

4. ADAPTATION OF SMALL ARCHITECTURAL OBJECTS AND GREEN INFRASTRUCTURES FOR SUSTAINABLE DEVELOPMENT IN URBAN PUBLIC SPACES

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4.1. Sustainable development

The alarming data on the massive population increase and pollution and waste generation alerted the international community so much that, in 1972, the United Nations Conference on the Human Environment convened in Stockholm, Sweden (United Nations, 1972).

From that moment, there began the implementation of criteria and common principles surrounding environmental matters which require collaboration between nations, as well as the adoption of international measures in order to serve the public interest. Not until 1987, with the publication of the Brundtland Report – *Our Common Future*, did the concept of **sustainable development** be defined as “*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*” (United Nations, 1987). The report outlines the relationship between environment, economy, and society and the need to find effective procedures to reverse the negative environmental consequences of industrialization, globalization, and population growth (Vidales Barriguete, 2019).

Based on this, we can consider there to be 3 fundamental pillars of sustainability: environmental sustainability, economic sustainability, and social sustainability (WEB-1) (Fig. 4.1).

- Environmental sustainability: supports the reasonable use of natural resources and the protection of nature. It is committed to the conservation of water, use of renewable energies, reduction of pollution, promotion of recycling, extension of green areas, implementation of sustainable mobility and construction, etc.

- Economic sustainability: focuses on the promotion of equitable wealth whilst also taking care of natural resources.
- Social sustainability: promotes not only the development of people but also of communities and cultures; trying to improve quality of life achieve gender equality and adequate and fair health, labor, and education systems.

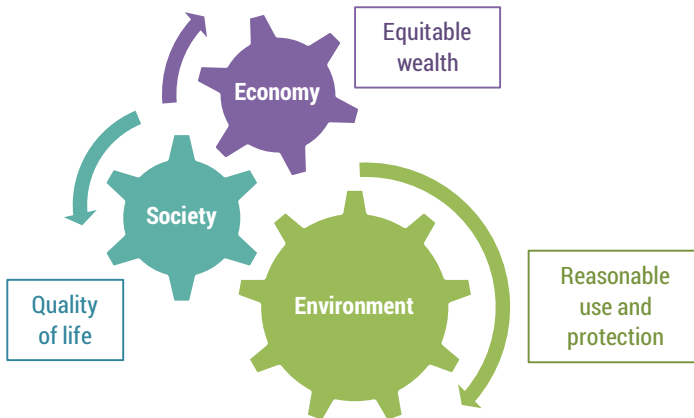


FIG. 4.1. The pillars of sustainability (Source: A. Vidales, 2020)

The Sustainable Development Goals, or Global Goals, adopted by all Member States, were created as a call to all countries *to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030* (United Nations, 2020).

4.1.1. 2030 Agenda

On September 25, 2015, 193 countries signed the agreement to fulfill, by 2030, the 17 Sustainable Development Goals (SDGs) formulated by the United Nations (Fig. 4.2) (Ministerio de Derechos Sociales y Agenda 2030, 2020).

For the duration of 15 years (2015–2030), countries involved must undertake the necessary means to achieve the implementation of the SDGs. They must not only rely on public administrations (responsible for basic and common structures), but also on the private sector (creator of shared value) and civil society (responsible for the legacy of a prosperous future) (Comunidad Por El Clima, 2020).

As such, each country implements its own political strategies to achieve the SDGs in order to protect the common good and ensure the well-being of its people. For example, promoting energy efficiency and renewable energies; creating new regional regulations, strategic frameworks and action plans to the boost circular economy; developing new Urban Agendas with more sustainable social and environmental models; raising the minimum inter-professional wage; creating social bonds; establishing equal opportunities; etc.



FIG. 4.2. Sustainable Development Goals. (Source: United Nations Development Programme, ...)

The 17 SDGs are all inter-related. Moreover, they are divided into 169 objectives in such a way that the successful completion of one is intrinsically linked to the achievement of others. These goals are reflected in the following summary (WEB-1):

- Elimination of poverty and hunger, improving quality of life.
- Increase in access to basic services such as water, sanitation, and sustainable energy.
- Advocacy for inclusive education and fair work.
- Promotion of innovation and generation of reinforced infrastructure in communities and cities with sustainable consumption and production.
- Minimization of inequalities in the world (social, gender, economic...).
- Protection of the environment, combating climate change, and caring for the oceans and terrestrial ecosystems.
- Creation of a peaceful environment and sustainable development with the collaboration of the different social agents.

4.1.2. Sustainable cities

There is no doubt that cities are the key to achieving many of the Sustainable Development Goals. Approximately 56% of the world's population lives in large cities (over 4 billion people), and it is estimated that this number will increase by a further 10% in just 25 years. In many cases, this has led to the uncontrolled expansion of urban areas, with basic services and the infrastructures necessary for development and a good citizen quality of life not being taken into account. For example, it is worth noting that even though cities only occupy 3% of the world, they are responsible for up to 70% of all greenhouse gases and account for between 60% to 80% of energy consumption (Iberdrola, 2020).

It is, therefore primordial that we rethink urban management models and their planning in order to create spaces that are more in line with the **eleventh Sustainable Development Goal: “Sustainable Cities and Communities”**. This involves ensuring cities be safer, more inclusive, and have resilient models in which production and consumption are sustainable and in which the real needs of citizens and their socio-cultural relations, etc. are analyzed (Fig. 4.3).



FIG. 4.3. University area in Vienna – Austria (Source: photos by A. Vidales, 2020)

There is a Sustainable Cities Index, created by ARCADIS in collaboration with the United Nations Program Human Settlements Programme (UN-Habitat), whose biannual report is based on the analysis of the 3 fundamental pillars of sustainability mentioned in section 1.1:

- Environmental: factors for pollution, emissions, energy used, recycling and composting rates, mobility, etc.
- Economic: factors for the business environment, possibility of starting a business, health of the economy, tourism, employment rates, etc.
- Social: factors for quality of life, life expectancy, dependency, crime, obesity rates, etc.

This index considers that a city is sustainable when the 3 requirements are met. There is no point in having a very “green” city with good relations between neighbors if the city does not also have any possibility of creating business or finding work, since there would not be an adequate quality of life for the inhabitants and long-term sustainability would not be possible. Among the most sustainable cities are Zurich, a solid, liveable city that is committed to urban ecology; Singapore, which despite its almost 6 million inhabitants has focused on mobility and aims to have 80% of its buildings sustainable; Stockholm, which stands out for the Hammarby Sjöstad neighborhood, a former industrial area now reconverted, which also has a sustainable water, energy

and waste management system; London, for its great economic opportunities and its environmental initiatives; and Amsterdam, for its continuous investment in improving the quality of life of its inhabitants and reducing emissions (Arcadis, 2018).

4.2. Sustainable trends in public places

The main purpose of the eleventh Sustainable Development Goal “Sustainable Cities and Communities”, is to achieve public spaces that contribute to ensuring that all citizens have *access to safe and affordable housing and basic services* (Pont, 2020). In general, cities have better opportunities related to these basic services (education or health), better communication and technology systems, and more job opportunities. However, this does not mean that improvements in these fields are not needed.

Public spaces in cities are a very important part of our daily lives. We use them constantly and they support many social and cultural activities and meetings. Therefore, it is necessary to reflect on these spaces, on their needs, on their shortcomings (Fig. 4.4), on the factors that give them identity, and on the elements that make them up (Bonells, 2016). All this should be considered with the future of the next generations in mind.



FIG. 4.4. Left: Bicycle “resting” on a park bench. Right: Backpacks “sitting” on a park bench (Source: photos by Alejandra Vidales; in Vienna – Austria, 2020)

This is where sustainability becomes important as a mechanism for the development of public spaces. Water, vegetation, energies used, accessibility, and materials used in the creation of public areas must be related to, and interact with, life.

4.2.1. Green and blue infrastructures

The European Commission's Communication *Green Infrastructure (GI) – Enhancing Europe's Natural Capital*, refers to these infrastructures as a *strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings. It includes green spaces (or blue spaces in the case of aquatic ecosystems) and other physical elements in terrestrial (natural, rural, and urban) and marine areas*" (Comision Europea, 2013).

The concept of green and blue infrastructure is targeted at making the concept of gray infrastructure disappear. The latter includes traditional transport structures such as roads or airports; the distribution of services such as water and gas networks or solid waste facilities; social spaces such as schools and hospitals or sports areas; and commercial facilities such as quarries, factories, or offices (Magdaleno Mas, Cortés Sánchez, Molina Martin, 2018).

Moreover, the objective of the green and blue infrastructure is to improve the environment in order to obtain improved goods and services in the ecosystem. **Green infrastructure** offers solutions not only to environmental problems (environmental conservation, adaptation to climate change) but also to social problems (water distribution, pollution reduction, green areas in urban spaces) and/or economic problems (job creation).

Blue infrastructure is related to water, its planning and management, and the ecosystems related to it (Fig. 4.5).

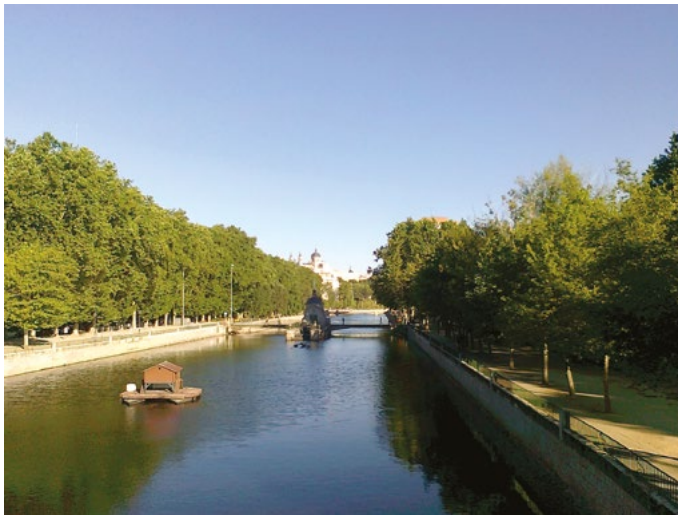


FIG. 4.5. The river corridor 'Manzanares' in Madrid, Spain (Source: photos by M^a A. Flórez de la Colina, 2012)

4.2.2. Biophilia

Direct contact with elements of nature produces great benefits for human mental, physical and emotional health. There are many studies that have shown this fact. There are also many practices that have been based on this: from recovery rooms overlooking a wooded area having been found to help with quicker recovery in their patients, and stays in hospital rooms with more sunshine leading to a reduction in the time spent hospitalized, to indoor gardens making children forget that they are hospitalized (Rosales Pérez, 2019).

The concept of **biophilia** may be defined as the integration of elements of nature in interior or exterior areas, with the goal of evoking the essence of being in nature (Fig. 4.6). The objective is to ultimately make individuals feel better and allow them to find new connections with their space through the use of their senses (smell, sounds, humidity, temperature...) (Seguí, 2020).

However, as with any green area being utilized by humans, it needs to be maintained. An example of this is the refurbishment of the main lobby at the long-standing Atocha station in Madrid which saw the installation of large plants and trees in addition to a pond. The refitting illustrates the problems that can occur: from the lack of acclimatization of some species that had been initially selected for the green zone, to other more unpredictable problems such as the need to periodically remove some abandoned pets from the pond.



FIG. 4.6. Left: Green Wall, Caixa Forum. Right: Inside Atocha railway station, Madrid, Spain (Source: photos by M^a A. Flórez de la Colina, 2017)

The strategy is to incorporate, in the space, elements of nature, such as water, natural light, vegetation, wood, or stone. Moreover, in the creation of such spaces, biophilia looks to use as many possible shapes that living or inert beings can create so that there is also a direct visual connection with the environment (Stouhi, 2019). For example, tree trunks, butterfly wings, mountains or the movement of water, are references commonly used in this philosophy.

4.2.3. Placemaking

Placemaking consists of transforming a space into an area. It is done for and by local residents (artists, activists, entrepreneurs...) and in collaboration with the public administration and private sector (Fig. 4.7).

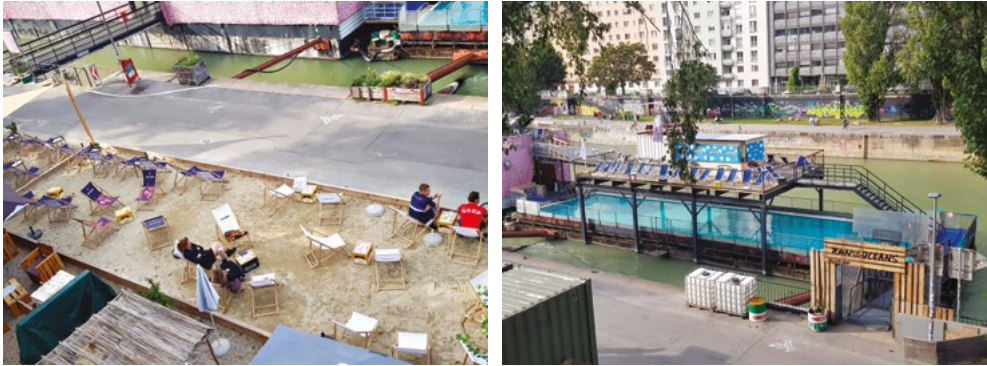


FIG. 4.7. Beach area (left); pool area and drinks area (right) – Vienna Donaukanal, Austria (Source: photos by Alejandra Vidales, 2020)

Firstly, an urban strategy is established, in which the thematic focuses are identified, the proposal and the objectives of the project are made clear, the ideas for the areas of intervention are developed and, of course, the actions are coordinated with public and private organizations. Secondly, the project is implemented, with an open call for people, projects, and cooperation workshops.

This strategy maintains that design and architecture alone do not create large public spaces. The support of bureaucracy is needed to allow innovation and activation in public areas (Krebs, 2020) and the participation of public and private entities, as well as the spaces' users is also needed.

4.3. Sustainable design strategies for small urban architectural objects in public spaces

The previously mentioned approaches are reflected in the wide variety of elements that occupy urban public spaces. The design of these spaces has been the incorporation elements linked to the technical needs related to the different types of infrastructure required in a modern city. However, it has also been adhering to other criteria, such as the potential for greater use, the extent of the spaces' functionality, its energy-saving potential, the use of recyclable materials, and the incorporation of more green elements to them.

The creation of new urban green spaces is fundamental in reducing the carbon footprint caused by cities. In Madrid, the Madrid-Rio project made a large financial investment to improve basic infrastructure in the city, which had been damaged by the creation of an urban freeway, the M-30. A very important section of this expressway was buried in the south of the city, freeing up a large amount of space near the Manzanares river, most of which was refurbished to be green areas, or to be used for sports or leisure. The cultural recovery of historical spaces whose image had been damaged by the creation of this main urban road, was not initially supported by some social groups who estimated that the cost of intervention would be very high. However, with the passing of time and the eventual use of these historic spaces, many changed their minds (Flórez de la Colina, 2016).

Prior to this intervention, the riverbanks had already been cleaned and treated, with there also being the establishment of a floodgate system which allowed water to be dammed. This subsequently created a very convenient microclimate on the banks, since part of the water evaporated due to the very dry climate of Madrid, which became especially dry in the summer months. The reflection of the water also improved the aesthetic appeal of the engineering and architectural work found along the riverbank (Fig. 4.8).

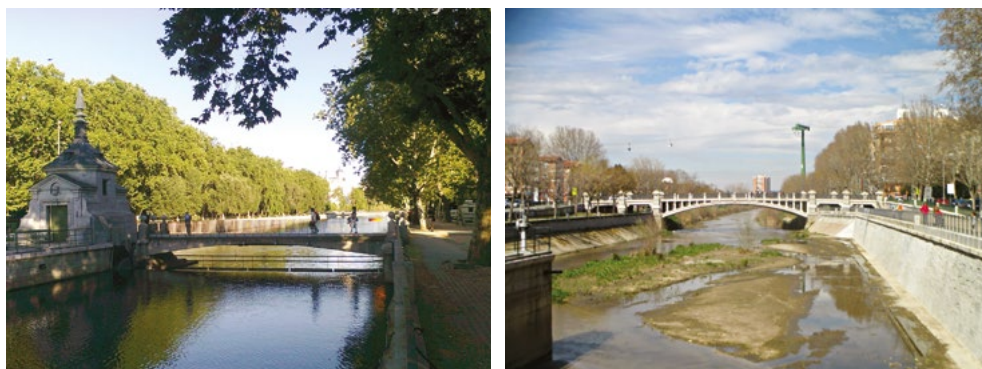


FIG. 4.8. Riverbanks of the Manzanares river, near Queen Victoria bridge, Madrid, Spain. Left: 2012, with the reflection of the water. Right: 2019, with sandbanks in the riverbed (Source: photos by M^a A. Flórez de la Colina, 2012 and 2019)

The lack of maintenance of the floodgates due to a motivation to save money and a municipal policy that promoted a “greater naturalization of the river”, changed the river’s image. Now, the riverbed has sandbanks and small islands with reeds that contribute to the increasing presence of birds and insects, even in this urban area.

Special care has been taken in the design of objects that are used to refurbish this new urban green space in Madrid. The new infrastructures vary with the biggest being the new bridges and pedestrian walkways, like the one created by French architect Dominique Perrault in Arganzuela, inaugurated in 2011 (WEB-2) or the “Shell Bridge”

in Matadero, by West 8 and Burgos+Garrido, Porras+LaCasta, and Rubio & Álvarez-Sala, with mosaics by Daniel Canogar (WEB-3) one of the two new twin footbridges that join both banks of the river Manzanares (Fig. 4.9).



FIG. 4.9. New bridges and footbridges in Manzanares river, Madrid, Spain. Left: Bridge designed by D. Perrault. Right: Bridge with mosaics near Matadero (Source: photos by M^a Aurora Flórez de la Colina, 2019)

Smaller objects in these public spaces consist of playground equipment, information panels, and the evacuation and ventilation systems used for the tunnels (Fig. 4.10 and 4.11). For these smaller objects, sustainable materials have been used: steel, granite from the mountains near Madrid, as well as wood, are the most commonly used. They contrast, for example, with the plastic that was previously used in children's playgrounds and which is currently being reduced.



FIG. 4.10. Madrid-Rio Project, small objects located in the new public space, in Madrid, Spain. Left: Infrastructure and fountains with granite stone. Right: Emergency exit from underground tunnel (Source: photos by M^a A. Flórez de la Colina, 2019)



FIG. 4.11. Madrid-Rio Rio Project, small objects located in the new public space, in Madrid, Spain. Left: Children playground: information panel. Right: Children playground: steel and wood (Source: photos by M^a A. Flórez de la Colina, 2019)

References

1. Arcadis, Centre for Economics and Business Research (2018) Citizen Centric Cities. The Sustainable Cities Index 2018, Arcadis design and consultancy for natural and built assets, UK. Available: https://www.arcadis.com/media/1/D/5/%7B1D5AE7E2-A348-4B6E-B1D7-6D94FA7D7567%7DSustainable_Cities_Index_2018_Arcadis.pdf
2. Bonells, J. E. (2016) Arquitectura y espacio público urbano, *Jardines sin fronteras*, Available: <https://jardinessinfronteras.com/2016/12/10/arquitectura-y-espacio-publico-urbano/> [Accessed: 12.10.2020]
3. COMISIÓN EUROPEA (2013) Infraestructura verde: mejora del capital natural de Europa, Bruselas, 6.5.2013. *Comunicación de la Comisión al Parlamento Europeo, al Consejo, al Comité Económico y Social Europeo y al Comité de las Regiones*, p.3, Available: https://eur-lex.europa.eu/resource.html?uri=cellar:d41348f2-01d5-4abe-b817-4c73e6f1b2df.0008.03/DOC_1&format=PDF. Cited in: Ministerio para la transición ecológica y el reto demográfico (2020), *Estrategia Estatal de Infraestructura Verde y de la Conectividad y Restauración Ecológicas* [Accessed: 12.10.2020]
4. Comunidad Por El Clima (2020) ¿Qué es la Agenda 2030? Available: <https://porelclima.es/equipo/2592-agenda-2030> [Accessed: 12.-10.2020]
5. Fernández, R. (2019) Porcentaje mundial de población residente en áreas urbanas de 1985 a 2050,” *Statista*, Available: <https://es.statista.com/estadisticas/635368/porcentaje-de-poblacion-areas-urbanas-del-mundo/> [Accessed: 12.10.2020]
6. Flórez dela Colina, M.A. (2016) Sustainable Development of Historic Cities: Rediscovering Madrid’s Urban Facade from its River, *Procedia Engineering* 161:1965–1970. World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium 2016, WMCAUS 2016. DOI: 10.1016/j.proeng.2016.08.787. Available: <https://www.sciencedirect.com/science/article/pii/S1877705816330168> [Accessed: 12.10.2020]
7. Iberdrola, (2020) *Te descubrimos las ciudades más sostenibles del mundo* Available: <https://www.iberdrola.com/medio-ambiente/ciudades-sostenibles> [Accessed: 12.10.2020]

8. Krebs, R. (2020) Transform from ‘space’ to ‘place,’ *Training School COST RESTORE*, Vienna (Austria)
9. Magdaleno Mas, F., Cortés Sánchez, F. M. and Molina Martín, B. (2018) Infraestructuras verdes y azules: estrategias de adaptación y mitigación ante el cambio climático Green and Blue Infrastructures: Adaptation and Mitigation Strategies to Climate Change, *Ing. Civ.*, 191, 105–112. Available: <http://193.145.71.12/index.php/ingenieria-civil/article/view/2350> [Accessed: 12.10.2020]
10. *Ministerio de Derechos Sociales y Agenda 2030, Objetivos de desarrollo sostenible* (2020) Available: <https://www.agenda2030.gob.es/objetivos/home.htm> [Accessed: 12.10.2020]
11. Pont, E. (2020) En marcha hacia unas ciudades y comunidades más sostenibles, *La Vanguardia*
12. Rosales Pérez, N. de J. (2019) *Arquitectura y Biofilia. Percepción del espacio laboral universitario*, Tesis Doctoral, Universidad Autónoma de San Luis de Potosí (México)
13. Seguí, P. (2020) El diseño biofilico. El poder de la arquitectura y la naturaleza., *Ovacen*, vol., p.. [Online]. Español / Spanish. Available: <https://ovacen.com/el-diseno-biofilico-el-poder-de-la-arquitectura-y-la-naturaleza/> [Accessed: 12.10.2020]
14. Stouhi, D. (2019) Aire y naturaleza en el interior: beneficios de la biofilia en la arquitectura, *Plataformaarquitectura*, Available: <https://www.plataformaarquitectura.cl/cl/927694/aire-en-el-interior-beneficios-de-la-biofilia-en-la-arquitectura> [Accessed: 12.10.2020]
15. UNITED NATIONS (1972) International Conference, *Report of the United Nations Conference on the Human Environment*, Stockholm, 5–18 June 1972. Available: https://www.un.org/ga/search/view_doc.asp?symbol=A/CONF.48/14/REV [Accessed: 12.10.2020]
16. UNITED NATIONS (1987) General Assembly, *Part I. Common Concerns. 2.Towards sustainable development. The concept of sustainable development*. In *Brundtland Report: Our Common Future*, Report of the World Commission on Environment and Development, Governing Council of the United Nations Environment Programme, Fourteenth session held at Nairobi from 8 to 19 June 1987. Available: <https://undocs.org/en/A/42/427> [Accessed: 12.10.2020]
17. UNITED NATIONS (2020) Development Programme, *Sustainable Development Goals*, Available: <https://www.undp.org/content/undp/en/home/sustainable-development-goals.html> [Accessed: 12.10.2020]
18. Vidales Barriguete, A. (2019) *Caracterización fisicoquímica y aplicaciones de yeso con adición de residuo plástico de cables mediante criterios de economía circular*, Tesis Doctoral, Universidad Politécnica de Madrid (España)
19. WEB-1 Acciona, “¿Qué es el desarrollo sostenible?,” Article in Acciona website, 2020. Available: <https://www.acciona.com/es/desarrollo-sostenible/> [Accessed: 12.10.2020]
20. WEB-2 Ayuntamiento de Madrid, “Puente Monumental Parque de Arganzuela”. [Online]. Spanish / Español. On line article in *Bienvenidos a Madrid (página oficial de turismo)* Website. Available: https://www.esmadrid.com/informacion-turistica/puente-monumental-parque-dearganzuela?utm_referrer=https%3A%2F%2Fwww.google.com%2F [Accessed: 12.10.2020]
21. WEB-3 Arquitecturaenacero, “Puente Cáscara Matadero Madrid Río”. *Simón García, fotografía de arquitectura* Available: <https://www.arqfoto.com/puente-cascara-matadero-madrid-rio/> [Accessed: 12-10-2020]; Acciona, “Proyecto de Pasarelas Gemelas sobre el río Manzanares en Madrid, España” Available: <https://www.youtube.com/watch?v=GVL0IoGJJHA/> [Accessed: 12.10.2020]