

Conference Paper

Developing Open-Air Sports Facilities to Enhance Socio- Family Relations

V. Susanto* and A. S. Ekomadyo

Architecture, School of Architecture, Planning and Policy Development, Bandung Institute of Technology, Bandung, Indonesia

ORCID IDVanessa Susanto: <https://orcid.org/0000-0003-4681-722X>Agus Suharjono Ekomadyo: <https://orcid.org/0000-0002-6124-6886>**Abstract.**

Ice skating is a prominent winter sport, and ice rinks provide an excellent place for socio-family relation enhancement, which means that sports are indeed a great tool to enhance parents' and children's bond. Most ice rinks were built indoors in Southeast Asia since the climate is not suitable for outdoor-built facilities. Unfortunately, the COVID-19 pandemic raised a new challenge for this sport's development. This study aims to determine whether an outdoor ice rink can be built in a tropical climate that also serves as a place for socio-family relationships to blossom. The method utilized is a research-based design where observational data from several ice rinks was interpreted into the notion of a healthy sports facility that is a synthetic ice rink with its technical advantages and unique atmosphere, setting an example of thoughtful design in correlation to a sport's development. This innovative design concept offers a new attraction as open-air rinks add to the scenery, are energy-efficient, and are cost-effective since their maintenance is cheaper than mechanical, indoor ice rinks.

Keywords: ice rink, socio-family relationsCorresponding Author: V.
Susanto; email:
[vanessasusanto@students.
itb.ac.id](mailto:vanessasusanto@students.itb.ac.id)**Published** 27 December 2022Publishing services provided by
Knowledge E

© V. Susanto and A. S.

Ekomadyo. This article is distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the SIRES Conference Committee.

1. INTRODUCTION

Sport is a civilizational cultural heritage, and the connections between sport and society are very complex [1]. The importance of parental and sibling examples is highlighted, as, at an early age, the child needs a positive role model to encourage physical activity [2]. 'Good' parenting nowadays necessitated supporting and encouraging children's sporting activities - it is seen as desirable to parents for their children to be 'rounded' individuals with a range of abilities and interests [3]. Hence, it is conspicuous that children's sports activities manifest beneficial results - physically, socially, and psychologically among families.

One of the most developing and promising winter sports in Southeast Asia is ice skating. The majority of parents are enthusiastic about introducing their daughters to ice skating since, according to them, ice skating trains not only their children's physical

OPEN ACCESS

strength, but also flexibility, balance, and agility, profound in executing various graceful movements on the ice. Based on the First Author's personal experience as a national figure skating athlete, observations from 4 primary ice rinks in Indonesia display the vast sociofamily relations candidly, scattered at several spots in the arena, both from regular visitors who skate for recreational purposes, as well as professional athletes who train competitively.

Unfortunately, the current dire situation that hit worldwide forces everyone to reconsider and re-evaluate every choice and consequence in various sectors and fields – to keep our feet on the ground for the sake of everyone's health. The sporting world, in general, is heavily impacted, especially ice skating. Several studies have determined that in enclosed ice skating rinks, increased breathing rates of skaters and hockey players, coupled with elevated air pollutant levels, could negatively affect health. Exhaust gases discharged from the resurfacing equipment include significant quantities of carbon monoxide (CO) and nitrogen dioxide (NO₂), which may induce adverse health effects [4-8]. These poor air quality problems persisted mainly due to insufficient ventilation or failure of several rink equipment [9-15].

The only solution to this problem is to design a synthetic ice rink, known for its feasibility that can be built indoors and outdoors. Within a short construction period, layers of synthetic panels are placed and joined into desirable configurations, and they are ready to be skated on. The panels' properties more or less resemble the friction of ice that skaters will not notice the difference at all [16,17]. Not only does it reduce energy use significantly, but the synthetic ice rink also boasts low-cost maintenance.

One particular thing that the First Author experienced first-hand as a national figure skater who practices 2-4x a week in an enclosed ice rink is that staying inside for prolonged hours can be unpleasant and strenuous. Spending time inside the rink to train vigorously without exposure to natural environments might trigger stress and negatively impact our mental state. Since the construction and maintenance of an outdoor mechanical ice rink are unattainable in this region, a synthetic ice rink seems suitable to tackle the hurdles in designing an open-air ice skating arena. As the border between indoors and outdoors becomes a blur, the natural ventilation that provides open-air circulation while displaying the panorama around the arena accommodates the users' need for a healthy environment. According to the Attention Restoration Theory (ART), natural environments' restorative potential is situated because nature can replenish depleted attentional resources [18,19]. Moreover, studies suggest that recuperation from stress occurs faster and more completely during passive exposures to natural rather than urban environments [20-22].

Based on these issues, the concept of designing energy-efficient, healthy, and safe sports facilities is suggested through the design of an outdoor synthetic ice rink for recreational and professional purposes, providing an exceptional spatial experience that entices visitors to keep them coming and using these facilities. Adjusted to withstand Southeast Asia's tropical climate, this project can be a breakthrough in sports facility development that prioritises users' comfort, socio-family relationship nourishment, and, most importantly, emphasises architects' contribution towards designing healthy buildings.

2. METHODS

The method used in presenting the findings in this paper is research-based design. Observations were conducted in four primary ice rinks in Indonesia: BX Rink, Sky Rink Jakarta, Oasis Centre Arena, and Gardenice Bandung. Research and data were collected during field observation, and the First Author is responsible for observing and experiencing the atmosphere in these ice rinks. For the participatory method, the First Author's background as a competitive athlete is contemplated to explore the socio-family relationship display in every arena. Meanwhile, the Second Author observed an outdoor ice rink in Umekoji Park in Kyoto, Japan - a subtropical climate. Photographs of observations from the five ice rinks were collected to be analysed, churning ideas that might solve current ice rinks' problems. As a whole, the writing team became observers whose discoveries were used as considerations in designing the outdoor synthetic ice rink design, as described above.

3. RESULTS AND DISCUSSION

Observations revealed that several socio-family relationships were happening inside ice rinks. Here are the captured images depicting numerous social activities:



Figure 1: (a,b) Socio-family relationships in BX Rink, Tangerang.



Figure 2: (a,b) Socio-family relationships in Gardenice Rink, Bandung.

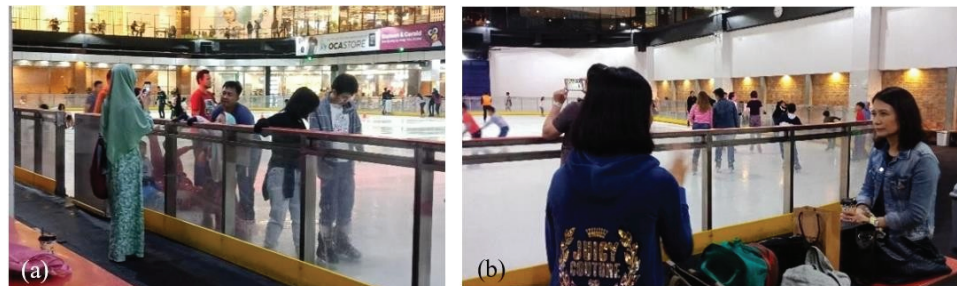


Figure 3: (a,b) Socio-family relationships in Oasis Centre Arena, Cakung.

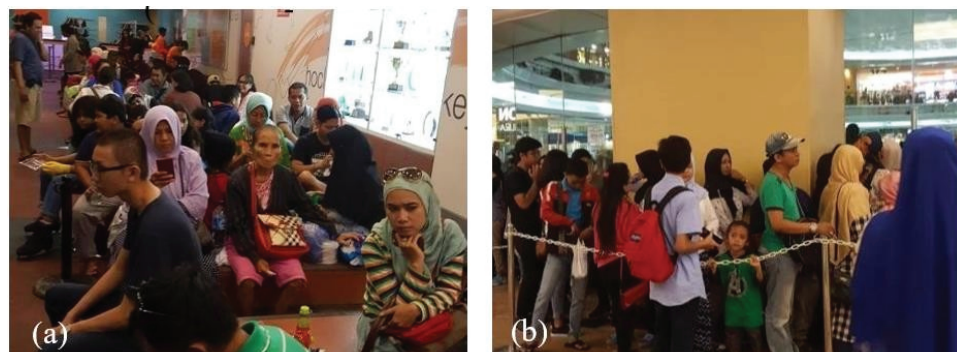


Figure 4: (a,b) Socio-family relationships in Sky Rink Jakarta.



Figure 5: (a,b) Socio-family relationships in Viva Square Kyoto, Umekoji Park.

Based on these rinks' observational data, it can be concluded that the ice rink as a sports facility is proven to provide a medium for socio-family relationships to blossom. This relationship is hinted from various social activities, ranging from parents who bring

their children to skate while bringing their whole family into the rink to watch them having fun, parents of fellow athletes who spend their time chatting with each other while observing their kids' skating lessons, to siblings and their buddies playing around. Interestingly, if the ice rink is built outdoors adjacent to a public landscaped garden, the environment made it easier to induce and strengthen the visitors' socio-family relationships, as the openness of nature can replenish depleted attentional resources. Incorporating nature's landscape into the arena's surroundings undoubtedly contributes to more prime spots where social relationships flourish and prevail. Subsequently, this concept also offers a comprehensive approach toward creative design: place-making (Figure 1, 2, 3, 4, and 5).

4. Fundamentals of a Space: Place-Making

People do things in place. What they do, in part, is responsible for the meanings that a place might have [23]. Space is formed because of an object or activity in it. Place-making is a process in which the community participates in shaping a shared space. The formation of this place includes planning, design, management, and programming processes [24]. Place-making-themed architectural design is a simple way is composing form/space by imagining how that place will be livelier with the presence of activities and gives off good vibes by the users [25]. In architectural theory and based on Heidegger's phenomenology, Schulz [26-28] proposed the notion of place and *genius loci* that emphasises the meaning of architecture as human experience. Architectural phenomenology is a concept that allows designers to visualise buildings from the perspective of the human perceptual experience. However, the expression of phenomenology in design is based on emotions that depict space through words such as 'sense' and 'spirit' [29]. Therefore, the essence of place-making is deemed comparatively executed only when the user feels comfortable and attains an unforgettable experience while spending his time doing activities in the desired place. These evoked moods within a place's atmosphere make an individual eager to frequent that location to feel the unique spatial experience exclusive in that exact area. Thus, the arena's place-making aspect becomes crucial to be recognised in the design to attract visitors' attention and introduce the novelty of a synthetic ice rink to the public.

There are three evolutionary traditions in place-making studies [30,31]: phenomenological/ humanistic, approaching place from the perspectives of human experience [27,32]; psychometric, which analyses place by attributing numeric measures to psychosocial phenomena and then analyses these data using quantitative techniques [33];

and social constructivism, which sees it as a socially constructed phenomenon [34]. The concern of design with the social dimension emerges from understanding that design is about the product as the result of the design process and the process itself and thinking that guide into the desired results [35]. The design process has a social significance because the designer interacts with many actors to the appropriateness of the design result [36]. In the social dimension, the design is about formalism and building aesthetics and considers user behaviour to deliver a suitable building and built environment and support human values [37]. The reciprocal relation between social form and built form is reflected in words: 'When space is socially constructed, the social form is spatially constructed [35]. Dovey [34] related the role of designing a built form to a complex social desire for a better future. Unfortunately, the stakeholders often have misconceptions about design work, and design knowledge is more based on individual opinion than technical and rational insight [38].

5. Design outcomes

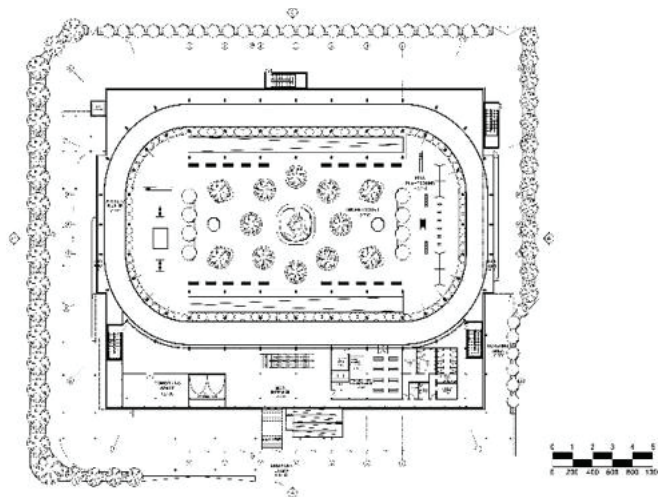


Figure 6: Ground floor plan.

Based on theoretical studies and observations, this is the design plan and 3-dimensional study of the arena (Figure 6, 7, and 8). This design concept presents an outdoor synthetic ice rink that has been fully adapted to the tropical climate conditions, exposing a 360-degree panoramic scenery around the arena that visitors can relish. The ice rink's shape resembles a running track, drawing inspiration from the perimeter ice rink in Lentpark (Figure 9), Germany [39]. This outdoor arena is made as an open-air facility to provide natural ventilation where air can flow seamlessly, minimising the usage of a mechanical air conditioning system, improving building air circulation and energy

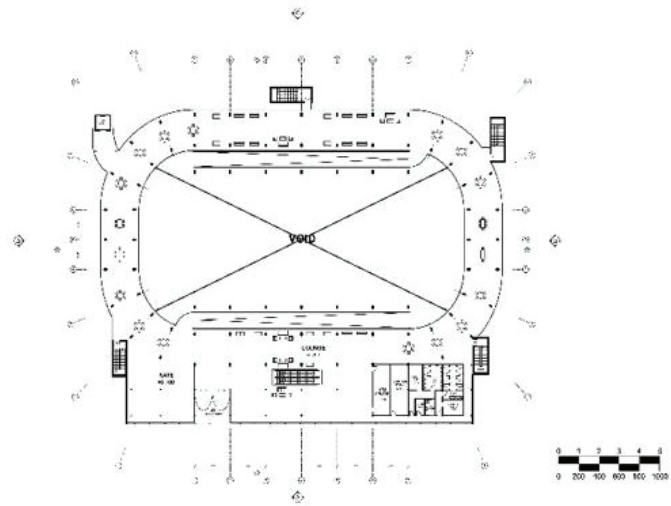


Figure 7: Second floor plan.



Figure 8: Exterior perspective.

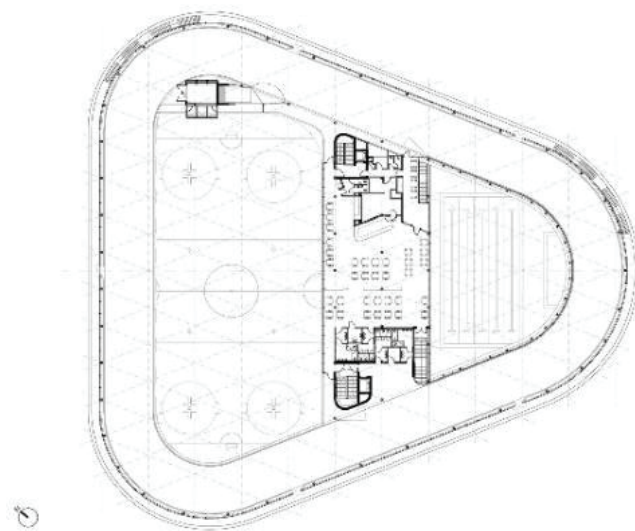


Figure 9: Lentpark's perimeter ice rink.

efficiency. Unlike mechanical ice rinks, which require enclosed spaces to preserve an indoor climate with specific temperature and humidity to prevent the ice melting [40], synthetic ice rinks can be built outdoors, and its maintenance is considerably cheaper and more manageable. This rink is placed on the ground floor and sheltered right under the building's top floor, which also functions as an open lounge where visitors can relax while enjoying the serene view. A landscaped garden with seating lies in the middle of the ground floor, enhancing the restorative component within the building and providing more space to encourage social-family relationship occurrences within the vicinity. Ice skaters and visitors can immerse themselves in this extraordinary spatial experience, whether they are skating outdoors and enjoying its surroundings in the garden while keeping an eye on their children have fun (Figure 10).

A synthetic ice rink is made up of plastic panels installed and arranged in certain configurations. These panels bear a coefficient of friction value comparable to the ice. Unlike mechanical ice rinks, which require a refrigeration system with enormous energy consumption and have to be located in an enclosed area [40], the synthetic ice rink can be assembled effortlessly without complicated mechanisms and heavy equipment, constructed both indoors and outdoors, and maintained at such low-cost [41-43]. In the context of healthy sports facilities, the architectural design contributes to the visual character of buildings that has important impacts on human experience, since environmental cues affected an individual's appraisal of the scene, emotions, inferences, and behaviour [44].

Users from all backgrounds are welcome to skate, whether they skate for recreational or training purposes since the ice quality is identical to indoor mechanical ice rinks. The facility's inclusiveness does not stop there, since the garden is accessible via ramps, accommodating a more pleasant entry for aged and disabled people. The availability of healing restorative environments may influence older people's perception of their health, satisfaction, and the quality of the environment in which they live [45]. Moreover, all visitors are welcome to delight in such fascinating features inside this building. The notion of universality in a sports facility might be unheard of, which is why this arena is projected to be the benchmark for prospects in buildings within the sports and recreation typology.

The studies mentioned above have stated that exposure to the natural environment can directly influence individuals' psychological well-being; therefore, this matter needs to be highlighted in the planning and design process [20]. By addressing these concerns in relevance to the evolution of sports, which is applicable as a medium for socio-family relationships [46], the necessity for healing environments in restoring one's



Figure 10: Arena overview. (a) Central garden. (b,f) Perspectives of synthetic ice rink. (c) Interior of skating lounge. (d) Second floor overview. (e) Terrace view overlooking the garden.

mindfulness [18,19], and meticulous planning on sport facilities that prioritise its users' comfort and health [47], the conceptualisation of this arena responds to the challenges that hindered ice skating development in tropical weather in the wake of COVID-19 pandemic. As indoor environments can physically affect human health through factors such as air quality and thermal comfort [48], and the risk of getting infected from the airborne transmission of viruses indoors spiked, particularly in crowded, poorly ventilated environments [49-54], nature's exposure becomes pivotal to be reconsidered into the design process of public spaces. This issue is resolved by applying synthetic ice as a substitute for mechanical ice rinks, replacing the latter's weaknesses while maintaining friction similar to an ice sheet [16]. This attractive atmosphere serves as an asset to draw the presence of visitors and rink users. Nonetheless, the arena's ambience accentuates a ground-breaking yet distinctive sense of place [23] never-before-found in other public spaces. Ultimately, frequent visits to the ice rink as a form of leisure exercise and using leisure sports facilities can effectively improve an individual's self-evaluation of health [55].

6. CONCLUSION

Ice skating is one of the most renowned winter sports in Southeast Asia. Unfortunately, this steadfast growth has been halted due to the COVID-19 pandemic. Costly maintenance of the facility exacerbated with low air quality in an enclosed ice rink is the main factor that might diminish the public's enthusiasm for ice skating. Observations in Indonesia's ice rinks have revealed significant evidence of socio-family relationship occurrences, which tremendously underlines the benefit of physical activity in nurturing relationships between family members through sports as the catalyst. Sufficient research to study users' behaviour in ice skating facilities becomes vital in the early stages of the design process to ensure users' comfort and health. The demand for innovation and advanced technology in building sports facilities is proposed through this ice skating arena comprised of two main attractions: an outdoor synthetic ice rink and a landscaped garden, which is essential in emphasising spatial experience and restorative environments inside the building, and also nourishing socio-family relations through sports. Healthy architecture's contribution to designing sustainable buildings that can endure challenges in different eras is fundamental in developing sports facilities for future generations to treasure.

ACKNOWLEDGEMENTS

The publication of this article is supported by the Bandung Institute of Technology, 2020. We thank the informants and those who contributed to the writing process.

References

- [1] Bazić J. The social aspects of sport. *Phys. Edu. Sport Centuries*. 2018;5(1):49–66.
- [2] Armstrong N. Children are Fit but not Active. *Educ Health*. 1989;7:28–32.
- [3] Wheeler S, Green K. Parenting in relation to children's sports participation: Generational changes and potential implications. *Leis Stud*. 2012;33:1–18.
- [4] Lee K, Yanagisawa Y, Spengler JD. Carbon Monoxide and Nitrogen Dioxide Levels in an Indoor Ice Skating Rink with Mitigation Methods. *Air Waste*. 1993;43(5):769–71.
- [5] Lee K, Yanagisawa Y, Spengler JD. Reduction of air pollutant concentrations in an indoor ice-skating rink. *Environ Int*. 1994;20(2):191–9.
- [6] Lee K, Yanagisawa Y, Spengler JD, Nakai S. Carbon monoxide and nitrogen dioxide exposures in indoor ice skating rinks. *J Sports Sci*. 1994 Jun;12(3):279–83.

- [7] Brauer M, Spengler JD. Nitrogen dioxide exposures inside ice skating rinks. *Am J Public Health*. 1994 Mar;84(3):429–33.
- [8] Brauer M, Lee K, Spengler JD, Salonen RO, Pennanen A, Braathen OA, et al. Nitrogen dioxide in indoor ice skating facilities: an international survey. *J Air Waste Manag Assoc*. 1997 Oct;47(10):1095–102.
- [9] Rundell KW. Pulmonary function decay in women ice hockey players: is there a relationship to ice rink air quality? *Inhal Toxicol*. 2004 Mar;16(3):117–23.
- [10] Drake H, Zimmerman C, Osachoff G, Baytalan G, Siddiqui M, Frosst G, et al. Cluster of respiratory illness in British Columbia linked to poor air quality at an indoor ice arena: A case report. *BC Med. J*. 2020;62:50–3.
- [11] Pennanen AS, Salonen RO, Aim S, Jantunen MJ, Pasanen P. Characterization of Air Quality Problems in Five Finnish Indoor Ice Arenas. *J Air Waste Manag Assoc*. 1997;47(10):1079–86.
- [12] Rundell KW. High levels of airborne ultrafine and fine particulate matter in indoor ice arenas. *Inhal Toxicol*. 2003 Mar;15(3):237–50.
- [13] Spiering BA, Wilson MH, Judelson DA, Rundell KW. Evaluation of cardiovascular demands of game play and practice in women's ice hockey. *J Strength Cond Res*. 2003 May;17(2):329–33.
- [14] Thunqvist P, Lilja G, Wickman M, Pershagen G. Asthma in children exposed to nitrogen dioxide in ice arenas. *Eur Respir J*. 2002 Sep;20(3):646–50.
- [15] Carlisle AJ, Sharp NC. Exercise and outdoor ambient air pollution. *Br J Sports Med*. 2001 Aug;35(4):214–22.
- [16] Stidwill TJ, Pearsall D, Turcotte R. Comparison of skating kinetics and kinematics on ice and on a synthetic surface. *Sports Biomech*. 2010 Mar;9(1):57–64.
- [17] Buckeridge E, LeVangie MC, Stetter B, Nigg SR, Nigg BM. An on-ice measurement approach to analyse the biomechanics of ice hockey skating. *PLoS One*. 2015 May;10(5):e0127324.
- [18] Kaplan R, Kaplan S. *The Experience of Nature: A Psychological Perspective*. Cambridge University Press; 1989.
- [19] Kaplan S. The restorative benefits of nature: toward an integrative framework. *J Environ Psychol*. 1995;15(3):169–82.
- [20] Ulrich RS. Visual landscapes and psychological well-being. *Landsc Res*. 1979;4(1):17–23.
- [21] Ulrich RS, Dimberg U, Driver BL. Psychophysiological Indicators of Leisure Consequences. *J Leis Res*. 1990;22(2):154–66.

- [22] Ulrich RS, Simons RF, Losito BD, Fiorito E, Miles MA, Zelson M. Stress recovery during exposure to natural and urban environments. *J Environ Psychol.* 1991;11(3):201–30.
- [23] Creswell T (Thrift N, Kitchen R, editors). *International Encyclopedia of Human Geography.* 1st ed. Oxford: Elsevier; 2009.
- [24] Tamariska SR, Ekomadyo AS. 'PLACE-MAKING' RUANG INTERAKSI SOSIAL KAMPUNG KOTA. *Jurnal Koridor.* 2017;8(2):172–83.
- [25] Ekomadyo AS, Nurfadillah A, Kartamihardja A, Cungwin AJ. *IOP Conf. Ser. Earth Environ. Sci.* IOP Publishing; 2018. p. 12012.
- [26] Norberg-Schulz C. *Existence, Space & Architecture.* New York: Praeger; 1971.
- [27] Norberg-Schulz C. *Genius Loci: Towards a Phenomenology of Architecture.* New York: Rizzoli; 1991.
- [28] Schulz CN. *The Concept of Dwelling: On the Way to Figurative Architecture.* New York: Electa/Rizzoli; 1985.
- [29] Chen J, Cao Y, Chen J. A quantitative analysis of creating genius loci in a museum based on spatial visibility analysis. *MATEC Web Conf. EDP Sciences;* 2019. p. 4003.
- [30] Morgan P. Towards a developmental theory of place attachment. *J Environ Psychol.* 2010;30(1):11–22.
- [31] Sudrajat I. *Urban Approaches to Built Environ. (Placlid).* Paper presented at: Proc. Int. Semin. Place Mak. Identity Rethink; 2012; Jaya, Indonesia.
- [32] Y.-F. Tuan. *Space and Place.* Minnesota: University of Minnesota; 1977.
- [33] Patterson ME, Williams DR. Maintaining research traditions on place: diversity of thought and scientific progress. *J Environ Psychol.* 2005;25(4):361–80.
- [34] Dovey K, Raharjo W. *Becoming Prosperous.* London: Routledge; 2010.
- [35] Ekomadyo AS, Riyadi A. Design in Socio-technical Perspective: An Actor-Network Theory Reflection on Community Project 'Kampung Kreatif' in Bandung. *Archives of Design Research.* 2020;33(2):19–37.
- [36] Dilnot C. Design as a socially significant activity: an introduction. *Des Stud.* 1982;3(3):139–46.
- [37] Sommer R. *Social Design: Creating Buildings with People in Mind.* Prentice Hall; 1983.
- [38] Carvalho L, Dong A, Maton K. Legitimizing design: a sociology of knowledge account of the field. *Des Stud.* 2009;30(5):483–502.
- [39] 39. Schulitz Architekten. *Lentpark.* Archdaily; 2014.
- [40] Bogomoloff H. *IIHF Ice Rink Guide.* International Ice Hockey Federation; 2006.
- [41] 41. T Boskus and P Rios. *US Patent 8,129,005 B2.* USPTO; 2012.

- [42] H. H. Park, E. Y. Park, and S. Park. US Patent 6,139,438. USPTO; 2000.
- [43] Toshio S. 1979. US Patent 4,169,688. USPTO; 1979.
- [44] Nasar JL (Moore GT, Marans RW, editors). *Advances in Environment, Behavior, and Design*. New York: Plenum Press; 1997.
- [45] Berto R. Assessing the restorative value of the environment: A study on the elderly in comparison with young adults and adolescents. *Int J Psychol*. 2007;42(5):331–41.
- [46] Wheeler S. The significance of family culture for sports participation. *Int Rev Sociol Sport*. 2012;47(2):235–52.
- [47] Rice L. Archnet-IJAR. *Int J Archit Res*. 2019.
- [48] Bokalders V, Block M. *The Whole Building Handbook: How to Design Healthy*. Routledge; 2010.
- [49] Morawska L, Tang JW, Bahnfleth W, Bluysen PM, Boerstra A, Buonanno G, et al. How can airborne transmission of COVID-19 indoors be minimised? *Environ Int*. 2020 Sep;142:105832.
- [50] Coleman KK, Nguyen TT, Yadana S, Hansen-Estruch C, Lindsley WG, Gray GC. *Sci Rep*. 2018;8:1.
- [51] DiStasio AJ 2nd, Trump DH. The investigation of a tuberculosis outbreak in the closed environment of a U.S. Navy ship, 1987. *Mil Med*. 1990 Aug;155(8):347–51.
- [52] Knibbs LD, Morawska L, Bell SC. The risk of airborne influenza transmission in passenger cars. *Epidemiol Infect*. 2012 Mar;140(3):474–8.
- [53] Li Y, Huang X, Yu IT, Wong TW, Qian H. Role of air distribution in SARS transmission during the largest nosocomial outbreak in Hong Kong. *Indoor Air*. 2005 Apr;15(2):83–95.
- [54] Moser MR, Bender TR, Margolis HS, Noble GR, Kendal AP, Ritter DG. An outbreak of influenza aboard a commercial airliner. *Am J Epidemiol*. 1979 Jul;110(1):1–6.
- [55] Lo CW, Hsu TH. Leisure sports facilities make urban residents benefit of leisure sports facilities in the view of healthy city in Taiwan. *Int. Conf. Big Data, Electron. Commun. Eng*. 2019; Atlantis Press; 2019.