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NATURAL LIGHTING AND THE ARCHITECTURE OF AN INDOOR SWIMMING POOL AT NNAMDI AZIKIWE UNIVERSITY, AWKA, ANAMBRA STATE

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ABSTRACT

Sports are activities or experiences that give enjoyment or recreation; pastime; diversion such an activity, when competitive, requiring more or less vigorous bodily exertion and carried on, sometimes as a profession, according to some traditional form or set off rules, whether outdoors or indoors. In recent years, there has been an increased focus on sustainable design strategies for indoor sports halls, with a particular emphasis on reducing energy consumption and costs. Day lighting reduces energy consumption, improves visual comfort, and creates a sense of well-being for users. The people in Awka, are interested in sports, but currently lack a modern day indoor swimming hall to address their swimming interest. The primary aim of this research is to create awareness and bring to the attention of the Anambra State urban players that Awka, has no known indoor swimming facility especially, within the Nnamdi Azikiwe University with a huge students' population. The research adopted qualitative and descriptive research methods dealing with data from both primary and secondary sources. With the introduction of an indoor swimming pool at Nnamdi Azikiwe University, Awka, the population of the school will increase as it will attract students interested in swimming that is lacking in most southeast schools and cities. This research recommends the introduction of an indoor swimming pool at Nnamdi Azikiwe University, Awka, and if not for any other thing, to help the university in, increasing their student's population, create jobs for the students, attract revenue to the university and encourage inter university competitions.

Keywords: Architecture, Indoor, Swimming Pool, Natural Lighting, Sports.

Introduction

Human activities varied and some of them are classified as sports. Sports, according to Neufeldt and Guralnik (1988), are activities or experiences that give enjoyment or recreation; pastime; diversion such an activity, when competitive, requiring more or less vigorous bodily exertion and carried on, sometimes as a profession, according to some traditional form or set off rules, whether outdoors, as football, gulf, etc. or indoors, as basketball, bowling, etc. An activity involving physical exertion and skill in which an individual or team

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competes against another or others for entertainment (Spots, 2023).

According to Types of Sports (2023). Sports are classified either according to the primary equipment used in playing it or to the setting where it is played. It includes all forms of competitive physical activity or games which through casual or organized participation, aim to use, maintain or improve physical ability and skills while providing enjoyment to participants, and in some cases, entertainment for spectators. It is a way to relieve stress and maintain a healthy body by engaging in different types of sports. With them, one does not just enhance physical health; he or she enjoys and have great time with friends. Sports promote friendliness, teamwork, hard work, and discipline. The satisfaction one gets while playing the sport equals, or even exceeds, the one, one gets from winning it.

Types of Sports

1. **Air Sports: a**ir sports include a vast domain of aerial activities done as sporting events.
2. **Athletics:** athletics refers to sports events that test the athlete's endurance, strength, and speed. It involves competitive running, walking, jumping, and throwing.
3. **Ball Sports:** ball sports are those games that use a ball in play. This includes various categories, including ball-over-net, ball-and-bat, and ball-and-stick games.
4. **Board Sports:** these types of sports are played with a specific board used as primary equipment. Examples of this type are surfing and skateboarding.
5. **Combat Sports:** combat sports are also called fighting sports. It is a competitive contact sport that involves one-on-one combat. It covers all martial arts and ancient fighting events, whether they use brute force or specific weapons.
6. **Cycle Sports:** cycling, or cycle sports, includes all competitive physical activities that use bicycles. They can be carried out as a race or a performance that shows tricks through using bikes.
7. **Gymnastics:** gymnastics is the performance of systematic exercises that requires and shows balance, flexibility, coordination, strength, and overall physical conditioning. These are often done by using different apparatuses, such as rings, beams, and bars.
8. **Ice Sports:** ice sports, as its name suggests, include sporting events that are performed in an ice field. They are mostly held during winter sports competition.
9. **Indoor Sports:** these are those games that do not require an open field to be played. They can be carried out at home or in a specially structured indoor setting. Most table-top games are indoor ones. Some outdoor sports were developed to be played indoors, too. Examples of these are indoor cricket and indoor soccer.
10. **Mind Sports:** a mind sport is a game based on a particular intellectual ability to strategize and win competitions. It does not need

arduous physical exercise and movement of the body. Therefore, it requires more mental than physical skills.

11. **Multisport Race:** this refers to the events that consist of components upholding different sports. It mixes a group of disciplines, usually athletics that are performed consecutively. Examples of this type are the triathlon, tetrathlon, pentathlon, and so on.
12. **Motorsports:** this is the general term referring to the various competitive sporting events that utilize motorized vehicles for racing or non-racing competitions.
13. **Racket Sports:** racket sports encompasses all games that involve hitting a ball or another object through the use of rackets. These types of sports showcase and improve the agility and speed of the players.
14. **Strength Sports:** the focus of this type of sport is an athlete's muscular strength and capability. A strength athlete trains and competes by showing his muscle build or power. Examples of these sports are weightlifting, power-lifting, and bodybuilding.
15. **Target Sports:** this refers to competitive games that involve throwing or shooting a piece of equipment to hit a target. It enhances focus and concentration and promotes patience.
16. **Water Sports:** water sports cover all sporting events played or performed in water.

The primary focus of this work is on water sports and particularly, indoor swimming pools. In general, water sports have rich and diverse history that dates back thousands of years. From swimming to diving and water polo, these sports have captivated individuals and communities around the world. The origins of water sports can be traced back to ancient civilizations, where swimming was a vital skill for survival and transportation. Ancient Egyptian and Assyrian artwork depict swimmers dating back to at least 2500 BCE, while ancient Greek and Roman cultures held swimming and diving competitions as early as the 8th century BCE (Nunn, 2002). These early forms of swimming and diving laid the foundation for future water sports.

Water sports became an integral part of the modern Olympic Games since their revival in 1896. Swimming competitions, including freestyle, breaststroke, backstroke, and butterfly events, were featured in the inaugural Olympics in Athens which took place in 1896. Over the years, new swimming disciplines were added, such as individual medley and relays (International Olympic Committee, 2023). Diving and water polo were also introduced as Olympic sports in subsequent editions of the games, further contributing to the popularity of water sports worldwide.

Swimming is one of the most popular recreational activities all over the world. It is also a form of sports in several countries and health and fitness experts stress the importance of including it in their exercise regime. Biologically, it improves the blood circulation in the body and it is a great workout for all the muscles. It is a form of

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low impactaerobic activity and increases strength and cardiovascular stamina. Apart from being a full body exercise, it is also a great way to relax and rejuvenate. In fact, swimming is considered as one of the greatest stress busters and people use it to control their body weight.

The types of aquatic water sports include the following:

- **Canoeing:** Canoeing is a popular water sport that involves propelling a canoe through various bodies of water, such as lakes, rivers, and even whitewater rapids, using paddles. It has a rich history dating back thousands of years and is deeply rooted in indigenous cultures worldwide (plate 1). Canoeing gained prominence in the modern era through European exploration and colonization, with significant contributions from early North American settlers and fur traders (Cadieux, 2018).



Plate 1. Canoeing; Source: Edgar Bullon, 2015

- **Parasailing:** Parasailing is a recreational kiting activity where a person or multiple people are towed behind a vehicle while attached to a specially designed canopy wing that resembles a parachute, known as a parasail wing. Parasailing, also known as parascending, paraskiing, or parakiting, is a sport in which an individual wears a parachute and is pulled behind a motorboat to sail through the air (plate 2).

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Plate 2. Parasailing; Source: Edgar Bullon, 2015

- **Windsurfing:** Windsurfing is a wind-propelled water sport that is a combination of sailing and surfing. It is also referred to as "sail boarding" and "boardsailing" and emerged in the late 1960s from California's aerospace and surf culture. Windsurfing is one of the most popular sea sports, combining sea and wind as tools at the beautiful beaches worldwide. The practice of windsurfing is simply controlling the wind while you are balancing yourself on the water (plate 3).



Plate 3: Windsurfing; Source: Edgar Bullon, 2015

- **Water Polo:** Water polo sport is played in a swimming pool by teams of seven with a buoyant ball resembling an association football or soccer ball. A game of water polo mainly consists of the players swimming to move about the pool, treading water (mainly using the eggbeater kick), passing the ball, and shooting at the goal. In 1874, the London Swimming Association codified the rules for water polo, and the sport began to spread internationally (International Swimming Federation, 2023). It was included in the Olympic program for the first time in 1900 and has since become a highly competitive and globally recognized sport (plate 4).

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Plate 4: Water Polo; Source: Edgar Bullon, 2015

- **Free diving:** A sport or activity of diving underwater without the use of breathing apparatus, especially in deep water. Free diving is the practice of holding your breath when diving underwater without the use of breathing equipment, such as a scuba tank. Free diving is a way of life for some people, a competitive sport for others, and a hobby for many (plate 5).



Plate 5: Free diving; Source: Edgar Bullon, 2015

- **Boating:** Boating is the leisurely activity of travelling by boat, or the recreational use of a boat whether powerboats, sailboats, or man-powered vessels (such as rowing and paddle boats), focused on the travel itself, as well as sports activities, such as fishing or water-skiing. It is a popular activity, and there are millions of boaters worldwide (Boating, 2023). It has been a popular pastime for centuries, dating back to ancient civilizations. Unbelievably, the first known boat dates back around 8,000 years ago (plate 6).

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Plate 6. Boating; Source: Edgar Bullon, 2015

- **Fly boarding:** Fly boarding is an extreme water sport in which athletes compete using equipment called fly boards. A fly board can be best described as a personal watercraft fitted with a water jetpack/hover board. Fly boards were invented recently by a French watercraft rider in the Autumn of 2012 and were introduced to the world during the 2012 jet ski World Championship in China. It quickly became popular among water sport enthusiasts which led the way for a competitive sport to be developed out of it (plate 7).



Plate 7.: Fly boarding; Source: Edgar Bullon, 2015

- **Competitive Swimming:** Competitive swimming is a popular sport that involves racing against other swimmers in various swimming strokes over designated distances. Dating back to ancient civilizations, swimming competitions have been documented as early as 36 BC in Japan, with modern competitive swimming gaining prominence in the late 19th century (plate 8). The sport has since evolved into a highly regulated and organized activity, governed by international bodies such as FINA (Fédération Internationale de Natation) and enjoyed by millions of participants worldwide (SwimOutlet, 2023).

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Plate 8. Competitive Swimming; Source: Edgar Bullon, 2015

At the same time, indoor swimming has been around for centuries, but it was not until the 19th century that it became popular for recreation and exercise. The first indoor swimming pool in the United States was built in Boston in 1868. As Tower, McDonald and Stewart (2014) note, a major issue in the aquatics and recreation industry concerns a lack of clarity regarding the definition of aquatic centres and the types of amenities they provide. They also acknowledge a difficulty to suggest a single term that accurately describes all aquatic and recreation facilities. There have been many inconsistencies in naming buildings with swimming facilities nationally and internationally, with many different terms and names being used in past studies to describe aquatic centres; some of which include aquatic leisure centres (Sydney Water 2011), public pools (Wilkenfeld & Associates 2009), public aquatic and recreational centres (Howat 2013), aquatic and recreational centres (Tower, McDonald & Stewart 2014), aquatic facilities (Rajagopalan2014), indoor swimming pools and leisure centres (Hancock & Chem 2011), public swimming baths (Saari & Sekki 2008), natatoriums (USA Swimming 2010) and leisure pool facilities (Kampel, Aas & Bruland 2014).

There is also conflict within ABS figures regarding the collection of data about the sport and recreation industry. Tower, McDonald and Stewart (2014) pointed out that in recent years there have been three changes in the statistical parameters of measurement for facilities that include aquatic and recreational centres. Aquatic centres were included under health and fitness centres and gyms in 2010, then were changed to structured facilities such as gyms, public pools or courts in 2011; to add confusion, in the analysis and naming of aquatic centres, the ABS divided this type of building into two separate sections: indoor and outdoor facilities. Therefore, based on ABS (2011) data, there is no clear indication under which category aquatic centres with both indoor and outdoor swimming pools fall.

In addition, several past studies fail to clearly describe the exact facilities included within aquatic centres. For example, Tower, McDonald and Stewart (2014), stated that aquatic and recreational centre are defined as a community venue that

provides a pool and both fitness and active recreation facilities, but without specification of whether that pool is indoor or outdoor. Further, neither Sydney (2011) 'Best Practice Guidelines for Water Management in Aquatic Leisure Centres' provides a definition of what constitutes an aquatic leisure centre, nor do the Centre for Environmental and Recreation Management Performance Indicators' (CERM PI 2013, 2014), 'Operational Management Benchmarks for Australian Public Sport, Leisure and Aquatic Centres' reports indicate their included facilities.

The aquatic and recreational sector is a large global industry. In Europe, there are around 1.5 million sports facilities that include swimming pools, which represent 8% of the world's overall building stock (Step2Sport, 2015). In 2014, the Step2Sport project was introduced by several European countries to support the refurbishment of existing sport buildings contributing to the European Union's (EU) energy objectives. This project focused on two types of sporting facilities, indoor swimming pools and indoor sport facilities such as multifunction sports centres, community centres and gymnasiums, and aimed to have a long term effect on and involvement in Europe's strategic goals by contributing a minimum 20%reduction in CO_2 emissions by 2020. Indeed, Europe has a large number of sports centres with swimming pool facilities. That is, Norway has around 850 swimming pools ranging from small school pools to various amenities for therapeutic use, sports and leisure, as owned and operated by various municipalities (Kampel, Aas & Bruland 2014). There are also approximately 1,468 swimming pools in Belgium, 189 in Denmark, 750 in France, 3,168 in Germany, 29 in Greece, 89 in Ireland, 1,489 in Italy, 300 in the Netherlands, 116 in Portugal, 1,025 in Spain and 2,390 in the United Kingdom (UK) (Trianti, Stourna et al. 1998).

With over 10.4 million residential and 309,000 public swimming pools in the US(CDC 2016), it is unsurprising that swimming was the fourth most popular recreational activity in 2009 (US Census Bureau 2012). Additionally, there were approximately 301million visits to swimming pools each year by persons over the age of six, with 36% of children aged 7–17 years old and 15% of adults swimming at least six times annually (US Census Bureau 2012). Similarly, research on the overcrowding of swimming pools in China found there are well over 6,000 swimming pool facilities registered in China's Health Ministry Report (Kaushik 2015). Despite this information, it is still relatively difficult to obtain or source existing data on global aquatic centres and swimming pools, especially for developing countries.

The design of a swimming hall depends on its intended use, but most indoor swimming halls have several common features. According to Lachocki (2011), indoor swimming halls have evolved over the years to meet changing users' needs. He notes that, indoor swimming halls in the past, were primarily built for swimming competitions, with little consideration for recreational use. However, over time, the demand for indoor swimming halls for recreational purposes grew, leading to the creation of more versatile and multipurpose designs.

In recent years, there has been an increased focus on sustainable design strategies for indoor sports halls, with a particular emphasis on reducing energy consumption and costs. One of the most effective ways of achieving sustainable design in indoor sports halls is through day lighting, (natural light) to illuminate indoor spaces. According to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE),day lighting is the "controlled admission of natural light into a space to reduce or eliminate the need for artificial lighting." (ASHRAE, 2005).

Day lighting reduces energy consumption, improves visual comfort, and creates a sense of well-being for users. In indoor sports halls, day lighting can provide a natural and comfortable environment for sports activities while reducing the need for artificial lighting.
In their book, "Day lighting: Natural Light in Architecture," Peter Tregenza and Michael Wilson (2003), emphasized the importance of day lighting in architecture and how it can be used to create comfortable and sustainable indoor spaces. They noted that day lighting can be used to create a balance between natural and artificial lighting, resulting in spaces that are not only energy-efficient, but also visually appealing. The use of natural light in indoor sports halls requires careful considerations such as the orientation of the building, the location of windows, the size and shape of the space, and the use of shading devices.

Indoor swimming sports halls are essential spaces that require ample natural lightto provide the right ambiance and visibility to the users. However, many indoor swimming sports halls are designed with artificial lighting systems that do not provide the necessary illumination levels, resulting in poor visual sensitivity and discomfort to users. The use of natural lighting as an architectural tool can help in creating a sense of well-being, and improve productivity and performance. Several studies have investigated the use of natural lighting in different types of buildings, such as offices, schools, and hospitals. However, no such study has been seen in indoor swimming sports halls.

Awka, home to the prestigious Nnamdi Azikiwe University and the capital of Anambra State, with an everyday growing population of both young and old has no known indoor swimming pool. The people are interested in sports, but currently lacks a modern indoor swimming hall to address their swimming interest. To accommodate that, this research looked into the introduction of a modern day indoor swimming hall at Nnamdi Azikiwe University, where the interest of both the university and the general Awka population will be served especially, with the university hosting various sports events and competitions. The absence of a suitable indoor sports (swimming) venue poses a huge challenge to both sports enthusiast and Awka community as a whole.

Aim

The primary aim of this research is to create awareness and bring to the attention of the Anambra State urban players that Awka,

has no known indoor swimming facility especially within the Nnamdi Azikiwe University with a huge students' population.

Research Method

The research adopted qualitative and descriptive research methods dealing with data from both primary and secondary sources.

Findings

With the introduction of an indoor swimming pool at Nnamdi Azikiwe University, Awka, the population of the school will increase as it will attract students interested in swimming that is lacking in most southeast schools and cities. The work noted that, swimming as a sport has not been adequately promoted in southeast and not particularly introduced in the area universities. Swimming is a good source of income for the communities where they exist and it will not be different for Nnamdi Azikiwe University and Awka community as a whole.

Equally, it is a good source of employment as it creates opportunities for both the students and people within the school community, has the potential to attract sports tourism that would generate revenue for both state and local economy

It equally, allows individuals access to swimming regardless of the weather conditions. Even during the rainy season or unfavourable weather days, people train and compete in provided controlled environment.

Recommendation

This work recommends the introduction of an indoor swimming pool at Nnamdi Azikiwe University, Awka, and if not for any other thing, to help the university in, increasing their student's population, create jobs for the students, attract revenue to the university and encourage inter university competitions.

The introduction of the inddor swimming pool at the university will encourage weekend activities and sports tourism with the university and an added advantage to the university. The health benefits of a swimming pool will never be over emphasized and this work strongly recommends the introduction of the swimming pool.

Conclusion

The population of Anambra State is growing by all means especially, with the insecurity in northeast and southwest Nigeria. Farm lands are fast disappearing and replaced with housing accommodations of different types. In all these, no efforts are made to introduce recreation facilities and especially, swimming pools. The word's outlook in life is fast changing and people are getting conscious of the life styles and research has shown that swimming helps in improving the health of the people so, swimming facilities are welcomed in communities. At the same time, Nnamdi Azikiwe is equally growing in students' population and needs diversification in activities within the university. The introduction of a well-established sports facility will be an added advantage and particularly, an indoor swimming pool.

REFERENCES

ASHRAE (2005) American Society of Heating, Refrigeration and Air-Conditioning Engineers, Ventilation for acceptable indoor air quality, 62.1-2007, ASHRAE.

Australian Bureau of Statistics (ABS) (2011). Australian social trends, June 2011, cat. no. 4102.0, ABS, Canberra, viewed 25 August 2014, <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Main+Features30Jun+2011>.

Boating (2023) Boating. In Free Encyclopedia Wikipedia Online. Retrieved June 17, 2023, from https://en.wikipedia.org/wiki/Boating

Cadieux, K. V. (2018). A Paddling Heritage: Canoeing in Ontario, 1950–1980. Ontario History, 110(1), 5-29.

Centers for Disease Control and Prevention [CDC] (2016). Information on healthy swimming and recreational water, viewed 9 July 2015, <http://www.cdc.gov/healthywater/swimming/fast-facts.html>.

Centre for Environmental and Recreation Management Performance Indicators [CERM PI] (2013). Operational management benchmarks for Australian public sports, leisure and aquatic centres, data file, Centre for Tourism and Leisure Management, UniSa, Adelaide, SA.

Centre for Environmental and Recreation Management Performance Indicators [CERM PI] 2014, Operational management benchmarks for Australian public sports, leisure and aquatic centres, data file, Centre for Tourism and Leisure Management, UniSa, Adelaide, SA.

Hancock, MD &Chem, MI (2011). 'Indoor swimming pools and leisure centres: model to improve operational effectiveness and reduce environmental impact', in CIBSE Technical Symposium, De Montfort University, Leicester, UK, 6–7 September, viewed May 2016,

Hancock, MD &Chem, MI (2011). 'Indoor swimming pools and leisure centres: model to improve operational effectiveness and reduce environmental impact', in CIBSE Technical Symposium, De Montfort University, Leicester, UK, 6–7 September, viewed May 2016, < http://www.dee-associates.com/pdfs/CIBSE%20Paper%20for%20September%20conference%

Howat, G (2013). Personal benefits for Australian public aquatic & recreation centre customers, research report, Centre for Tourism & Leisure Management (CTLM), UniSA Business School, University of South Australia, <https://www.alfaleisure.org.au/wpcontent/ uploads/2014/05/UniSA-Howat-final-ARV-report-15-1-14.pdf>.

International Olympic Committee. (2023). Swimming. Retrieved from https://www.olympic.org/swimming

International Swimming Federation. (2023). Water polo history. Retrieved from https://www.fina.org/history-water-polo

Kampel, W, Aas, B &Bruland, A 2014, 'Characteristics of energy-efficient swimming facilities: A case study', Energy, vol. 75, no. 1, pp. 508–512.

Kaushik (2015). 'Chinese swimming pools: the most crowded in the world', Amusing Planet, blog post, viewed 9 July 2015, <http://www.amusingplanet.com/201

2/08/chinese-swimmingpools-most-crowded-and.html>.

Lachocki, Thomas M. (2011). "Indoor Swimming Hall." Environmental research 45.1 (1988): 127-139.

Neufeldt,Victoria and Guralnik, David B. (1988). Third Collage Edition. Webster's New World Dictionary of American English. Macmillan. USA

Nunn, S. (2002). Ancient Egyptian Swimming: Implications for Modern Swimmers. The Journal of Egyptian Archaeology, 88, 67-80.

Peter T., Michael W. (2003). "Daylighting – Architecture and Lighting Design" vol. 129, no. 1, pp. 186–198.

Rajagopalan, P (2014). 'Energy performance of aquatic facilities in Victoria, Australia', Facilities, vol. 32, no. 9/10, pp. 565–580.

Saari, A &Sekki, T (2008). 'Energy consumption of a public swimming bath', The Open Construction and Building Technology Journal, vol. 2, pp. 202–206.

Spots (2023). sports meaning in english - Google Search

Types of Sports (2023). List of Sports: Names of Different Types of Sports and Games • 7ESL

Step2Sport (2015), Goals, viewed 9 July 2015, <http://step2sport.eu/?page_id=8>.

Sydney Water (2011). Best practice guidelines for water management in aquatic leisure centres, viewed 25 August 2014.

SwimOutlet (2023), The History of Swimming - [https://www.swimoutlet.com/guides/the-history-of-swimming]

Tower, J, McDonald, K & Stewart, B (2014) Community benefits of Victorian aquatic and recreation centres: technical report for Aquatics and Recreation Victoria, technical report, Victoria University, Institute of Sport, Exercise and Active Living, Melbourne, VIC, <http://vuir.vu.edu.au/27290/>.

Trianti-Stourna, E, Spiropoulou, K, Theofilaktos, C, Droutsa, K, Balaras, CA &Santamouris, M (1998). 'Energy conservation strategies for sports centers: part b. swimming pools', Energy and Buildings, vol. 27, no. 2, pp. 123–135.

US Census Bureau (2012). Arts, recreation, and travel: participation in selected sports activities, 2009, viewed 8 July 2015, <http://www.census.gov/compendia/statab/2012/tables/12s1249.pdf>.

USA Swimming (2010). A green initiative unique to natatoriums, viewed 8 May 2015,<http://www.usaswimming.org/ViewMiscArticle.aspx?TabId=1755&Alias=rainbow&Lang=en&mid=7715&ItemId=3633>.

Wilkenfeld, G & Associates (2009). Swimming pools and electric space heating: the case for coverage by the Building Code of Australia, Australian Building Codes Board, viewed 21 August 2014, <https://www.scribd.com/document/202465225/3117-Swimming-Pools-and- Electric-Space-Heating-the-Case-for-Coverage-by-the-BCA>.