Barrier-Free features and precincts with inclusive components. In addition to the previous statement, both inclusive buildings, and the inclusive precincts, shall remain non-utilitarian if they are not connected by a "Universally-designed" mobility corridor. Thus, Universal Mobility may be categorized as one of the top priorities in the United Nation's Sustainable Development Goal Number 11 which indicates "Sustainable Cities and Communities".[3] This paper focuses on Universal Mobility at the pedestrian level of old cities.

Pedestrian-level infrastructures in old cities are often affected by poor infrastructure and pose a threat to able-bodied and users with wheelchairs or walking assistance alike. Concerning this, a stretch in Central Kolkata (in India) is considered a case example for this paper. The typology of urban patterns is complex in old-core Indian cities (like Kolkata) due to the multiplicity of building uses, thus attracting users from a diverse age groups.[4] Age diversity presents a challenge to decision-makers regarding the type of facility in the pedestrian environment; on the other hand, it promotes the need for universal mobility[5]. Mahapatra, Mori, and Nomura (2021) establish that the challenges in implementing Universal Mobility in an urban Indian context can be attributed to legislative as

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2. United Nations Department of Economic and Social Affairs, *Goal 11: Make Cities and Human Settlements Inclusive, Safe, Resilient and Sustainable* (United Nations Department of Economic and Social Affairs, 2015).

3. M. Brussel, M. Zuidgeest, K. Pfeffer, and M. v. Maarseveen, "Access or Accessibility? A Critique of the Urban Transport SDG Indicator," *International Journal of Geo-Information* (2019): 1-23.

4. G. D. Mahapatra, and K. Puntambekar, *Reinterpreting Urban Fabric in Cities with Living Heritage: The Case of Central Kolkata* (Delhi: COPAL Publishing Group, 2020).

5. Mahapatra, and N. Mandal, *Re-inventing Urban Spaces by Accessing Accessibility in Old City Core - A Case of Kolkata (*Chisinau: Lap Lambert Academic Publishing, 2019), 11-17.

well as population density.[6] Old Indian cities are experiencing degeneration in terms of their urban fabric.[7] Since old cities are often associated with historic value, maintaining physical revitalization is also an added challenge for architects and city officials alike.[8] Furthermore, a unique assessment format is necessary for understanding the context-specific accessibility conditions of old core Indian cities.

The holistic approach to urban development should be to create a livable city and not mere infrastructural development.[9]Cognition, especially, plays an important role in improving the spaces of public use, including pedestrian spaces.[10] The importance of cognition is well-established in walkability, especially for elderly people. Additionally, mental maps are an effective form of cognitive perception of spaces; thus, serve as an essential tool for differently-abled and elderly.[11] In this context, pedestrians needed to be prioritized in the user group segment of the urban development. There are many definitions of a pedestrian. Besides regular walking by able-bodied people, pedestrian also includes people in a non-motorized wheelchair or, driving a motorized wheelchair with a speed of less than 10km/hr on the level ground.[12] Although international and national guidelines/goals encourage pedestrianization, poor urban-level pedestrian quality discourages pedestrian activity.[13]

This research paper is apportioned into three segments hereafter: 1) Analysis, 2) Major Findings, and 3) Proposals. 02 data sets are dealt with in the "Analysis" segment, they are a) Pedestrian Volume, and b) Cognitive Data (comprising Noise, Light, and Thermal Comfort Data). In "Major Findings", the following points are highlighted: a) Importance of Light in Cognition, b) Impact of Sound on

6. Mahapatra, S. Mori, and R. Nomura, "Universal Mobility in Old Core Cities of India: People's Perception," *Sustainability* 13, no. 8 (2021): 1-36.

7. Mahapatra, K. Puntambekar, and S. Ckakraborty, "Understanding Transformation Dynamics in Old Cities," *Conscious Urbanism* 1, no. 1 (2021): 30-41.

8. S. Tiesdell, T. Oc, and T. Heath, "Towards the Successful Revitalization of Historic Urban Quarters," in *Revitalizing Historic Urban Quarters* (eds.) S. Tiesdell, T. Oc, and T. Heath, 200-212 (Oxford: Architectural Press, 1996).

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10. R. Chopra, and Mahapatra, "Cognitive Mapping in Spaces for Public Use," *IJRET: International Journal of Research in Engineering and Technology* 7, no. 9 (2018): 138-142.

11. P. Gould, and R. White, *Mental Maps* (London: Allen and Unwin, 1986).

12. Roads and Traffic Authority NSW, *How to Prepare a Pedestrian Access and Mobility Plan - An Easy Three Stage Guide* (Sydney: New South Wales Government, 2002).

13. M. Taleai, and E. T. Amiri, "Spatial Multi-Criteria and Multi-Scale Evaluation of Walkability Potential at Street Segmnet Level: A Case Study of Tehran," *Sustainable Cities and Society* 31 (2017): 37-50.

Walkability, and c) Influence of Temperature on Mobility. In the last part of the paper "Proposals", the linkage between the five senses in humans and their pedestrian behavior and the roles of hormones in facilitating cognition in streetscape for specially-abled people, is mentioned. Additionally, the importance of Assistive Technology in achieving Service Level Benchmarks (hereafter, SLBs) is also discussed in the last leg of the paper. The details of the survey and the findings are mentioned hereafter.

Materials and Methods

The data collected by the authors in the case area for this research are 1) Pedestrian Volume and 2) Cognitive Data including Noise, Light Intensity, and Thermal Comfort. The locations where the data were collected along the study area are represented in Figure 1 and elaborated in Table 1 thereafter.

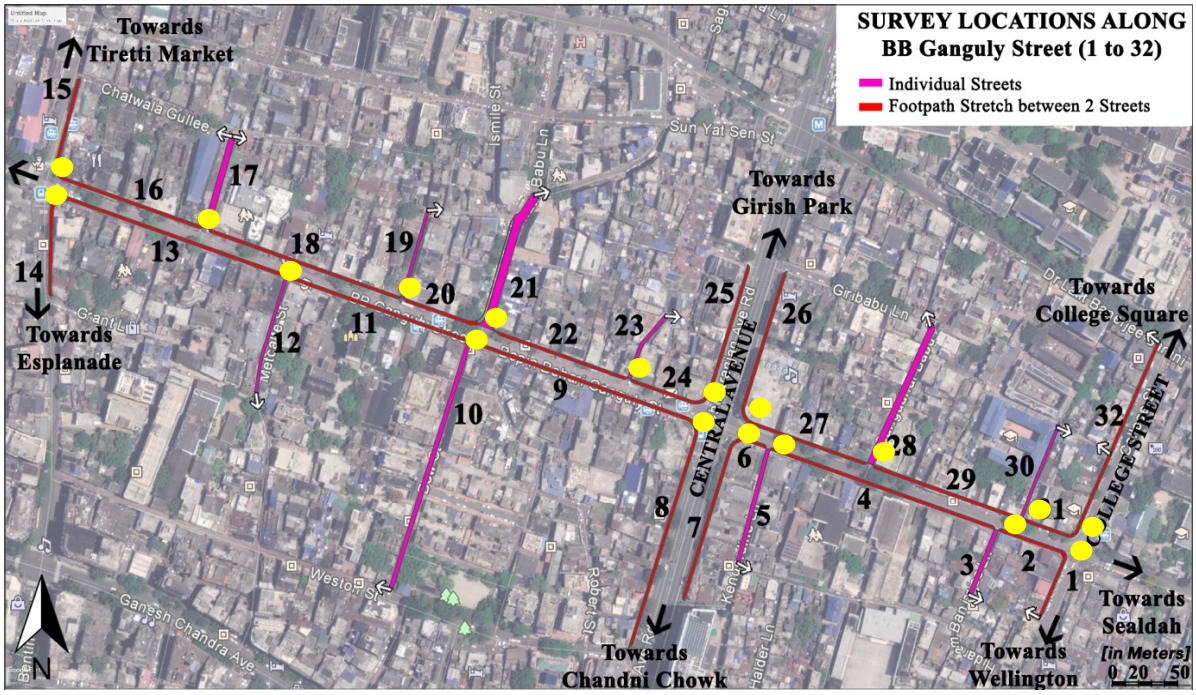


Figure 1. *Survey Locations*

The station points for the "Cognitive" survey were midway in some of the footpaths shown as number 1 to 32 as shown in Figure 1. The names of the footpaths selected (with corresponding footpath widths) for the survey are mentioned in Table 1. Furthermore, the station points for the "Pedestrian Volume" survey were done at the yellow points shown in Figure 1.

Table 1. *Name of Station Points for Survey*

Corresponding Numbers in Figure 1	Name of Station Points	Footpath Width
1	Nirmal Chandra Dey Street	2.1
3	New Bowbazar lane	5
5	Kenderdine Lane	3
7	Central Avenue (GATE 4: Yogayog Bhawan)	2.1
8	Central Metro (GATE 1: Indian Airlines)	2.1
10	Bow Street	3.8
12	Metcalfe Street	3.5
14	Bentinck Street	2.1
15	Rabindra Sarani Rd.	1.9
17	Chatawalla Gully	3.5
19	Phears Bye Lane	2
21	Phears Lane	4.8
23	Giri Babu lane	2.4
25	Central Metro (GATE 2: Lalbazar)	1.9
26	Central Avenue (GATE 3: RITES)	1.8
28	Gangadhar Babu lane	5
30	Bibi Rozio Lane	1.8
32	College Street	1.9

Pedestrian Volume [Peak Hour 15-Minute Interval]

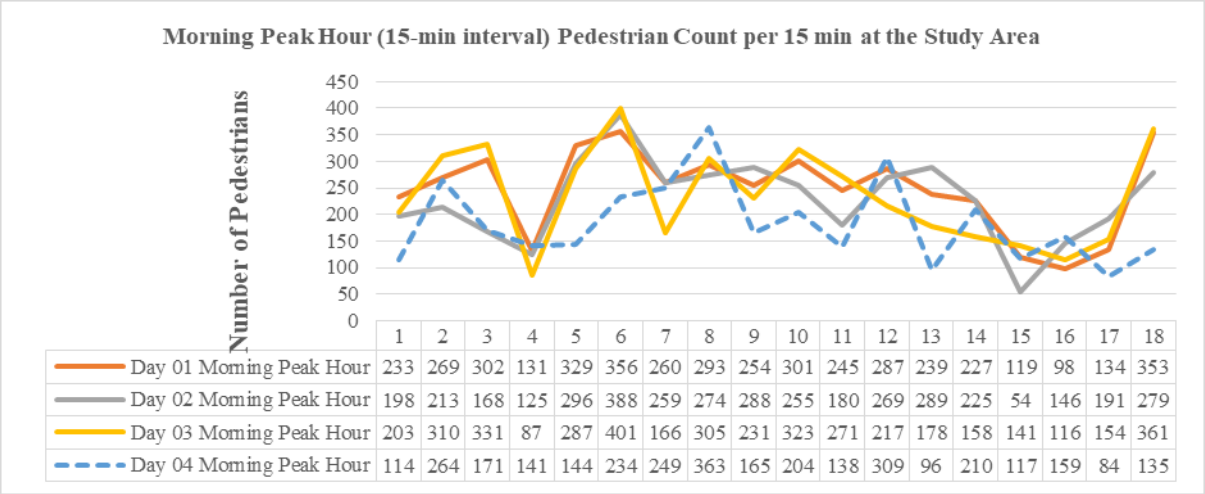
The peak-hour (15-minute interval) Pedestrian Volume Data were recorded three times in 2020 (on 25.10.2020, 14.10.2020, and 02.11.2020) and once in 2021 (on 24.09.2021). On each of the days, the data was recorded twice a day – at Morning Peak Hour (9:00 a.m. – 11:00 am) and Evening Peak Hour (6 p.m. – 7 p.m.). In the morning, the educational institutions and businesses begin functioning around 9 am. The offices start slightly later around 10 am. The educational institutions close around 2-4 pm. However, the offices and businesses start closing around 7 pm. This is also the time when a lot of informal shopping functions. Thus, depending on the mixed land use genre of the space, multiple peak hours are set for the survey. The format used for the Survey is mentioned in Table 2.

Table 2. *Survey format for Pedestrian Count*

Peak Hour Pedestrian Count Survey [15-minute interval]		
Date of Survey		
Time		
Name of the street		
Latitude and Longitude		
Width of the street		
	Pedestrians coming towards the surveyor	Pedestrians going away from the surveyor
Morning Peak Hour (-)		

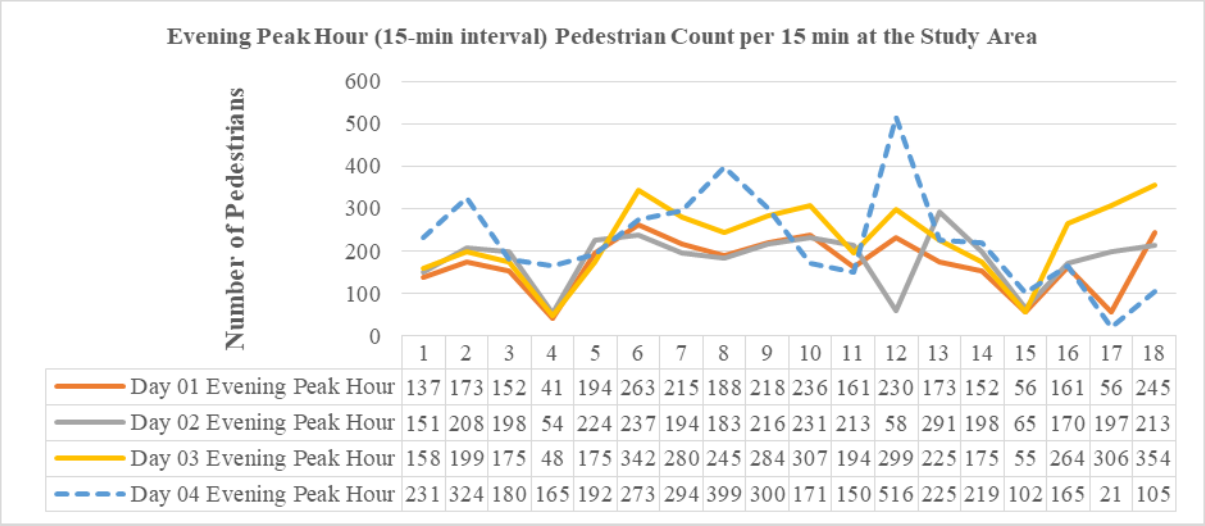
Evening Peak Hour (-)			
How many bicycles did you see during the survey?			
Did you see any differently-abled/ elderly people?			
Surveyed By:		*Checked By:*	

Figure 2 and Figure 3 represent the pattern of pedestrian traffic in the study area at morning peak hour and evening peak hour respectively.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Day 01 Morning Peak Hour	233	269	302	131	329	356	260	293	254	301	245	287	239	227	119	98	134	353
Day 02 Morning Peak Hour	198	213	168	125	296	388	259	274	288	255	180	269	289	225	54	146	191	279
Day 03 Morning Peak Hour	203	310	331	87	287	401	166	305	231	323	271	217	178	158	141	116	154	361
Day 04 Morning Peak Hour	114	264	171	141	144	234	249	363	165	204	138	309	96	210	117	159	84	135

Figure 2. *Morning Peak Hour (15-Min Interval) Pedestrian Count per 15 Minutes at the Study Area*



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Day 01 Evening Peak Hour	137	173	152	41	194	263	215	188	218	236	161	230	173	152	56	161	56	245
Day 02 Evening Peak Hour	151	208	198	54	224	237	194	183	216	231	213	58	291	198	65	170	197	213
Day 03 Evening Peak Hour	158	199	175	48	175	342	280	245	284	307	194	299	225	175	55	264	306	354
Day 04 Evening Peak Hour	231	324	180	165	192	273	294	399	300	171	150	516	225	219	102	165	21	105

Figure 3. *Evening Peak Hour (15-Min Interval) Pedestrian Count per Minute at the Study Area*

On average (mean value), the recorded Peak Hour (15-min interval) Pedestrian Count at the Study Area was 223 people in the morning and 201 people in the

evening respectively. The average pedestrian flow in morning peak hours can be attributed to the presence of morning schools, offices, churches, and related informal vending during those hours. However, the flow is consistent during the evening due to the crowd returning from offices, shops, and informal vending too. Thus, nearly 800 pedestrians (derived by multiplying the "Peak Hours 15-minute interval Pedestrian Count" by four) commute through the study area during peak hours.

Cognitive Data

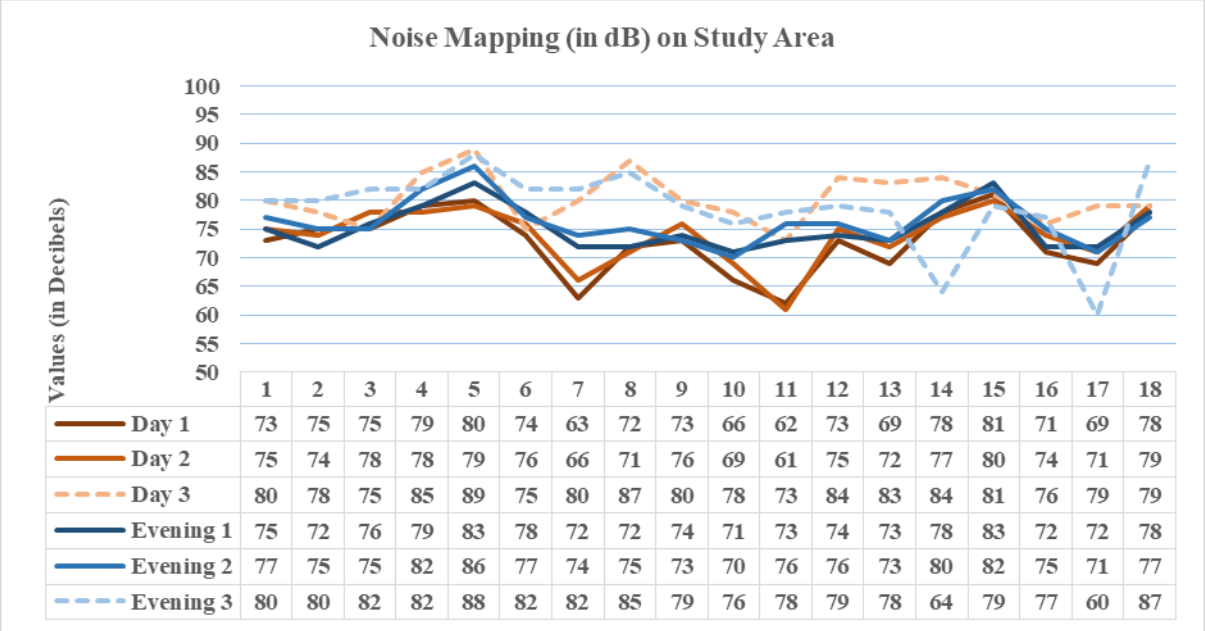
The next set of data for cognitive data involving noise, light intensity, and thermal comfort were recorded at the same time (peak hour) and date as the pedestrian volume survey. The data was recorded by the author using mobile-based applications.

Table 3. *Survey Format for Cognitive Data*

Cognitive Survey [Sound, Light and Temperature Data at Peak Hour]		
	Morning	Evening
Name of Surveyor		
Name of the street		
Date of Survey		
Time		
Sound Intensity (in Decibel)		
Light Intensity (in Lux)		
Temperature (in Degree Centigrade)		
Checked By:		

Noise

Figure 4 illustrates the Noise (Sound Intensity in Decibel) in the Study Area. The data were recorded using "Sound Meter", a mobile-based application.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Day 1	73	75	75	79	80	74	63	72	73	66	62	73	69	78	81	71	69	78
Day 2	75	74	78	78	79	76	66	71	76	69	61	75	72	77	80	74	71	79
Day 3	80	78	75	85	89	75	80	87	80	78	73	84	83	84	81	76	79	79
Evening 1	75	72	76	79	83	78	72	72	74	71	73	74	73	78	83	72	72	78
Evening 2	77	75	75	82	86	77	74	75	73	70	76	76	73	80	82	75	71	77
Evening 3	80	80	82	82	88	82	82	85	79	76	78	79	78	64	79	77	60	87

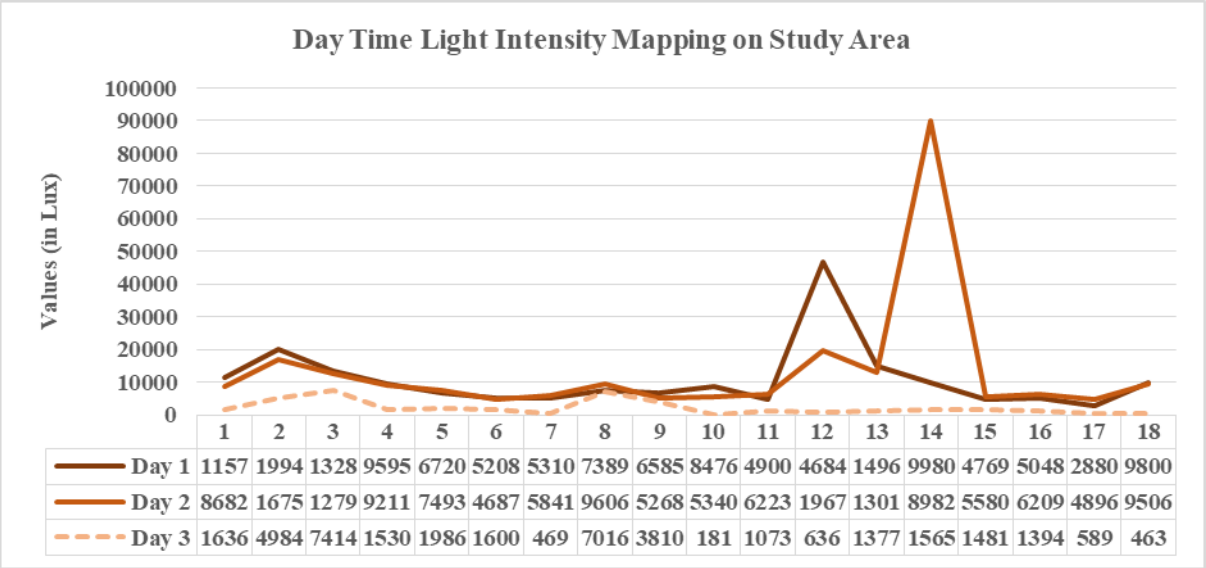
Figure 4. *Noise Mapping on Study Area*

Exposure over 85dB might lead to damage to hearing over prolonged exposure,[14] which has been observed in 04 out of 18 surveyed locations. The infrastructure and pedestrian environment need a more sensitive approach.

Light Intensity

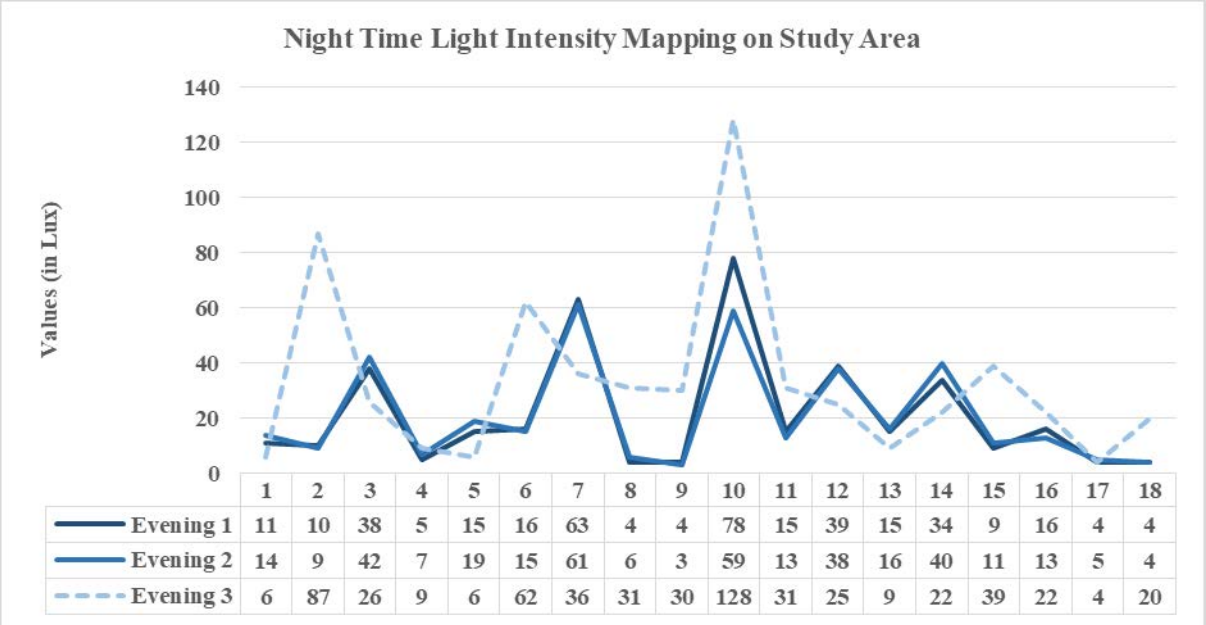
The Light Intensity (in Lux) in the Study Area during Day and Evening respectively are illustrated in Figure 5 and Figure 6. The data were recorded using a mobile-based application "Light Meter". The focus of this study was to understand whether the light intensity is satisfactory for people, especially during the evening/night.

14. National Center for Environmental Health. *What Noises Cause Hearing Loss?* (Centers for Disease Control and Prevention, 2019).



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Day 1	1157	1994	1328	9595	6720	5208	5310	7389	6585	8476	4900	4684	1496	9980	4769	5048	2880	9800
Day 2	8682	1675	1279	9211	7493	4687	5841	9606	5268	5340	6223	1967	1301	8982	5580	6209	4896	9506
Day 3	1636	4984	7414	1530	1986	1600	469	7016	3810	181	1073	636	1377	1565	1481	1394	589	463

Figure 5. *Day Time Light Intensity Mapping on Study Area*



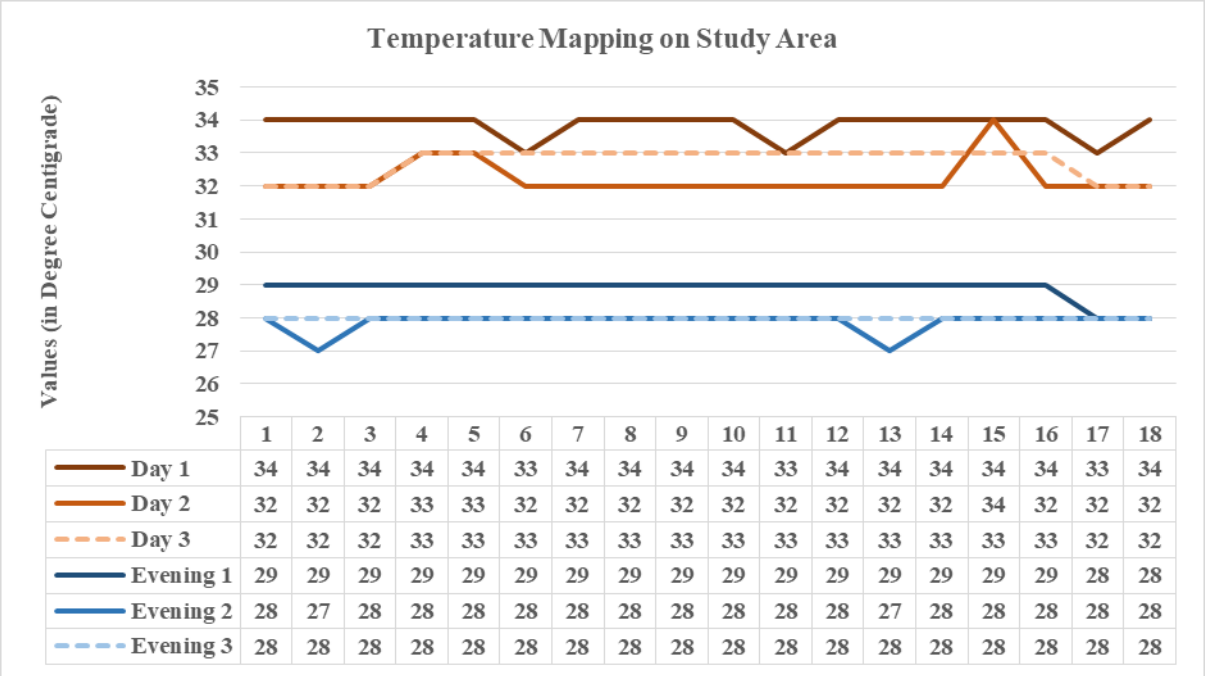
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Evening 1	11	10	38	5	15	16	63	4	4	78	15	39	15	34	9	16	4	4
Evening 2	14	9	42	7	19	15	61	6	3	59	13	38	16	40	11	13	5	4
Evening 3	6	87	26	9	6	62	36	31	30	128	31	25	9	22	39	22	4	20

Figure 6. *Evening Time Light Intensity Mapping on Study Area*

Despite having 93.75% of the streetlights in working condition (observed during the primary survey), instances show that there was >10lux illumination in certain pedestrian areas; thus, hinting towards a need for improved 'urban evening lighting'. The drastic differences in day and evening lighting create cognitive difficulties, especially for the elderly and differently-abled.

Thermal Comfort

The Temperature (in Degree Centigrade) in Study Area during Day and Evening respectively are illustrated in Figure 7. The data (in degrees Centigrade) were recorded using "Outside Temperature", a mobile-based application. This study was conducted mainly to access the real-time situation of pedestrians.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Day 1	34	34	34	34	34	33	34	34	34	34	33	34	34	34	34	34	33	34
Day 2	32	32	32	33	33	32	32	32	32	32	32	32	32	32	34	32	32	32
Day 3	32	32	32	33	33	33	33	33	33	33	33	33	33	33	33	33	32	32
Evening 1	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	28	28
Evening 2	28	27	28	28	28	28	28	28	28	28	28	28	27	28	28	28	28	28
Evening 3	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28

Figure 7. *Temperature Mapping on Study Area*

Although there is a minimal difference in day and evening temperatures during the surveyed dates, the actual scenario might be different. In summer, the temperature in Kolkata rises to 44 °C, complemented by 83% humidity: making the non-shadowed areas extremely uncomfortable. Besides, there are considerations like Apparent Temperature, Sensation and Perception, Time Required to feel the temperature change, Cardinal Direction, and "Felt" Temperature.

The aspects of light, sound, and temperature are related to the senses of vision, hearing, and touch, which need to be complemented with smell (landscape maybe) to create an enhanced cognitive experience.

Results

This section discusses two major things- 1) Criticism of the level of service based on the pedestrian data, and 2) Correlating various attributes of the field survey.

Criticism on the Level of Service

As per the Indian Road Congress (hereafter, IRC) guidelines, pedestrian areas in India must abide by certain ideal guidelines. IRC defines Level of Service (hereafter, LOS) using the "Pedestrian Space" method, which follows the formula: Pedestrian Space = Area / Peak Hour Volume. As per IRC, there is another way of calculating LOS using the "Flow Rate" method, which involves the formula: Pedestrian Unit Flow Rate = Peak 15-min Flow Rate/ (15 x Effective Walkway Width). However, for this paper, the "Pedestrian Space" method is being used, where:

Pedestrian Space = Area of Footpath/ Peak Hour Volume

Besides, the LOS thus determined is designated as LOS A, LOS B, LOS C, LOS D, LOS E, and LOS F, with LOS A being the best. The detail of the LOS is mentioned in Table 4.

Table 4. *Level of Service (Source: Guidelines for Pedestrian Facilities-IRC 103-2012, Indian Road Congress)*

S. No	Level of Service (LOA)	Pedestrian Space (area/peak hour volume)	Flow Rate (peak pedestrian flow rate/ effective walkway width)	Pedestrian Condition
1	LOS A	> 4.9	< 12	Ideal Pedestrian Condition
2	LOS B	> 3.3 - 4.9	< 12 – 15	Acceptable
3	LOS C	> 1.9 - 3.3	< 15 – 21	Just Satisfactory
4	LOS D	> 1.3 - 1.9	< 21 - 27	Poor
5	LOS E	> 0.6 - 1.3	< 27 – 45	Unsuitable
6	LOS F	< 0.6	Varying	Severely Restricted

[N.B.: The 'width' is footpath width and is calculated in meters; and the 'area' signifies footpath area (width x length) and is calculated in square meters.]

After interpreting the data collected during the survey in the case area, only seventeen out of the eighteen footpath stretches have LOS F or severely restricted pedestrian conditions. The one remaining footpath stretch is bearing the tag of LOS E or unsuitable pedestrian conditions. Thus, none of the footpath stretches have ideal/acceptable/satisfactory pedestrian conditions as per the guidelines laid by IRC. Tables 3 and 4 represents the LOS for each of the eighteen surveyed footpath stretches during the morning and evening peak hours. The following abbreviations are used in Tables 3 and 4:

W_E = Effective Walkway Width (in m)
L_E = Effective Walkway Length (in m)
A_E = Effective Walkway Area (in m)
V_{15} = Peak 15-min Flow Rate (in p)
V_{60} = Peak Hour Flow Rate (in p)
PS_D = Daytime Pedestrian Space Value (in sqm/ p)
PS_N = Daytime Pedestrian Space Value (in sqm/ p)

The W_E and L_E data were collected during the primary survey. A_E was calculated thereafter. V_{15} has been derived by taking the average of the Peak Hour (15-min interval) Pedestrian Count for the morning peak hour and evening peak hour respectively. V_{60} was determined by multiplying V_{15} by 4. PS_D and PS_N have been calculated by dividing the A_E by V_{60}. The data has been elaborated in Table 5, and Table 6 respectively.

Table 5. *Level of Service at Morning Peak Hour*

MORNING TIME: Determining Quantitative Level of Service (LOS) through PEDESTRIAN SPACE METHOD							
Street Name	**W_E**	**L_E**	**A_E**	**V_{15}**	**V_{60}**	**PS_D**	**Corresponding LOS**
Nirmal Chandra Dey Street	2.1	51.49	108.13	187	748	0.14	**LOS F**
New Bowbazar lane	5.0	51.68	258.40	264	1056	0.24	**LOS F**
Kenderdine Lane	3.0	87.62	262.86	243	972	0.27	**LOS F**
Central Avenue (GATE 4_Yogayog Bhawan)	2.1	126.43	265.50	121	484	0.55	**LOS F**
Central Metro(GATE 1_Indian Airlines)	2.1	176.77	371.22	264	1056	0.35	**LOS F**
Bow Street	3.8	26.84	101.99	345	1379	0.07	**LOS F**
Metcalfe Street	3.5	89	311.50	234	934	0.33	**LOS F**
Bentick Street	2.1	72.04	151.28	309	1235	0.12	**LOS F**
Rabindra Sarani Rd.	1.9	72.37	137.50	235	938	0.15	**LOS F**
Chatawalla Gully	3.5	70.94	248.29	271	1083	0.23	**LOS F**
Phears Bye Lane	2.0	66.03	132.06	209	834	0.16	**LOS F**
Phears Lane	4.8	57.85	277.68	271	1082	0.26	**LOS F**
Giri Babu lane	2.4	54.62	131.09	201	802	0.16	**LOS F**
Central Metro (GATE 2_Lalbazar)	1.9	110.67	210.27	205	820	0.26	**LOS F**
Central Avenue (GATE 3_RITES)	1.8	115.52	207.94	108	431	0.48	**LOS F**
Gangadhar Babu lane	5.0	109.26	546.30	130	519	1.05	LOS E
Bibi Rozio Lane	1.8	72.5	130.50	141	563	0.23	**LOS F**
College Street	1.9	163.12	309.93	282	1128	0.27	**LOS F**

Table 6. *Level of Service at Evening Peak Hour*

EVENING TIME: Determining Quantitative Level of Service (LOS) through PEDESTRIAN SPACE METHOD							
Street Name	**W_E**	**L_E**	**A_E**	**V_{15}**	**V_{60}**	**PS_N**	**Corresponding LOS**
Nirmal Chandra Dey Street	2.1	51.49	108.13	169	677	0.16	**LOS F**
New Bowbazar lane	5.0	51.68	258.40	226	904	0.29	**LOS F**
Kenderdine Lane	3.0	87.62	262.86	176	705	0.37	**LOS F**
Central Avenue (GATE 4_Yogayog Bhawan)	2.1	126.43	265.50	77	308	0.86	**LOS F**
Central Metro(GATE 1_Indian Airlines)	2.1	176.77	371.22	196	785	0.47	**LOS F**
Bow Street	3.8	26.84	101.99	279	1115	0.09	**LOS F**
Metcalfe Street	3.5	89	311.50	246	983	0.32	**LOS F**
Bentick Street	2.1	72.04	151.28	254	1015	0.15	**LOS F**
Rabindra Sarani Rd.	1.9	72.37	137.50	255	1018	0.14	**LOS F**
Chatawalla Gully	3.5	70.94	248.29	236	945	0.26	**LOS F**
Phears Bye Lane	2.0	66.03	132.06	180	718	0.18	**LOS F**
Phears Lane	4.8	57.85	277.68	276	1103	0.25	**LOS F**
Giri Babu lane	2.4	54.62	131.09	229	914	0.14	**LOS F**
Central Metro (GATE 2_Lalbazar)	1.9	110.67	210.27	186	744	0.28	**LOS F**
Central Avenue (GATE 3_RITES)	1.8	115.52	207.94	70	278	0.75	**LOS F**
Gangadhar Babu lane	5.0	109.26	546.30	190	760	0.72	LOS E
Bibi Rozio Lane	1.8	72.5	130.50	145	580	0.23	**LOS F**
College Street	1.9	163.12	309.93	229	917	0.34	**LOS F**

For a day as well as evening in the eighteen surveyed stretches in the case area, none of them have Level of Service A or B or C or even D. Only one (5.6%) of the surveyed stretches have a LOS E which represents unsuitable pedestrian conditions. The remaining case area has LOS F which represents severely restricted pedestrian conditions.

Correlating Various Attributes of Field Survey

In this section of the paper, the pedestrian data is correlated with the other factors in this research- 1) Footpath width, 2) Noise, 3) Light intensity, and 4) Thermal comfort. Pearson's Correlation with a 95% confidence interval has been used in this research. Tables 5 and 6 elaborate on the correlation between Peak Hour Volume (15 min) and Variables in daytime and evening time, respectively.

Table 7. *Level of Service at Evening Peak Hour*

DAY TIME: Correlation between Peak Hour Volume (15 min) and Variables:			
S.No.	**Variable**	**Correlation Coefficient**	**Relationship**
1	Footpath Width (in Metres)	0.25	Weak +ve
2	Avg. Sound Intensity (in Decibel)	-0.07	Weak -ve
3	Avg. Light Intensity (in Lux)	0.11	Weak +ve
4	Avg. Temperature (in deg Centigrade)	-0.30	Weak -ve

Table 8. *Level of Service at Evening Peak Hour*

EVENING TIME: Correlation between Peak Hour Volume (15 min) and Variables:			
S.No.	**Variable**	**Correlation Coefficient**	**Relationship**
1	Footpath Width (in Metres)	0.44	Moderate +ve
2	Avg. Sound Intensity (in decibels)	-0.17	Weak -ve
3	Avg. Light Intensity (Average Day Time)	0.35	Moderate +ve
4	Avg. Temperature (in deg Centigrade)	-0.06	Weak -ve

In most urban areas with planned layouts and systematic transportation schemes, there exists a strong correlation between the pedestrian count and other related factors. However, in this research, there is an absence of a strong correlation between the pedestrian count and the other factors of the field survey.

Further Linking the LOS with Previous Research

However, research in the same case area involving 125 individuals (74 able-bodied people under the age of sixty and 51 people from the senior citizen and differently-abled people category) from the case area shows that the users are not comfortable with the pedestrian environment.[15] Only 74.51% of the respondents from the senior citizens and differently-abled categories can use the pedestrian facility, in comparison to 93.24% of the able-bodied people under the age of sixty. Furthermore, on inquiring the respondents (who use the pedestrian facility) about pedestrian comfortability using a Likert Scale approach (1 being the worst and 10

15. N. Ricci, *The Psychological Impact of Architectural Design* (Claremont, California: Claremont McKenna College, 2018).

being the best) the weighted mean score of their (senior citizen and differently-abled category) response was 4.92 out of 10, which is a poor score in terms of walkability standards. The response from able-bodied people under the age of sixty was also below satisfactory standards. The aforementioned research also reflects the lack of Universal Mobility standards in terms of infrastructure in the case area.

Thus, it can be inferred that although there is no correlation between the LOS and the pedestrian count; the full potential of the walkable population is not explored due to the lack of proper pedestrian facilities.

Discussion

At the urban level, design elements (like buildings, road patterns, or sculptures) can have both positive and negative effects on human psychology.[16] Pritzker Award (1980 edition) winning architects like Luis Barragan have emphasized the emotional aspect of design. Similarly, Indian architect Pramod Beri has put forward the theory of 'Form follows Feelings'. Additionally, the role of four out of five fundamental human senses: vision, touch, smell, and hearing influences pedestrian movement. Thus, in the wake of the 21st -century's global focus on Universal Mobility, Architectural Planning should take into consideration the parameters of design that could positively influence pedestrians by targeting specific hormonal secretions. The role of Assistive Technology can be crucial in this process.

The way human beings behave in a particular socio-environmental setting is based on the type and rate of hormones that they secrete.[17] The hormone plays an important role in the aging process too.[18] Even for differently-abled people, the hormonal aspects are comparatively more important since they are having compromised physical and/or mental states.[19] Hormones impact human behavior.[20] It can also influence the cognition of humans in different physical environments.[21] Stimulus is received by the brain when a person walks in an environment and

16. C. S. Carter, "Hormonal Influences on Human Behaviour," in *New Aspects of Human Ethology* (ed.) A. K. Schmitt, 141-162 (Boston, MA: Springer, 1996).

17. V. Zjačić-Rotkvić, L. Kavur, and M. Cigrovski-Berković, "Hormones and Aging," *Acta Clinica Croatica* 49 (2010): 549-554.

18. A. K. P. Kumar, "Hormones and Behaviour," in *Encyclopedia of Animal Cognition and Behavior* (ed.) S. T. J. Vonk, 1-22 (Cham: Springer, 2018).

19. Carter, "Hormonal Influences on Human Behavior," 1996.

20. A. Kumar, P. Kumar, M. Faiq, V. Sharma, K. Sesham, and M. Kulandhasamy, "Hormones and Behaviour," in *Encyclopedia of Animal Cognition and Behavior* (eds.) J. Vonk, and T. Shackelford (Cham: Springer, 2018).

21. R. R. Kearns, and R. Spencer. "An Unexpected Increase in Restraint Duration Alters the Expression of Stress Response Habituation," *Physiology & Behavior* 122 (2013): 193-200.

accordingly the body responds, thus creating an associated memory leading to habituation. In contrast to the above, when a person walks in an environment that has a certain level of difficulty walking (like potholes, high sound of traffic, or poor visibility) a sense of fear is generated which leads to a sense of diminished security. The sense of fear is neurologically caused due to over-secretion of Epinephrine (Adrenalin and Cortisol) leading to an increased heart and breath rate.[22] In addition to this, the over-secretion of Epinephrine dilates the blood vessels in the lungs and muscles. Thus, specially-abled and elderly people often get disoriented and gets panicked when subjected to critical pedestrian conditions.[23] Architectural Planning Research can help human behavior by identifying and later influencing hormone secretion through architectural planning interventions.[24] Furthermore, the authors suggest that Assistive Technologies might prove beneficial for improving the behavior of the specially-abled and elderly in pedestrian environments.

Assistive Technology is essentially any technology or method to improve the daily life of specially-abled people.[25] The primary focus of assistive technology is to remove obstacles and foster the functional ability of a diverse user group.[26] Assistive Technology should be affordable and mandatory since it is considered a human right rather than a mere additional facility in the context of 21st-century urbanization[27]Although various assistive/ interactive technologies like HADRIAN, VERITAS, Inclusive CAD, SEE-IT, and the University of Cambridge fostered Inclusive Design Toolkit exist, their usage is highly dubious in the pedestrian context of developing nations.[28] Additionally, street-level assistive

22. University of Rochester Medical Center Rochester, *Neuroscience* (University of Rochester Medical Centre, 2022).

23. L. B. Fich, M. Wallergård, A. M. Hansen, and P. Jönsson, "Stress Hormones Mediated by the Built Environment. A Possibility to Influence the Progress of Alzheimer's Disease?" in *ARCH 17: 3RD International Conference on Architecture, Research, Care and Helath* (eds.) N. Mathiasen, and A. Kathrine Frandsen, 150-162 (Kongens Lyngby: Polyteknisk Boghandel og Forlag, 2017).

24. World Health Organization and The World Bank, *World Report on Disability* (Malta: World Health Organization, 2011).

25. J. Mueller, M. Jones, and L. Broderick, "Assessment of User Needs in Wireless Technologies," *Assistive Technology* 17, no. 1 (2005).

26. L. d. Witte, E. Steel, S. Gupta, V. D. Ramos, and U. Roentgen, "Assistive Technology Provision: Towards an International Framework for Assuring Availability and Accessibility of Affordable High-Quality Assistive Technology," *Disability and Rehabilitation: Assistive Technology* 13, no. 5 (2018): 467-472.

27. E. Zitkus, "A Review of Interactive Technologies Supporting Universal Design Practice," in *Universal Access in Human–Computer Interaction. Design and Development Approaches and Methods*, 132-141 (Springer, Cham, 2017).

28. C.-Y. Huang, C.-K. Wu, and P.-Y. Liu, "Assistive Technology in Smart Cities: A Case of Street Crossing for the Visually-Impaired," *Technology in Society*, 68, no. 101805 (2022): 1-8.

technology focused on specific disabilities like the visually impaired or auditory impaired.

To foster the use of assistive technology at the street level, the authors have proposed further investigation in the same domain, which is mentioned hereafter.

Conclusions

For understanding the pedestrian behavior of the elderly alongside others, a simulation study is being conducted by the authors. In the first phase, the study involves 25 individuals from 16 different nationalities.

A survey format (shown in Table 9) was used to record the participants' data.

Table 9. *Survey Format for Understanding Pedestrian Behavior*

Survey Format for understanding pedestrian behavior							
Date of Survey							
Time							
Temperature (in degrees Centigrade)							
Wind Speed (in meter/second)							
Humidity (in %)							
Precipitation			YES		NO		
Snowfall			YES		NO		
Participant							
Name			Country			Age	
Gender	MALE		FEMALE		TRANSGENDER		
Travel Reading							
With a prosthetic suit	While going		seconds	While coming		seconds	
Without a prosthetic suit	While going		seconds	While coming		seconds	
Surveyed By:			Checked By:				

A footpath stretches of approximately 150 meters within the Hokkaido University campus between Seicomart and the Graduate School of Engineering (shown in Figure 8) was selected, and the participants were asked to casually walk up and down in that stretch. This stretch has a relatively higher pedestrian footprint in comparison to the other parts of the university. The participants were further made to walk the same stretch (up and down) wearing a geriatric simulator, which made them behave like elderly people.

Apart from other deductions, on average, the time taken by an individual in a simulated elderly condition is 2.11 times more than the time taken under an able-bodied condition.

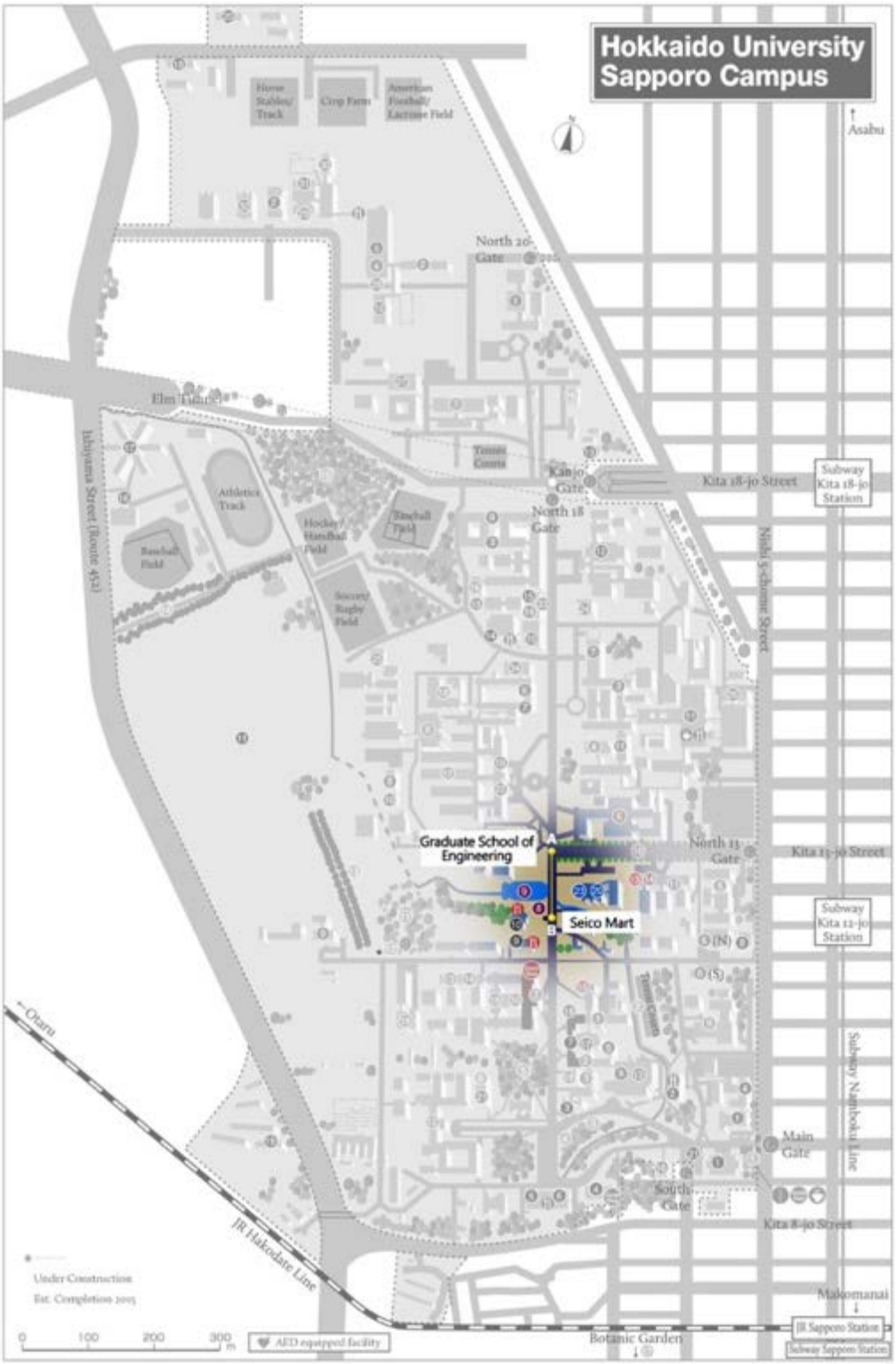
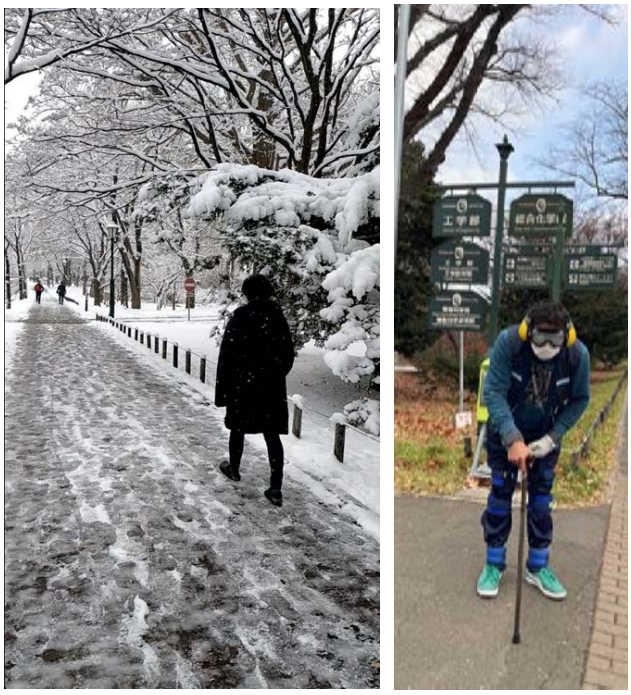


Figure 8. *Survey Location in Hokkaido University*
Source: Hokkaido University Official Website. https://www.global.hokudai.ac.jp/about/publications/campus-map/. [Accessed 28 April 2022.]

Figure 9 shows the different components that the geriatric simulator is composed of. Figures 10 and 11 show some pictures from the survey wearing the simulation suit and general conditions respectively.

Figure 9. *Simulation Suit*



Figures 10 and 11. *Pictures from Survey*

Apart from this, the authors are exploring the application of the Impairment Simulator Software developed by the researchers at the Engineering Design Centre in the Department of Engineering, University of Cambridge.[29] The software is used to generate alternate scenarios (like for differently-abled and elderly) and thereby open paths for strategic intervention.

Finally, the authors state that the methodological framework from this paper (results furnished in this paper and methodology for future research) shall be beneficial for researchers while designing/ planning for improving cognition in pedestrian-level Universal Mobility in other old cities of India.

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