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Designing a Holistic Environment for Athletic Performance: Athletics Canada High Performance Training Center

By

Sofia Naranjo Mata

The Supervisory Committee certifies that this *thesis* complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF ARCHITECTURE

SUPERVISORY COMMITTEE:

Dr. Stephen A. Wischer

Thesis Coordinator

DocuSigned by:

Stephen Wischer

CBA6CA6223024AC...

Dr. Ganapathy Mahalingam

Primary Advisor

DocuSigned by:

Ganapathy Mahalingam

CODF0AA3BE08476...

Approved:

05/09/2024

Date

DocuSigned by:

Susan Schaefer Kliman

C9FF1C4ACFB7438...

Department Chair



DESIGNING A HOLISTIC ENVIRONMENT FOR ATHLETIC PERFORMANCE: ATHLETICS CANADA HIGH
PERFORMANCE TRAINING CENTER

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Sofia Naranjo Mata

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ABSTRACT

Sports are highly profitable, but when looking at the design of sports buildings, the spectators and owners are the primary user groups, pushing athletes to the side and compromising where they train. As athletic talent continues to better with each generation, the environment in which the athlete trains must be considered as a factor in performance. By shifting the focus of design back onto the athletes, a prosperous environment can be created that improves their wellness and performance. By examining sports performance, how design affects the experience of users and surveying athletes, information can be derived that creates a protocol for athletic training facilities. Using this protocol when designing sports architecture prioritizes the athlete, creating a holistic environment for athletic performance.

DEDICATION

This project is dedicated to my mom, dad and sister. Their support is what has gotten me to this point in my life. Being the first in my family to attend graduate school, I can be at peace knowing that the sacrifices my parents made bringing my family to this country paid off. *Sí se puede.*

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1. INTRODUCTION

1.1. Problem Statement

For a great part of documented history, sports have played an integral role in society. The spectacle and display of peak athletic performance has created entertainment, brought communities together, and provided incentive to push the limits of what humanity can achieve. From young kids playing little league soccer to athletes that have dedicated so much of their time for a chance at success, sports find a way into everyone's lives. By standard human nature, people have discovered how to create massive amounts of profit from athletic competitions and they now hold incredible significance to the economy. The sports industry as a whole recorded a revenue of almost \$487 billion in the year 2022. This number is expected to increase and surpass \$600 billion in 2027 (Gough, 2023). Much of this profit comes from extrapolating as much money as possible from the athletes and the fan bases, which makes the dollar sign the main consideration when major organizations are making decisions. Though profit is important in the world of sports, it holds more precedence in the industry than the athlete, who is arguably the most necessary component for this industry to stay afloat. This precedence can be seen in the design of competition and training facilities. This creates an environment that is not tailored towards the athlete and does nothing to help improve their performance.

As time goes on, more is required for athletes to perform better than their competitors. With technology and civilization becoming more advanced, athletic talent has reached heights unheard of. New research allows for more effective training, elite resources are being offered at younger ages, and the bar keeps being raised for what is required to be great. Because the average athletic standard will continue to get better with each generation, athletes will begin looking to new areas that can help enhance their athletic performance.

In *The mind gym: an athlete's guide to inner excellence*, Don Shula, an NFL Hall of Fame coach, states that "the whole idea is to get an edge. Sometimes it takes just a little extra something to get that edge, but you have to have it" (Mack, 2002, p. 13). Nutrition, sleep, high level recovery, and mental training is just a small list of acts that athletes have learned to control to get an edge on their competition. When it comes to improving athletic performance, few have questioned the environment

that athletes spend all their time training and competing in. Within the design of athletic complexes lies an untouched group of controllables that can become another factor in the equation of athletic greatness. By shifting the focus of these facilities back onto the athlete, they can be designed to harbor an environment that improves the overall wellness and health of athletes, helping them reach their optimal conditions for being successful.

1.1.1. Research Questions

To enrich the relationship between sports and architecture, it must be asked "how can design decisions impact the mindset and wellness of athletes and in turn, impact their training and performance?" This research can be broken down into two distinct categories: the examination of athletes' incentives and mental states within sports psychology, and how architecture can influence the experience of users within a building. Other questions that will arise involve what emotions are desired during training and competing, what intrinsic motivations an athlete may have, and what components they believe are essential to successful training. These questions are to help make up for the lack of information there currently is regarding how the built environment directly affects the athlete's experience. Discovering these answers will lead to higher quality training and competition centers that are athlete focused.

1.1.2. Proposed Outcomes

By doing this research, an analysis of emotional and psychological factors for athletes can take place with the incentive of better understanding how the built environment affects them. With the gained knowledge from this research, it can be reintegrated into existing literature regarding design's impact on the users and innovative design solutions can be created. An example of this is an athlete stating that having autonomy over their training helps them feel more motivated and reduces the possibility of them feeling burnt out. A design solution to this would be to provide them with multiple places where their training can occur, such as distance runners being able to complete their training on trails outside the facility, or within the facility in an altitude training room. A set of these design schematics created by analyzing the data regarding an athlete's mindset will influence new concepts for training facilities that place the athlete at the forefront of major decisions.

1.2. Objective

1.2.1. Aim

The goal of this research is to recenter the needs of the athlete when it comes to the design of training facilities and question how this form of architecture can be optimized. To continue to increase the effectiveness and value of architecture, new approaches must be taken in how spaces are designed. By looking into other spheres of knowledge such as mental wellness and sports psychology, more information is gained that can influence an innovative design protocol that be implemented into this building type. These solutions will provide incentives for these massive teams and organizations to seek an architect that is well versed in this area of design. Athletes will have a higher likelihood of staying where their needs are prioritized and feeling valued can help with overall wellness and performance. This can demonstrate how something seemingly insignificant such as a building's design in relation to athletic performance can cause a chain reaction that provides people with their desired outcome of success.

1.2.2. Significance

As sports continue to grow, so will the stresses and pressure of being an athlete. When the foundational part of something so culturally significant begins to falter, the rest of it can come crashing down. Many of the beloved star athletes today fell in love with their sports at an early age, but when the sport becomes their job and livelihood, the incentive for continuing begins to go to outside sources. This coupled with collegiate, high school, and even youth athletes feeling the demands of athletics more harshly and at a younger age means shows that the base premise of sports being an enjoyable game is wavering. Elite athletes are beginning to recognize this and there are more conversations now regarding the mental health of athletes than ever before. There are many byproducts of sport, such as economic value, profit and cultural significance, and many decisions in the sports world are made with these byproducts taking the most precedence. This research signifies another area of athletics and training that is centered on the athlete, for without the athletes, sports would cease to exist. Taking care of a pivotal part of athletics will help the joy of the game be invigorated and rediscovered. By keeping the passion alive and the athletes well, sports can continue to play its role in society and be something that so many people love.

2. BACKGROUND

2.1. Background

The prevalence of sports architecture is undoubted as Rod Sheard states that “there is no other building type so powerfully able to touch the hearts and minds of the ‘common man’” (Sheard, 2001, pg. xiv). This building archetype can be seen as far back as 80 CE with the Colosseum built in Rome, Italy. The Colosseum was one of the first buildings designed to host large gatherings of people and marks the beginning of the evolution of these structures as the prevalence of sports also evolved (Augustyn et al., n.d.). These structures continue to get bigger and better as sports become more popular and have major influence on the growth of their surrounding urban fabric because of their economic and social impacts. Many economists have challenged whether the costs of the massive facilities and stadiums are worthwhile, but these places connect people, provide reasons for communities to be proud, and allocate space for the competitiveness and drive of the human spirit to be displayed (Pushparaj, 2021).

2.2. Literature Review

2.2.1. Sports Architecture Research

When beginning to research the topic of sports architecture, one can discover how much of this design sector is not solely focused on sports. As sports have become more profitable in recent years, demands for these buildings have shifted from a place to simply host events, to massive mixed use facilities that are sewn into the urban fabric and have significant impact on the cities they reside in (Kennedy et al., 2022). To ensure that these facilities are successful, many books have been compiled containing all the specific technicalities that must be considered when endeavoring in this architecture type. These technicalities include certain design aspects needed for each sport, programming and adjacencies within the programming, how this building type impacts the community around it, and what different users need from the building. To gain an understanding of the typical programming in these buildings, one must understand the three user groups that need to be satisfied with the design: the spectator, the owner, and the athlete. The spectator is the largest percentage of users within this design sector. Spectators provide the profit, the crowds, and the fan bases that so passionately fuel the sport. Spectators need to have a positive experience while viewing the sport to justify the money spent

attending the competition. Owners are the user group that demand a return-on-investment for these structures and push for the commercialization of the spaces adjacent to where the main building purpose is happening. With buildings of this size, the owners must also ensure that the impacts on the surrounding environment are positive so that project has greater likelihood of being well received by the community and the taxpayers that are oftentimes funding it. Lastly, it is necessary that the design allows the athlete to compete to their best ability and provide the entertainment that pushes for this building to exist in the first place (Sheard, 2001). By understanding what the users need and their reason for using the spaces, design within sports architecture can be better understood.

The basic programming created by understanding the user groups will begin to influence the forms of these structures. The function of these buildings are to view a sporting event and allow spectators to witness the competition. Because of this, most sport facilities follow an ellipses shape to best perform their desired function (Pawlikowska-Piechotka, 2021). Besides this basic concept, sports facilities range from small arenas for local communities to massive and iconic stadiums used for mega sporting events such as the Olympics. There is a great variety in the construction methods and visual designs of these structures where the cultural and historical context is depended on to influence these items (Pawlikowska-Piechotka, 2021). When questioning the basis of design within sports architecture, one source argues that there is limited literature that examines the rich relationship between sports and architecture beyond what is on a surface level. Of the professionals in sports history that have searched for the connection, their focus often falls onto the social and financial impacts that significant architecture projects have had. With little history paying attention to the visual, artistic, and cultural impacts of athletic buildings, the meaning of the form is lost (Flowers, 2017). With this lost meaning in the form, one begins to question how design norms within this building typology came to fruition.

During the postmodern architectural movement, people began to question the functionality of typical sports facilities from that era. All designs had straight lines, right angles, and a standardization occurred across facilities within the same sport. It was believed that these forms followed the essential function of sports, but there is utmost certainty that during this time, there had not been any experimental studies to compare sports performances within differing environments. The typical rules for

the design of sport facilities came not from the direct effects of sport, but instead a socially adopted standard that no one dared to step foot outside of (Eichberg, 1993). This standard can be altered to adapt to the needs of the athlete as all forms within sports architecture have been catered to the owners, the spectators and the surrounding community. By including athletes in the basis of designs, greater meaning can be found in the outcome.

2.2.2. Gap Identification

When reviewing sources regarding sports architecture, a deep knowledge of the programming, technicalities, business cycles, and tendencies is displayed in a great manner. To design an environment that is tailored to optimizing the performance of the athlete, information regarding how the built environment affects athletes is needed. This information is difficult to find in the current literature. One source included in this review had 227 pages of helpful information regarding the topic, but only four pages were dedicated to the needs of the athlete and none regarding their wellbeing was included. To design spaces that improve the wellness of the athlete, the research must venture outside the world of sports architecture and into areas of sports psychology, sports performance, and how the user's experience is affected by architecture. By examining sports psychology and sports performance, it can be understood what is needed for an athlete to perform their best. After knowing these requirements, review in the literature of how design impacts people within the buildings can be utilized to find design aspects that are conducive to the athlete's performance. By synthesizing information from three groups of sources, a design protocol can be implemented that offsets the lack of knowledge in how design impacts athletes who experience their buildings.

2.2.3. Sports Performance Research

The performance of the athlete and the team in the world of sports is vital to its successes as a whole. Sports performance is defined as "a multifactorial trait resulting from the interplay of individual, environmental, and task characteristics" which eventually results in what an athlete is able to accomplish (Gomes et al., 2020). Understanding the numerous aspects of varying levels of performance is intricate and constantly in motion, therefore an "adoption of a holistic perspective" is required to be fully knowledgeable (Gomes et al., 2020). When people think of what is required to be successful in athletics,

many think of the physical and athletic traits that all the best athletes in the world have. Though these physical aspects are vital in the sports excellence equation as a whole, there is a large variety of specific physical traits athletes desire as one goes from sport to sport. To create a design protocol that helps athletes in all situations, a factor that is present within every athlete must be the center of focus with this sports performance research- that factor is sports psychology.

Sports psychology must be researched because the mental state of the athlete is a necessary component to consider when analyzing performance during competing and training (Schinke et al., 2018). Similar to how athletes train their bodies to withstand the stresses of competition, their minds are trained to create the proper mental space needed to succeed. Athletes are much more susceptible to mental distress compared to their non-athlete counterparts (Schinke et al., 2018). It was hypothesized that when a body was under copious amounts of stress, it would lead to a higher likelihood of negative health effects, such as physical injury. This led researchers to closely examine how injuries in sport and stress factored into each other (Appaneal et al., 2014). It was discovered that stress was highly correlated with athletic burnout, which is defined as consistent exhaustion physically and emotionally, lesser feelings of accomplishment, and seeing a lost value in one’s sport (Li et al., 2013). How an athlete responds to stress can determine whether they have greater chances of injury (Appaneal et al., 2014). This is explained in the model of stress and injury shown in Figure 1.

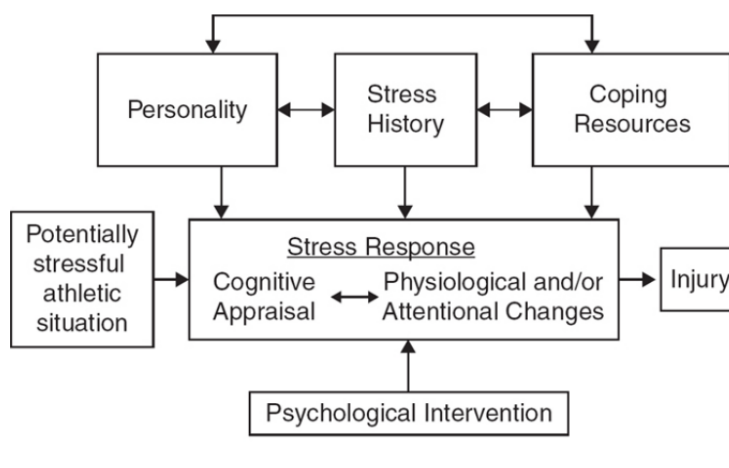


Figure 1. "Stress and injury model."
 Source: This model was produced by Appaneal, R. N., Perna, F. M., and Madrigal, L in *Psychological susceptibility to injury*, 2014, Figure 1.

The stress injury model demonstrates that “three categories of psychological risk factors (i.e., personality, history of stress, and coping resources)” alter how an athlete reacts to stressors within their sports and sequentially effects their chances of sustaining injury as described by Appaneal et al. (2014). This model also offers guidance for interferences and mental adaptations that can deter negative effects of stress and hopefully avert injuries in athletes. An important aspect of the stress and injury model is a person’s cognitive appraisal. This concept can be broken down into two reactions, the first being an assessment of the potential damage that stress can induce in a situation and second, an assessment of the coping mechanisms one can use to alleviate said stress. If the coping mechanisms are sufficient to offset the demands of said stress, there is little reaction to the stressors. Detrimental reactions to stress occur when the coping mechanisms are insufficient for stressor (Appaneal et al., 2014) which reduces the overall wellness of the athlete. By providing alternative and sufficient coping mechanisms, it reduces the negative impacts of the stressor and the athlete is less likely to feel the negative biophysiological responses to stress.

Stress, when contributing to overtraining, can also deter peak performance as it is a factor in burnout, which can cause injury and occurs when training is overtly intense. Symptoms that an athlete can experience due to overtraining displays closely to clinical depression and includes disruptive sleep, lower levels of hunger and sex drive, and an increase in anxiety and touchiness. Despite all the negative physical effects, a biopsychological approach should be taken to also counteract the mental detriments that occur concurrently to the physical detriments (Schinke et al., 2018). By minimizing stress, there is less of a risk for burnout and an athlete has greater chances of performing to their highest capability. With understanding the stress injury model and stress’s role in athletic burnout, reducing it an athletic situations is beneficial for increasing the overall wellness of the athlete and helping their performance.

Another key factor within sports performance is the motivation of the athlete. All athletic endeavors require some form of dedication and this desire to succeed is driven by multiple factors. There are two main forms of motivation to be considered: extrinsic motivation and intrinsic motivation. Intrinsic motivation is defined as completing a task for the rewarding feeling that one gains from participating. Extrinsic motivation refers to when separate outcomes and outside influences are the reason for finishing

a task (Oudeyer & Kaplan, 2007). There is an overall desire for athletes to have a greater percentage of inner motivations because they are more likely to stay consistent even when outside incentives waver, feel less nerves when it comes time to compete, and display a higher level of talent than those that are extrinsically motivated. One method that can increase whether someone participates in an activity based on inner motivations is described in the self-determination theory. This theory explains that “competence, autonomy, and relatedness” are essential human desires (Hollembek & Amorose, 2005, p. 21).

Competence is important because it distinguishes one’s actions as necessary and effective, therefore it is worthwhile completing them. Autonomy represents how one has freewill to their thoughts and actions. Feeling one’s actions as their own fulfills the desire for autonomy. Lastly, relatedness describes the camaraderie people experience with those who complete similar tasks as them. When a task fulfills these three categories, a person is more likely to willingly participate because there will be more satisfaction felt (Hollembek & Amorose, 2005). By creating a training environment that satisfies these three needs, the athlete is likely to have greater inner motivations and not have to rely on inconsistent sources to successfully complete their training. These motivations are key factors in the mindset of an athlete and must be considered when optimizing performance.

With knowing how mental components such as stress and motivation can impact an athlete’s training and competition, there is no doubt that the mental state of the athlete must be cared for. But with the added stressors and cultural norms seen within the world of sports, this task isn’t as easy as it seems to be. Athletes are praised for not letting pain interfere with reaching their goals. This appraisal places that behavior on a pedestal and it carries over to how they handle their mental health. This standard of showing no weakness pushes athletes to wait until the last possible moment to seek help when mental health concerns are present. (Schinke et al., 2018). To counteract the historical precedent of placing physical health over mental health, a priority must be placed on reducing current stigmas and supporting the mental wellness of athletes. Allowing space for conversations to occur regarding an athlete’s mental health can help prevent negative emotions and successfully treat dysfunctional symptoms that damper elite performance. This mental awareness helps take a step back from the ‘no pain no gain’ model that many athletes grew up with and creates space for new mental techniques that

can assist in the desired outcome. R.J. Schinke et al. states that “mindfulness and resilience [are] two key components associated with well-being” that can contribute to a successful environment for performance (2018, p. 630). Mindfulness is an encompassing term that covers a variety of practices that help the user notice details around them intentionally and in the present moment. Mindfulness differs from other mental health practices as it tries to alter the relations that the user feels between themselves and their thoughts and encourages the user to fully feel their emotions. An example of mindfulness at work are its practices helping athletes enter their flow state, which is defined in *Mindfulness in athletes* “as complete absorption in the task at hand, and the quality of present-moment and non-self-conscious concentration” (Anderson et al., 2021). Those who are more mindful have greater chances of experiencing said flow states, which are significant factors in obtaining optimal performance in sport (Anderson et al., 2021). Mindfulness not only harbors a good mindset for an elite athlete, it also deters psychological issues, which in turn can lessen the likelihood of suffering physical injuries (Nippert & Smith, 2008). Mindfulness is a dependable and easy practice to increase mental skills and overall wellbeing that is readily available to all (Anderson et al., 2021) and factor into an environment made in mind of the athlete’s wellness. With a brief journey reviewing literature regarding sports performance and the psychology of athletes, one can begin to understand the basic necessities needed for peak athletic performance.

2.2.4. Architecture’s Impact on the User Research

For an environment to be optimized for athletic performance, there needs to be in depth knowledge regarding how a building’s design can influence the user. With an understanding of what deters and optimizes athletic performance, it can guide research into what emotions and outcomes are desired for creating a design protocol for athletic facilities. Stress is a great deterrent for performance and a significant amount of research has been done in regard to how stress can be alleviated through design. In *Quantifying human experience in architectural spaces with integrated virtual reality and body sensor networks*, researchers used a group of body sensing machines on users to obtain quantifiable results of the body’s reaction to differing design decisions within a virtual environment. Previous literature was used to determine the design parameters that would be used to create positive and negative

environments. The four design features used were levels of luminance, amount of natural light, colors used within a space, and visibility of landmarks and entrances. The conclusion from the literature was that lower levels of luminance and darker colors on surfaces increased stress whereas natural daylight and being able to see entrances and landmarks outside reduce stress. To measure participants reactions to these design decisions, their heart rates, types and levels of brain activity, and skin conduction were recorded and analyzed. By analyzing the reactions of participants in both environments, it was found that they had greater emotional reactions in the negative environment and concluded that the positive environment did not induce stress. Besides the bodily reactions that were recorded, there was a survey that the participants completed. Approximately 84% of participants said they would rather spend time in the positive environment and noted that it was more focused, relaxing, and pleasant in that environment. With these findings, it can be concluded that design not only impacts one's perceived feelings in a space, but that the body also experiences effects from how spaces are designed. To reduce negative psychological and bodily reactions in spaces, there should be lots of daylight, high levels of luminosity, lighter colors, and visibility of outdoor landmarks and entrances (Ergan et al., 2019). Findings through studies like this can begin to influence which design features will help in obtaining the desired outcomes.

Stressed spaces: mental health and architecture is another source that displays how design can impact users, specifically in regard to mental health and healthcare architecture. Light was once again a design feature touched upon in this literature review. It was shown that light had beneficial effects on patient's emotional states, outlooks and overall health. Patients that stayed in areas of the hospital that were exposed to more natural light reported lower levels of stress, pain and significantly cheaper pain medication costs, with the highest useful outcomes in the morning hours of the day. Additionally, light helped improve accuracy in visual functions and balanced the body's natural circadian rhythm (Connellan et al., 2013). Though these outcomes were seen in healthcare settings, they can be applicable to athletic facilities because they share the goal of optimizing the health of their building's users. Providing views of nature was a new design feature found in this review. Nature offers patients a helpful diversion from painful sensations, therefore reducing the severity of pain. Views of nature also influenced and reduced anxious and stressful emotions (Ulrich et al., 2008) as well as introducing nature to the inside of the

building with indoor plants (Connellan et al., 2013). A view of nature was described in a separate review as a space with prominent greenery, water, or landscape, lack or concealment of manmade aspects, and a greater number of curved lines than straight (Ramadan & Kamel Ahmed, 2019). This separate review by Ramadan & Kamel Ahmed named *Spatial design through stimuli to promote wellness through buildings' design* seconded the information found in previous studies and introduced new features to this research.

When designing for wellness, colors are a tool that can help in achieving optimal results. There are numerous beneficial responses that the body can experience through color, making it useful in designing holistic spaces that help people. Ramadan and Kamel Ahmed list specific physiological reactions to color, "for example, the red color activates the circulation system and benefits the five senses; blue raises metabolism, stabilizes the heart, muscles and bloodstream; green strengthen bones and muscles, disinfects bacteria and virus, and relieves tension" (2019, p. 13). Color is typically the most notable aspect of a material, so altering colors in spaces will greatly change its ambience (Ramadan & Kamel Ahmed, 2019). Materiality is another aspect of interior design that will affect the user's experience. Natural materials can be used to emulate a sensation of the natural environment (Ramadan & Kamel Ahmed, 2019) which is proven to lessen negative physiological and psychological responses (Ulrich et al., 2008). Natural materials are greatly desired over their synthetic counterparts, but the use of material and color should be heavily coordinated with the function of each space to ensure the proper outcome of these choices (Ramadan & Kamel Ahmed, 2019). By understanding the differing effects of colors and materials, they can be altered so that the environment of a space matches its purpose.

Mindfulness was another vital component in sports performance and understanding which design features promote it will be useful in creating a successful design protocol. A study by Thampanichwat et al. examined Instagram posts to see what kinds of architectural environments were most associated with mindfulness. Three design concepts were chosen for the study: "traditional Japanese, Biophilic design, and Buddhist contemplative space" (Thampanichwat et al., 2023). Figure 2 describes the different components of each design concept.

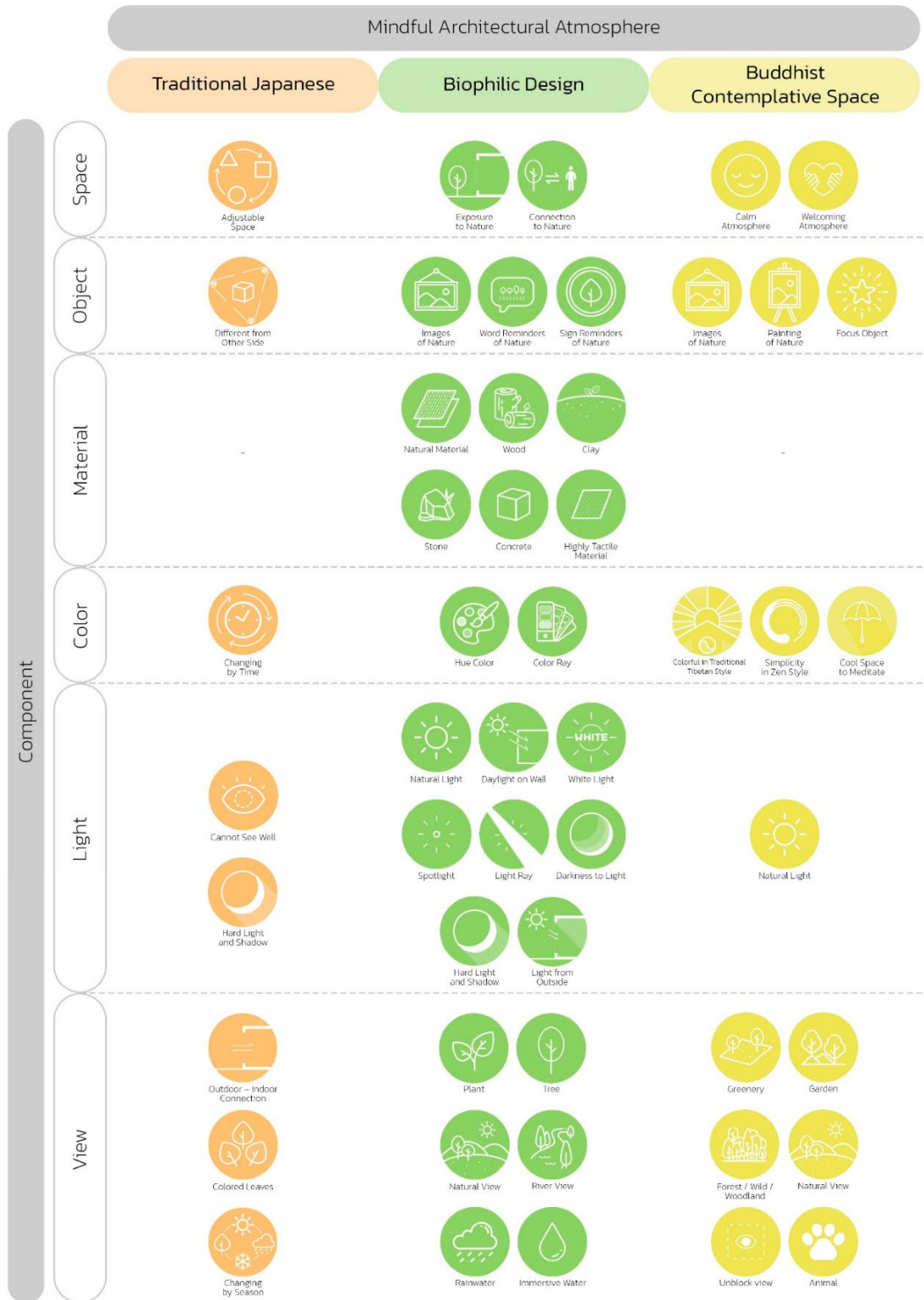


Figure 2. "The architectural atmosphere influencing mindfulness."
 Source: This figure was produced by Thampanichwat, C., Bunyarittikit, S., Moorapun, C., and Phaibulputhipong, P. in *A Content Analysis of Architectural Atmosphere Influencing Mindfulness through the Lens of Instagram*, 2023, Figure 1.

Their research discovered that people connect mindfulness to Japanese architecture the most, with biophilic design closely following (Thampanichwat et al., 2023). While it is noted that this data is for which design methods are associated with mindfulness, not which have proven to support it, it does repeat many of the previous design features which have been proven to improve the user's experience within a building.

For a design protocol to be created, it must be understood what features influence the effects of the environment that is being designed. Discovering what features alter the user's perception of stress, pain and wellness, while promoting their practices of mindfulness can determine whether or not a design aspect will be included in the final result.

2.3. Project Type

To showcase how athletic facilities can be better designed for the wellbeing and performance of the athletes, an indoor track and field training facility will be designed. Though the main focus of this facility will be to optimize training, it will be suitable to host competitions but it will not be its primary function. This facility will be designed as a training location for Team Canada track and field athletes to complete their training near its Olympic Park in Calgary, Canada.

When looking at the history of the design of sports facilities as a whole, function has always taken precedence. For this specific project type, the need for indoor track facilities came from the desire to have an area to train year round where there would be no effects from weather and the climate. There hasn't always been facilities specifically designed for hosting indoor training and competition. The place of origin for indoor track and field is considered "The Stadium", located in Chelsea, England (*Indoor Athletics*, 2015). None of these initial indoor track competitions were held in a venue specifically for that, but rather in a multi-use arena. It was once indoor track made it across the Atlantic to the Americas that the sports was able to get better footing. (*Indoor Athletics*, 2015). One of the first recorded indoor track facilities in the United States was the Empire City Skating Rink, which was built by John C. Babcock. Babcock was approached by two athletes and formed the New York Athletic Club and wanted to host an indoor track meet for the skating rink's first event. The tradition of hosting these competitions began and many of the meets in New York City are still held today. After Europe recovered from World War II and

organizations in the United States such as the NCAA began attracting more athletes, more facilities were being made specifically for indoor track and field (*Inside America*, 2016).

Indoor track and field is the main purpose of this space, but for a well-rounded environment suited for athletic success, additional spaces athletic support spaces are needed. The spaces include weight training, athletic training, treatment and recovery, and other program elements that are included in performance facilities. These elements will be elaborated on in the detailed space program. Because of these additional spaces, this building type can also be described as the athletic complexes typically seen for university athletics. By choosing a project type that has a wider variety of spaces, a greater application of the research can be shown.

2.4. Project Issues

The issue that will be solved with this project is how to recenter the focus of design within athletic complexes on the athlete. Through solving this primary issue, the greater issue of providing new ways for athletes to improve their performance can also be solved. As stated in the section providing a literature review for sports architecture, this sector is becoming increasingly complex with multiple building types being compiled into one (Kennedy et al., 2022). It is vital to enrich the community that sports projects are being placed within, but many of the design decisions for these buildings are being made at the expense of the athlete. By making athletes a primary consideration in the basis of design, better buildings can be created for their interests.

Improving the performance of athletes is not simple issue to solve as sports performance is a highly complex topic in and of itself (Gomes et al., 2020). There is little information regarding how design can affect the athlete. To solve the issue, a different route must be taken. First, understanding sports performance and which factors can optimize an athlete's performance is necessary. To connect this information with architecture, design strategies that improve the experience of the user within a building must be researched to get the desired outcomes. By deriving the information, it can be understood how the environment in which the athlete trains factors into performance.

3. METHODOLOGY

3.1. Approach

This research will be approached with a focus on the athlete and a holistic view of how their performance can be increased. This holistic view can be separated into two categories: the performance of athletes and the promotion of wellness through qualities of the environment. Following the collection of data regarding the athlete's mindset and their wellness through a survey and an interview, there will be connections made between those results and literature of sports performance and wellness within architecture to create a general design protocol that can be implemented into athletic training and competition facilities.

3.1.1. Data Collection

Data to answer the research questions will be gathered in two manners: a survey and a one-on-one interview. The survey titled *Examining emotions and motivations as factors in training and competition* will ask qualitative questions regarding athlete's mindsets and what they believe are the most important components in being successful. The only identifying factors that will be collected are what sport the athlete does, whether it is an individual or team sport, and the level of collegiate athletics they participate in. Other questions that will be asked include features they believe are most important in a training facility, what causes them to burn out, and what they do to remain motivated. Collegiate athletes will be the base requirement for this survey because to have made it thus far in an athletic career, the athlete has had to have been successful. By knowing that the subjects are talented in their respective sport, it ensures that the data is being collected from people who have the desired outcomes for this research.

Apart from this survey, an interview will be conducted with a professional athlete to ask more open ended questions to gain more insight on the topic. Similarly to why collegiate athletes are the base requirement for the survey, professional athletes have greater defined success because only a small percentage of athletes reach that level. This athlete has competed in high stake events all across the globe. By analyzing their experiences competing in some of the highest quality competition venues, it can be discovered how they felt the environment affected their performance. With a one-on-one interview,

more specific questions will be asked to cover the gaps that the survey is not able to address. These inquiries will help discover the relationship between sports and architecture.

3.1.2. Analysis

3.1.2.1. Survey Results and Analysis

The first part of the data collection was the survey mentioned before. This survey was shared with athletes at North Dakota State University and athletes apart of a mental health support page on Facebook. There was a total of 104 participants in the survey. Figure 3 shows the range of sports that were covered by the participants in the survey. Figure 4 further breaks down the demographics of the survey participants. There was a relatively even distribution of athletes who competed in team sports and individual sports. Sports that were noted as 'individual' also included sports that had team aspects to them, such as gymnastics and wrestling, but are noted as 'individual' because the athlete competes solo and without their teammates.



Figure 3. Sports represented in survey.
World cloud diagram showing which sports were represented in the survey. Larger words had a greater number of survey respondents.

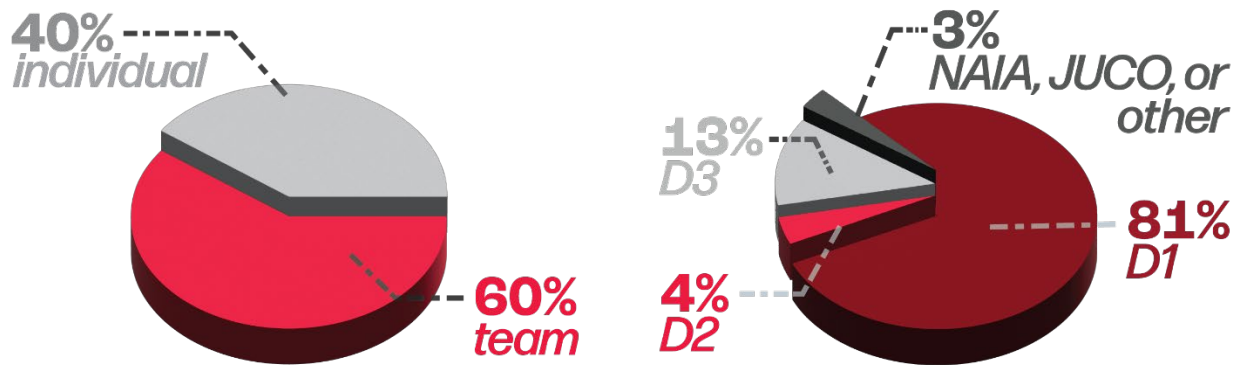


Figure 4. Survey demographics.

The left pie chart shows the percentage of participants that were in team or individual sports. The right pie chart shows the percentage of participants that competed in each level of collegiate athletics.

The survey began with questions regarding athlete's motivations, emotions, and factors that contribute to burnout. Figure 5 shows whether athletes felt they were more intrinsically or extrinsically motivated. Intrinsic motivation is defined as completing a task for the rewarding feeling that one gains from participating. Extrinsic motivation refers to when separate outcomes and outside influences are the reason for finishing a task (Oudeyer & Kaplan, 2007).

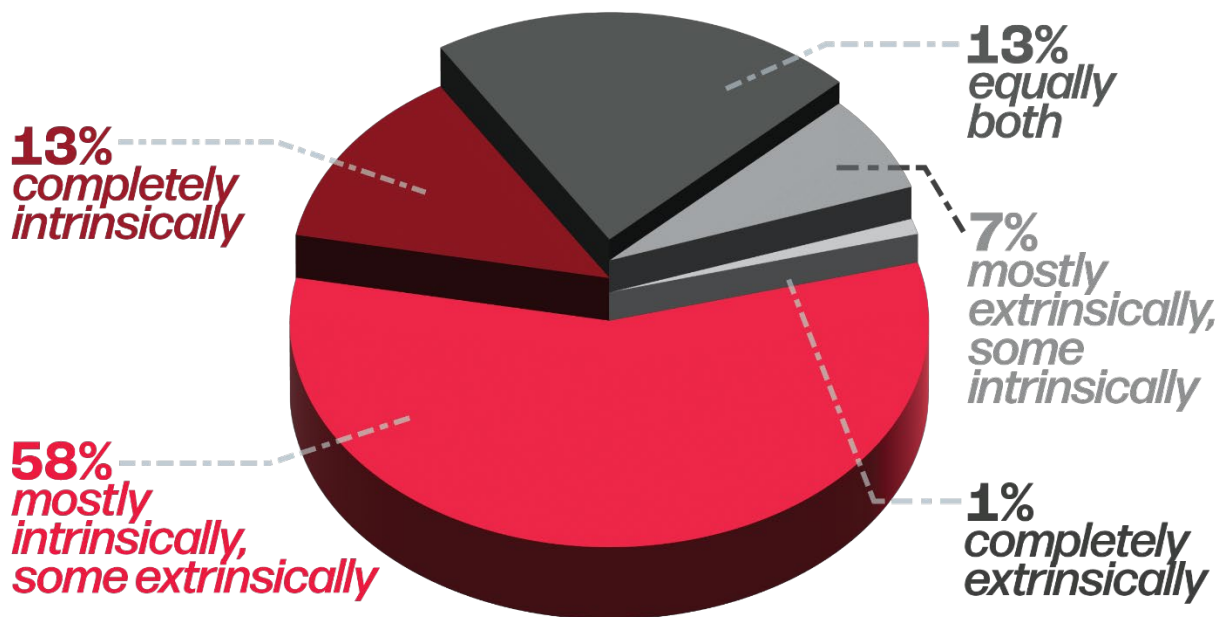


Figure 5. Would you describe yourself as more intrinsically or extrinsically motivated?

Intrinsic motivation comes from within us whereas extrinsic motivation arise from external factors. An example of intrinsic motivation is participating in sport because of your love for the game. An example of extrinsic motivation is attending additional training sessions because your coach requires it.

A combined total of 71% of respondents said they had a greater portion of intrinsic motivations when it came to their training. This demonstrates that outside factors are not the main contributors for why an athlete trains in a large number of athletes. To help these athletes, a positive training environment should be created so that participants have a pleasant experience and have greater chances of feeling fulfilled by their training. This will stimulate a higher level of intrinsic motivation, which in turn is affected less by outside influences and stays more consistent, offering a higher quality of training.

To understand athlete’s intrinsic motivation on a deeper level, respondents were asked to list one or more intrinsic motivations that they had. Though the question was open response, 48% of respondents listed something that had to do with personal achievement. Examples included the desire to be the best, being better than the day before and achieving goals set by themselves. Because so many athletes display this drive on their own, supporting their wellness, helping their mental state and minimizing the chances of burnout helps this motivation continue and optimizes their outlook. Other notable responses included respondent’s love of competition, the enjoyment of the sport they participated in and other statements shared in Figure 6.



Figure 6. List one or more intrinsic motivation you have. Respondents were asked to list one or more intrinsic motivation that they had. The question was an open response and participants were able to enter whatever they wanted. The responses were then analyzed and categorized into the keywords shown above.

The next question asked respondents what they depended on to complete their training when they weren't feeling as motivated. Responses to this question are shown in Figure 7. The most selected responses included remembering personal goals and reminding themselves how hard they had worked, with the most selected response being depending on training partners and teammates, pushing the incentive to include group training areas so that athletes may train concurrently with each other. Similar to previous questions, much of what they depended on was sourced from within themselves with remembering their goals and the hard work that has been completed. By supporting the athlete as a whole, there are greater chances of them remaining motivated and staying more consistent with training.



Figure 7. When you are not motivated, what do you depend on to complete your training? Respondents were able to select all that applied. Red color represents the percentage of respondents that selected each response.

With understanding what helps keep the athlete motivated, the next question had the goal of discovering what the greatest contributors to athletic burnout are. When an athlete is burnt out, they are less likely to have successful training. The survey responses are displayed in Figures 8 and 9 and respondents were able to select multiple responses. The greatest response was physical injury, with mental health issues and loss of motivation closely behind. Other responses that had over or close 50% of respondents that selected them were "personal issues outside of sport, lack of recovery and no variety and training" (Naranjo Mata, 2023).

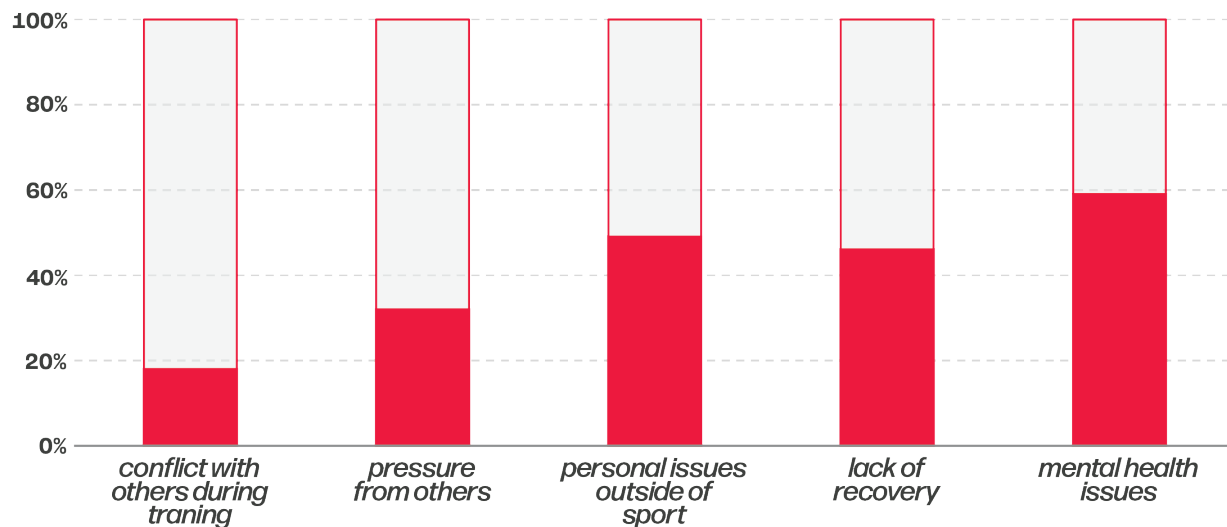


Figure 8. What causes you to burn out from training?
 Respondents were able to select all that applied. Red color represents the percentage of respondents that selected each response.

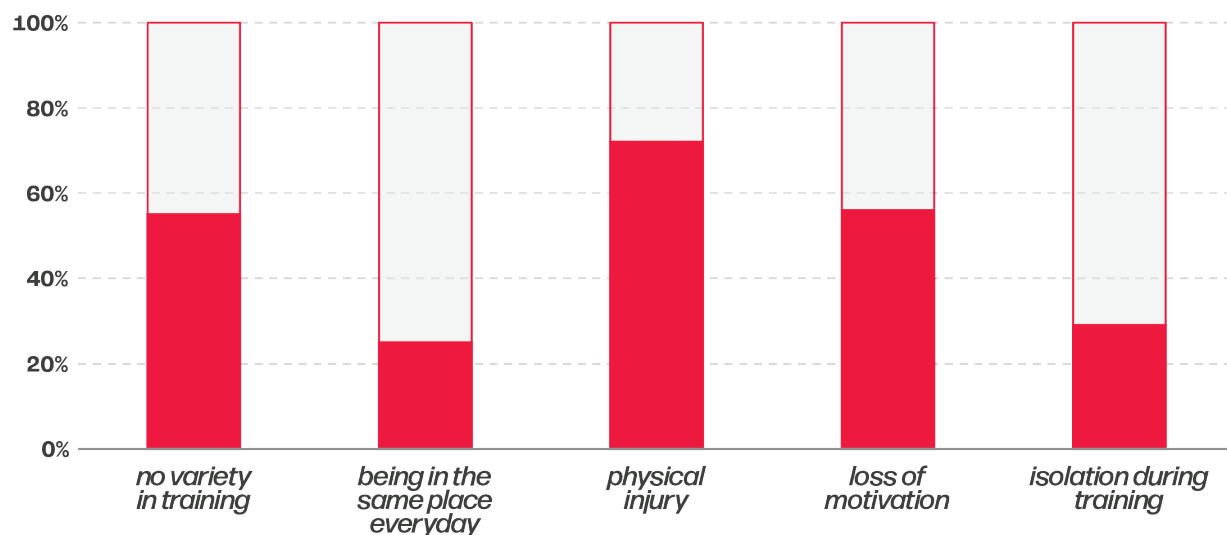


Figure 9. What causes you to burn out from training? Cont.
 Respondents were able to select all that applied. Red color represents the percentage of respondents that selected each response.

The next question was laid out similar to the previous one, but required respondents to select one answer as the greatest cause to their burnout instead of all that they felt were applicable. The results were alike to the previous question, with staying mentally and physically being the top two answers. Having no success in competition was also a highly selected response.

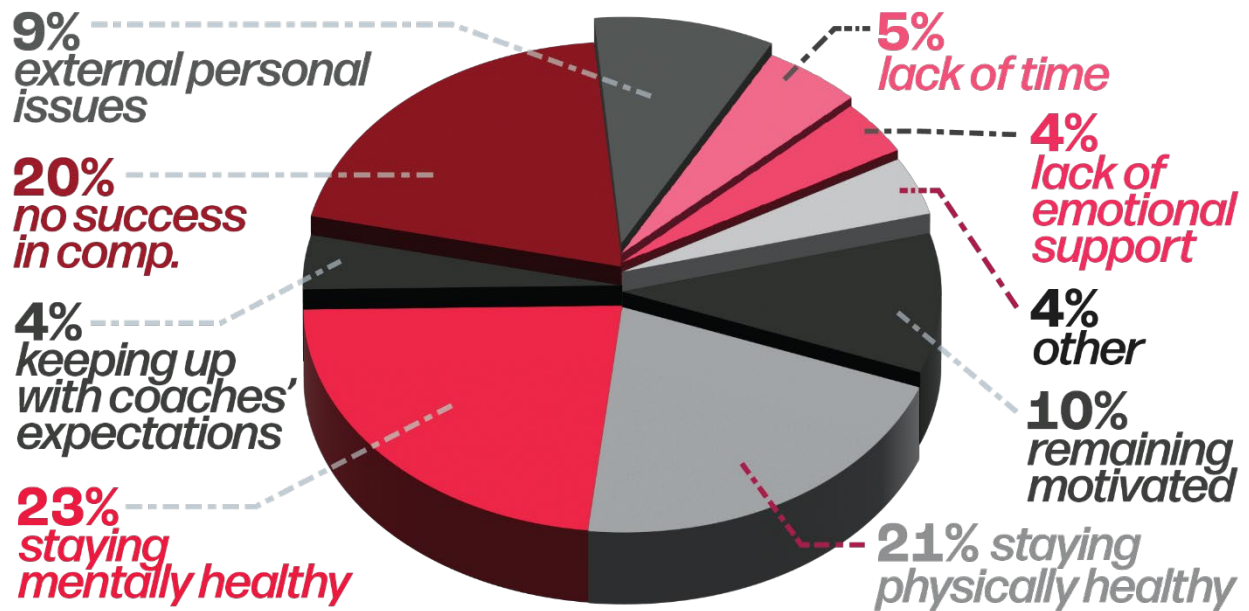


Figure 10. What is your greatest obstacle when it comes to training successfully? Respondents were asked to select what they believed to be the greatest single contributor to athletic burnout.

Based on the previous review of sports performance, it is indicated that stress increases the risk of physical injury and deters the mental state of the athlete (Schinke et al., 2018). With mental health issues and physical injuries facing many athletes, designing an environment to assist in alleviating stress can help athletes reduce the chances of experiencing these performance dampeners.

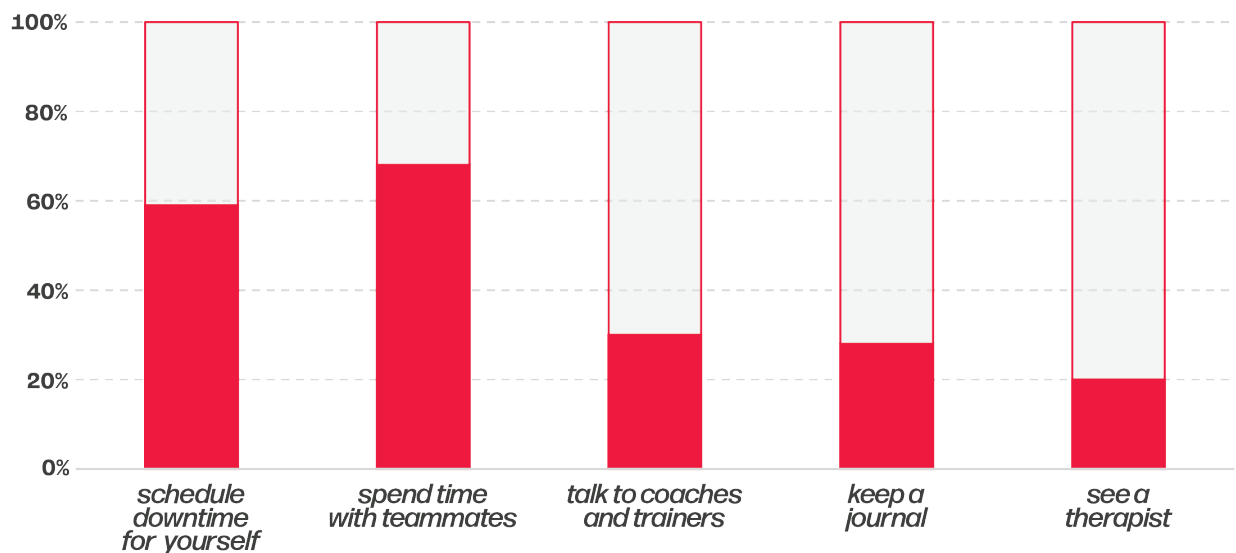


Figure 11. What do you do to take care of your mental health as an athlete?

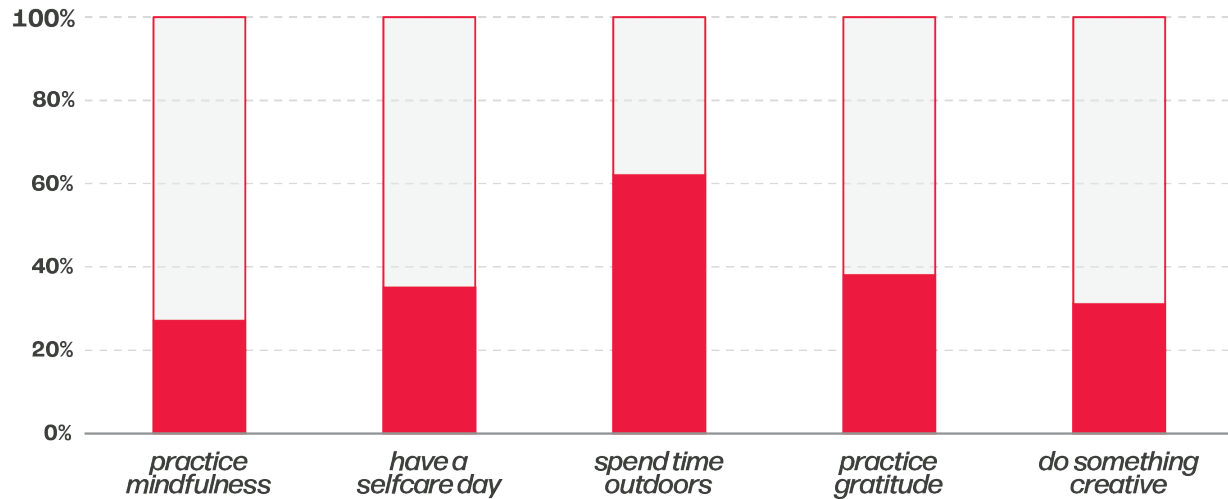


Figure 12. What do you do to take care of your mental health as an athlete? Continued. Respondents were able to select all that applied. Red color represents the percentage of survey respondents that selected each response.

Discovering what athletes did to take care of their mental health was next in the survey.

Participants were able to select numerous responses and results are shown in Figures 11 and 12. The most selected responses in order were spending time with teammates, spending time outdoors, and scheduling downtime. Ways this can translate to the design of a facility can be large windows to bring nature indoors and including areas that foster relationships between the athletes. Having this knowledge helps reduce athletic burnout since mental health issues were indicated to be a great contributor.

The next couple of questions aimed to compare which emotions athlete felt during competition compared to which emotions they felt allowed them to perform at their best. Figure 13 displays the emotions that were felt the most by survey respondents. 88% of respondents said they felt excitement during competition while 76% said they were focused- these were the most selected positive emotions. Some negative emotions that had high response rates were “nervous, anxious, and pressure” (Naranjo Mata, 2023). When comparing Figure 13 to Figure 14, which displays which emotions are desired, it’s shown that there are more bars on the right side of the graph, meaning that the emotions that athletes didn’t feel very much during competition are the ones they want to experience. The emotions that respondents felt the most, but did not want to, were “nervous, anger, and frustration” while the emotion that respondents didn’t feel but desired greatly was “confidence” (Naranjo Mata, 2023).

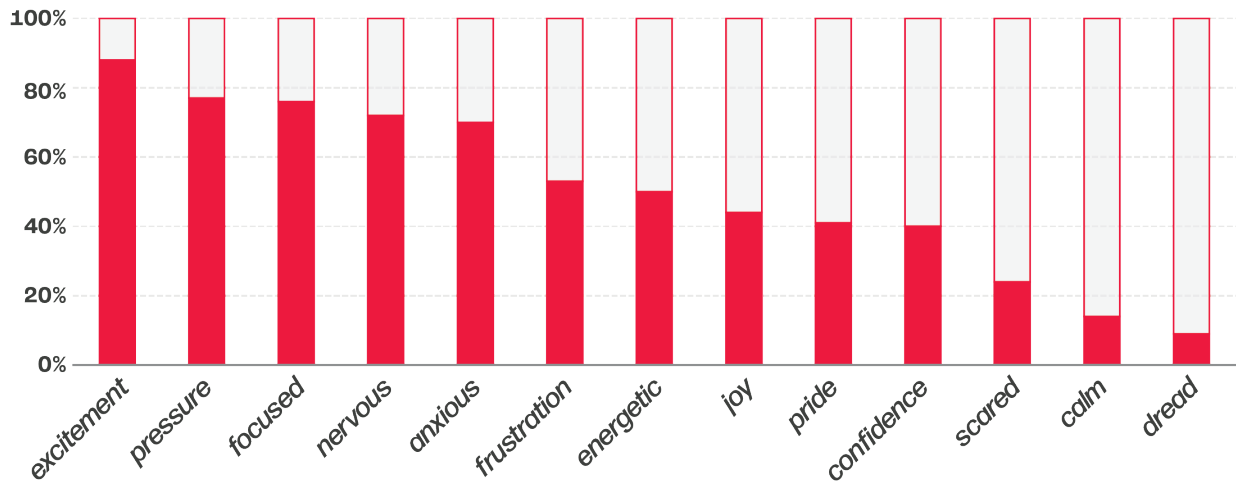


Figure 13. Which of these emotions are heightened during competition? Respondents were able to select all that applied. Red color represents the percentage of survey respondents that selected the emotion.

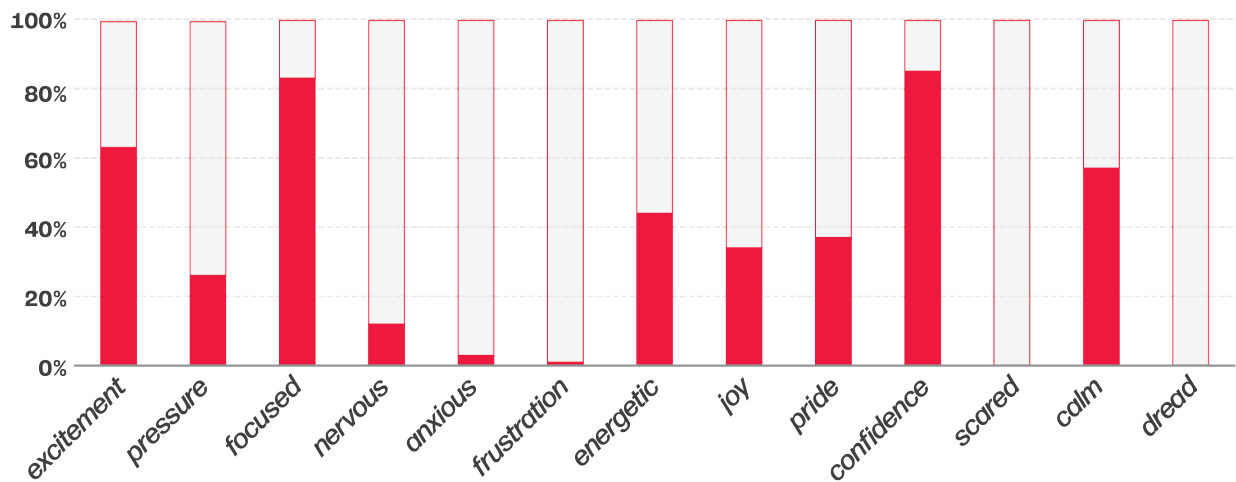


Figure 14. Which emotions help you to compete at your best? Respondents were able to select all that applied. Red color represents the percentage of survey respondents that selected the emotion.

A consistency between the two questions was that many athletes said they felt focused during competition and that it helped them to compete at their best. Some potential design solutions that can be decided from these responses are implementing spaces in training facilities that encourage practices of mindfulness and having focus enhancement features in areas for warm up so that this emotion desired for performance is encouraged.

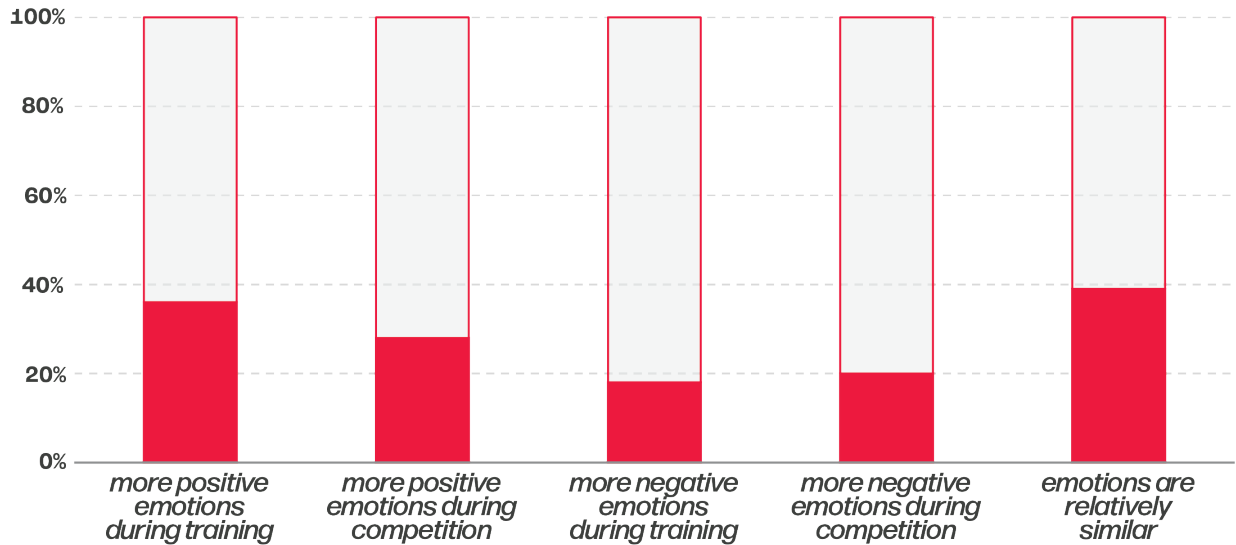


Figure 15. How do your emotions differ from training to competition? Survey respondents were able to select all that applied. Red color represents the percentage of survey respondents that selected each response.

Figure 15 displays the comparison in the amount of negative and positive emotions that athletes experienced between training and competition. Participants were able to select multiple choices, but response rates were low for this question. Responses indicated that emotions tended to be relatively similar between training and competition, with a slight lean towards having more positive emotions during training. The figure below shows when in the competition were emotions the greatest.

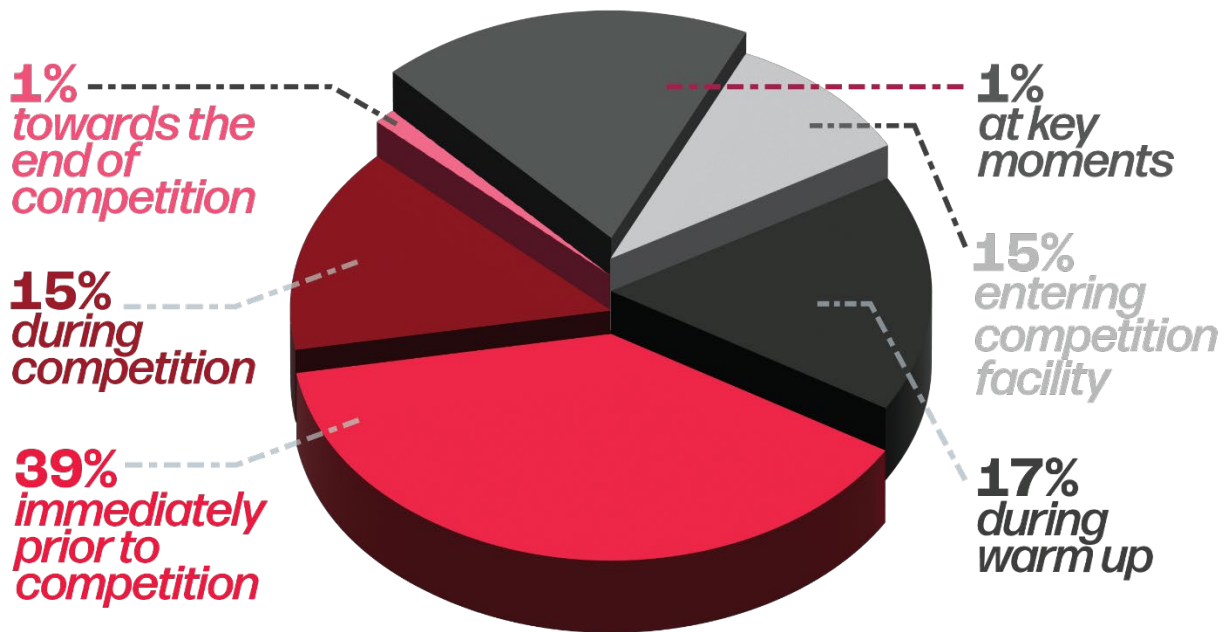


Figure 16. At what point in the competition are these emotions peaking?
Respondents were asked to select during which part of competition were their emotions felt the greatest.

39% of respondents selected that their emotions peaked immediately prior to competition and 17% said it was during warm up. Though some emotions are necessary to be successful, many can have negative effects on an athlete's mindset and are not desired as shown in Figure 14. By including design features in warm up and starting areas that are calming and stress reducing, it can help athletes not be overwhelmed by these emotions. Environments that promote mindfulness would also be beneficial in areas where stressful points of competition occur so that potential negative effects are minimized.

Responses shared in Figure 17 also demonstrate the importance of designing a space to encourage mindfulness practices. When participants were asked what they felt was most significant for athletic success, 40% responded with "having the right mindset" and the next closest response was having a "relationship with coaches, teammates, trainers and staff", which was selected by 24% of respondents (Naranjo Mata, 2023).

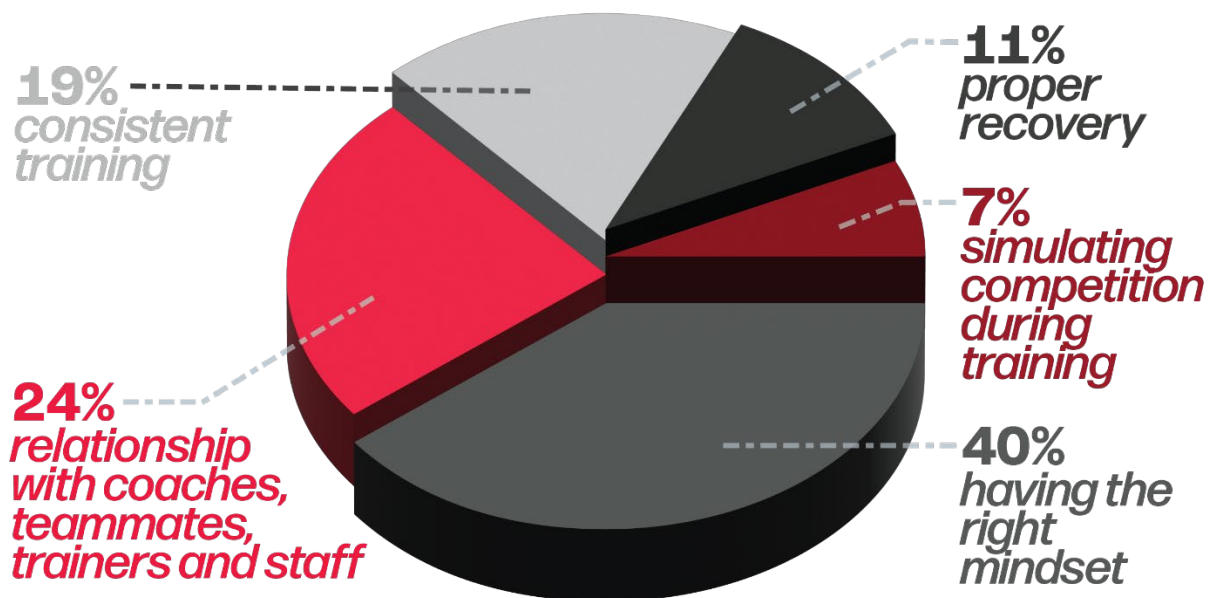


Figure 17. Which of these items do you believe is most crucial for success?
Participants were asked to select a single answer for what they believed was most essential for success.

The self-determination theory states that when the desire for autonomy is fulfilled by a task, that people are more motivated in completing that task and likely to repeat it (Hollembek & Amorose, 2005) which is an important aspect in successful training. Figure 18 displays that a total of 82% of respondents

said that having a choice in training was useful for staying motivated. To promote autonomy in training facilities to increase intrinsic motivation, a variety of training areas and methods can be offered that achieve the same results so athletes can complete their need for autonomy.

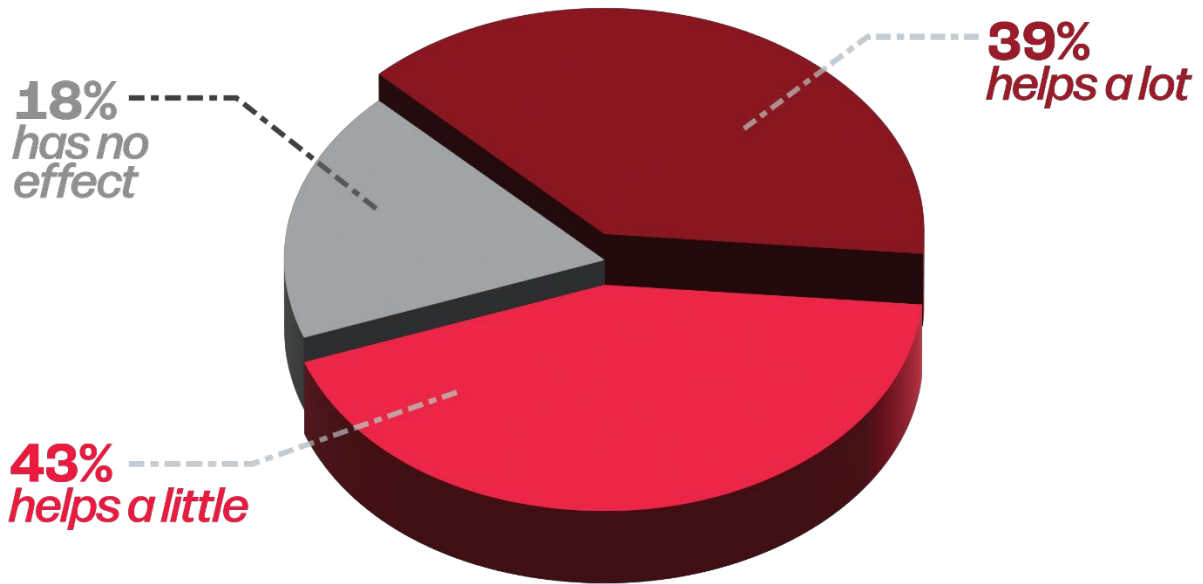


Figure 18. Does having a choice in your training help you stay motivated? Respondents were asked to indicate if having autonomy in their training helped their motivation.

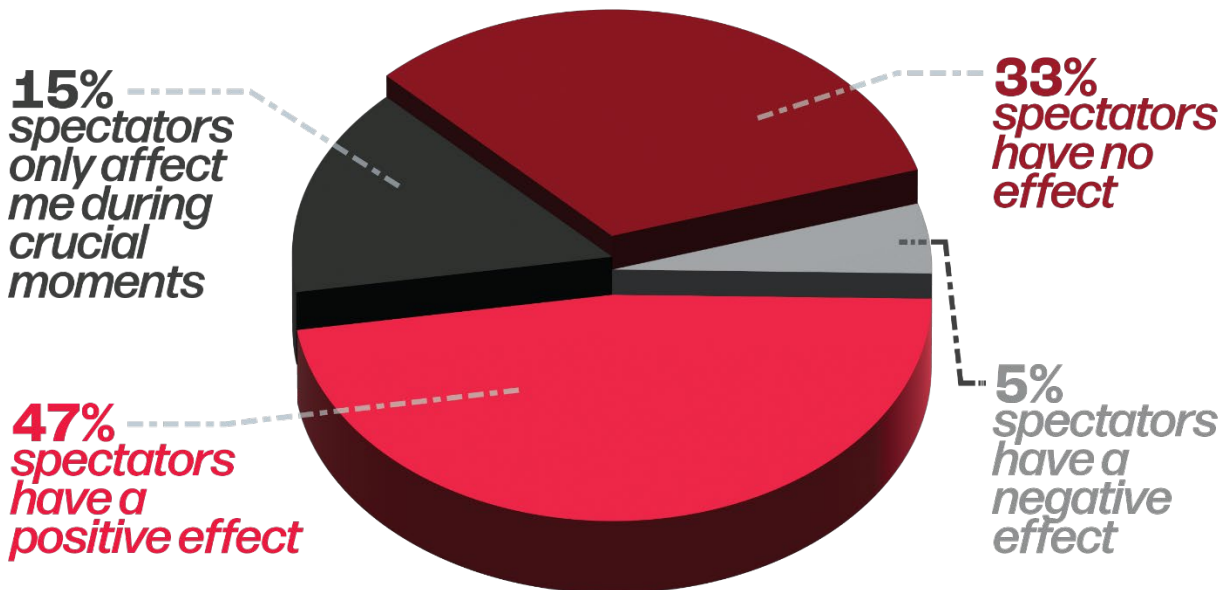


Figure 19. How do spectators affect you during competition? Participants were asked whether spectators had a positive, negative or no effect on their performance.

The next question explored what effects spectators have on athletes. Figure 20 displays the results, with almost half of respondents stating that spectators had a positive effect and 33% indicated that they had no effect. These results can influence the design of the spectators' proximity to the competition area in training facilities that also host competitions, which is a large majority of them.

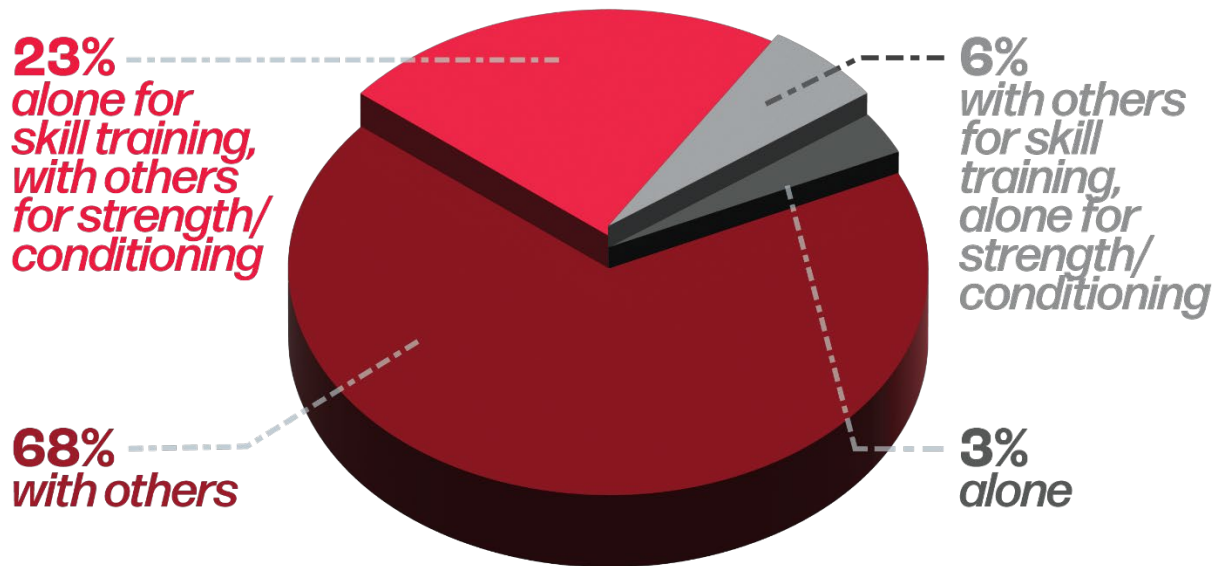


Figure 20. Do you train better alone, or with others? Respondents were asked whether they trained better with others or alone. The two options were also broken down further by providing different responses for distinct types of training.

For more understanding of how to optimize training, participants were asked whether they trained better alone or with others. Figure 21 displays that 68% said they trained better with others. 23% selected that they preferred to train "alone for skill training, but with others for strength and conditioning" (Naranjo Mata, 2023). The results specify that most training areas should be able to accommodate large groups, especially areas designated for strength training and conditioning. Smaller areas may also be implemented for skill training for athletes that desire that.

The next question inquired whether changing the scenery, environment, or location of training helped avoid burnout. 74% of respondents selected that it helped. This creates even more incentive to include a variety of training areas within athletic facilities to ensure that the athlete has change in pace every so often.

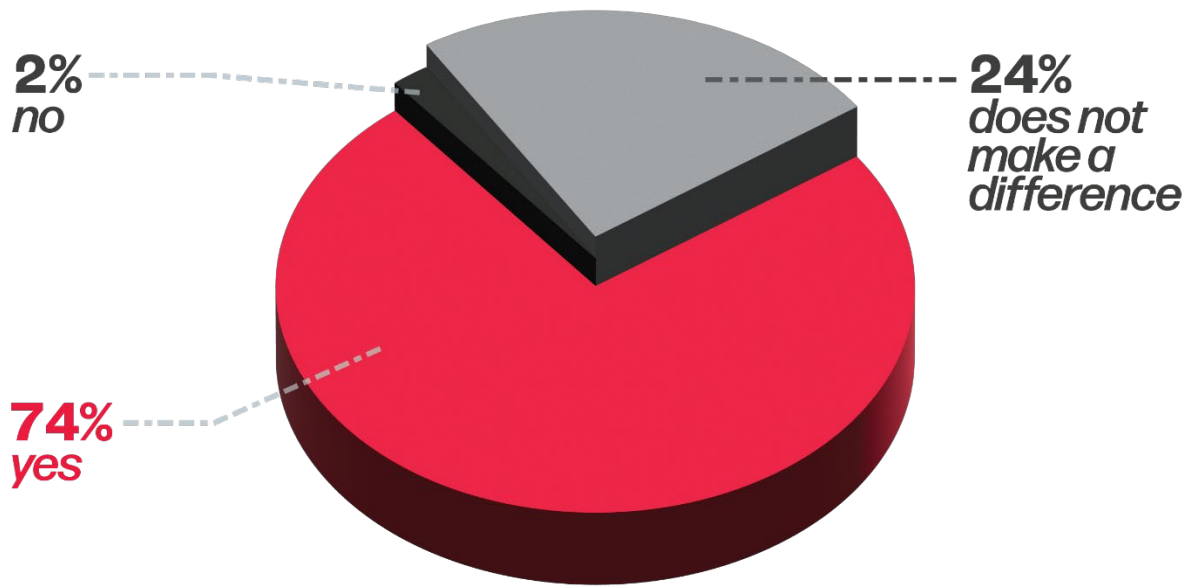


Figure 21. Is a change of scenery, environment, or location helpful in avoiding burnout? Respondents answered whether or not changing the scenery, environment, of location of their training helped them feel less burnt out.

To finish the survey, the athletes were asked direct questions regarding training facilities to understand what they felt would be the most important design features. Because the aim of this research was to recenter the athletes' needs in designing athletic facilities, these questions were crucial. Two questions of this sort were asked and had the same format. Respondents were asked to rank lists of design features based on how important they thought each one would be in a training center, with one being the most important. The first question inquired about specific design attributes and responses are shared in Figure 22. Participants indicated that "strong team branding and visual representation of goals" was the most important to have in a training facility with "high air quality" being the second most important (Naranjo Mata, 2023). This corresponds with previous data showing that many athletes are motivated inwardly and having reminders of these goals can help that motivation to not waver. The second question asked specifics in regard to the building programming and results are shared in Figure 23. Over half of the respondents said that having a variety of training areas was most important, with the second most important being similar, just with recovery areas. The next closest response was having

proximity to fuel and hydration. This backs up data from questions regarding the athletes' motivation and causes of burnout- having a variety of training areas in facility is crucial.

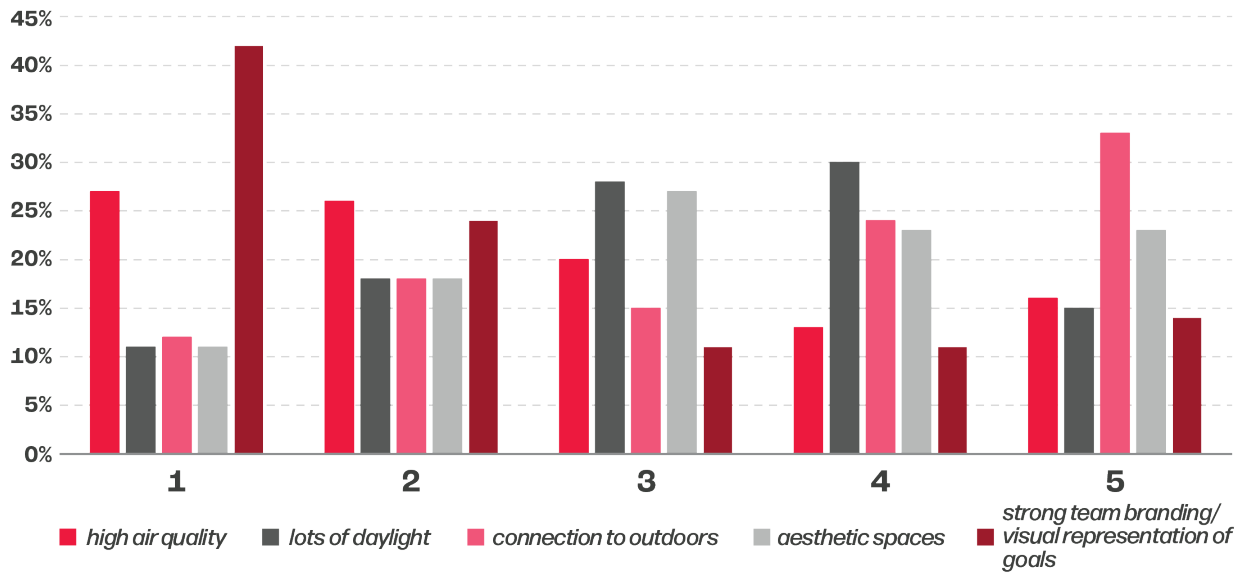


Figure 22. Which of these items are most important in a high quality training facility? Question one. Survey respondents were asked to rank the list of items in the key below the graph by importance, with one being most important and five being least important.

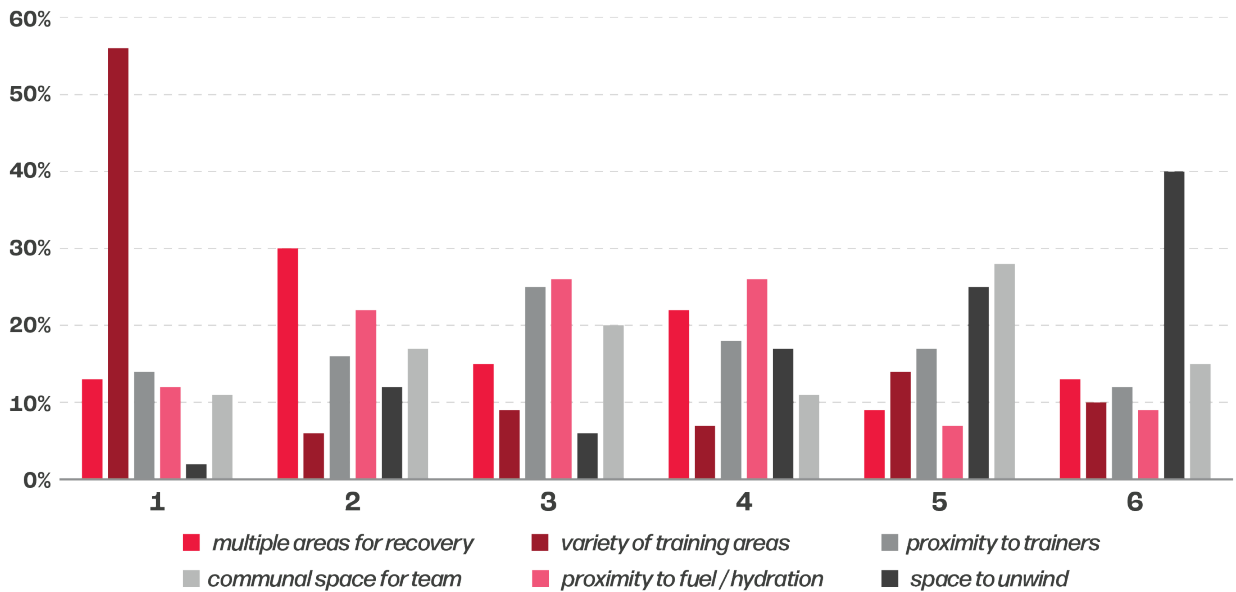


Figure 23. Which of these items are most important in a high quality training facility? Question two. Survey respondents were asked to rank the list of items in the key below the graph by importance, with one being most important and five being least important.

To summarize the results, there are many takeaways that will help in developing a design protocol for sports training facilities. One of the main points is that athletes who make it to this level have a high amount of intrinsic motivation. Participants also stated that having the right mindset was most crucial for success. To support this motivation and encourage the proper mindset, supporting the athlete's well-being as a whole is vital. Creating facilities that fulfill needs of autonomy, competence, and relatedness can create an environment that strengthens their inner motivation (Hollembek & Amorose, 2005) and fosters the best headspace for the athlete. The second takeaway is that the inability to stay healthy mentally and physically was the greatest deterrent to training for participants. With stress being a great contributor to physical injury (Schinke et al., 2018), designing facilities to alleviate stress can assist in keeping athletes healthy. Next, results indicated that emotions were relatively similar between training and competition. The emotions that athletes desired the most for their performance were focus and confidence, with confidence being the emotion that very few athletes said they experienced. Athletes stated that their emotions peak immediately prior to competition. To combat the negative emotions athletes feel prior to competing, warm up areas should be specifically designed to ease negative symptoms and promote confidence. The results from the next questions shared that participants had a strong preference for training with others instead of training on their own and that changing the environment where training occurs helped prevent burnout. These answers encourage the inclusion of a variety of training areas within facilities that accommodate group training so that athlete's desires are catered to. Lastly, strong team branding and the visual representation of goals was the design feature athlete's believed to be most crucial for a training facility with the most important programming need being a variety of training areas. By using this survey to influence the design protocol, the goal of recentering the athletes' needs in the design of training facilities is achieved, ensuring that this user group is adequately considered for this building type.

3.1.2.2. Interview Results and Analysis

To obtain more knowledge regarding athletes' experiences in training and competition facilities, an interview was conducted with a professional athlete. The goal of this interview was to ask more specific questions that couldn't be included in the survey, compare the differences between collegiate and

professional athletics, and gain knowledge about all the facilities the athlete had trained and competed in. This athlete has been a professional for five years now and throws shot put in the sport of track and field. They have competed in many Diamond League events, which are the top track and field meets in the world, the 2020 Tokyo Olympics and the recent 2023 World Athletics Championship. They were shared a starter set of questions prior to the interview so that they had sufficient time to think of their responses.

To begin the interview, the athlete was asked what their favorite place they had competed in was. Their response was the stadium for this past year's World Athletics Championship, which took place in Budapest, Hungary. This location is a campus that has an outdoor track stadium along with an indoor one. The athlete described how everything was brand new, very well lit, and how the lights changed colors nearly every day. This location also had their favorite warm up area, which had throwing areas where athletes could throw indoors but have their implements go outdoors and both an indoor and outdoor weightroom that were all state-of-the-art. The one downside of this warm up area was the distance there was between there and the competition area. Walking between the two worked the body a greater amount and comparing results from this competition to results from a competition where the warm up area was much closer shows how perhaps the extra expenditure of energy affected the competition, with the average throw being further in the other competition. Another negative experience the athlete encountered in warm up areas was an insufficient amount of room.

The crowds from the competition in Budapest were what made this competition their favorite. The athlete details how "the atmosphere was just crazy [and how] they did a slow clap for [them] all when [they] were throwing ... it was the whole stadium of some 40,000 people doing it." This response segued the interview to the next question, which questioned how big of an influence crowds had on competitions. The athlete stated that it was "the single most important thing" that there was, but more specifically, the energy of the crowd. The athlete recounted how even a small crowd of 200 spectators could produce a great atmosphere and that their excitement for the sport translated into competition. They recounted how when they competed in a brand new stadium during the 2020 Tokyo Olympics the lack of spectators lessened the excitement in the atmosphere. There is a great preference to have large

crowds during events, but athletes that compete at this level are less likely to depend on outside sources for their performance and compete at their best no matter what.

Shifting the conversation from competition to training, the athlete was asked to compare their experience training in their collegiate facility to where they trained currently. Both places are universities in the Midwest and besides where he currently trains having greater resources and more training areas only for track, there wasn't a very noticeable difference between the two. The athlete did state that both facilities were windowless and desperately lacked natural daylight, which made training inside during the long winters hard. Being under artificial lights in a facility where athletes spends lots of time every day can be draining and "being able to train [in] natural light makes a huge difference." They also expressed how the ability to allow fresh air into the facility is wanted. The athlete went on to compare his current facility to other ones he had visited, stating that his current facility lacked school branding and was somewhat "boring." A different university was the complete opposite and "oozed" their school colors and mascot everywhere, creating a unique atmosphere inside. They expressed how valuable a tool that would be for recruiting as well as uplifting people's mood during long training cycles.

After gaining information about an athlete's experiences in different facilities, the conversation shifted to the mental aspects of being an athlete. The athlete was asked to describe the biggest mental difference between collegiate and professional athletics. They described how especially in the sport of track and field, much of the focus was on themselves and the things they could control. Confidence was the emotion they felt most important for competing and it was necessary to confide in their training and their ability to execute. There is a fine balance between not getting in one's head too much to making sure that there are a couple mental points guiding the motions of the athlete. The athlete continued by stating that on days where motivations ran low, they focused on "try[ing] to get 1% better than yesterday" and taking it day by day. They ended the interview by emphasizing the importance of writing down their goals so that they could have a reminder of why they were there in the first place.

Looking at the interview as a whole, an interesting aspect is that the athlete responded alike to many of the responses from the survey, which the athlete did not take. Some similarities include the desire for natural light, exposure to the outdoors, the importance of strong team branding within training

facilities and how much of their motivation was driven by the desire for personal achievement. Some of their responses also were design features presented by researchers to give useful qualities to the environment and promote mindfulness. Light is helpful for improving moods and improving visual accuracy (Connellan et al., 2013) while showing natural scenes reduced stress (Ulrich et al., 2008). This survey helped gain intel from an athlete who had greater and wider experience in different athletic facilities and what mental characteristic are needed to be one of the top throwers in the world. All extra knowledge is beneficial for making creative design solutions for athletic performance.

3.1.2.3. Design Protocol



Figure 24. Design protocol for a holistic environment for athletic performance. This figure displays the ten step protocol created through a synthesis of research and literature reviews for designing buildings to better support the performance and well-being of the athlete.

Through a synthesis of literature reviews, survey results and analysis, and interview analysis, a design protocol can now be created. The goal of this protocol is to be a basis of design for athletic training and competition facilities to promote the wellbeing of the athlete in hopes of optimizing their athletic performance. These features were made to be broad so that they could be applied to every sport. Figure 24 displays the features of this design protocol. The subsections below provides a description for each of the features, an explanation for why it is beneficial to the athlete, and an example of how it can be applied. Although these conclusions have been made through literature research and athlete input, it should be noted that further research regarding how design can affect athletes specifically still needs to be conducted.

3.1.2.3.1. Multiple Areas for Training

By providing a variety of training areas within a facility, there are less chances of the athlete becoming burnt out and their intrinsic motivation is better supported. 56% of survey respondents said that a variety of training areas is the most crucial for a high quality training facility. Also, 74% of respondents stated that changing the scenery, environment and location of their training helped them avoid burnout. Implementing multiple training areas in a building fulfils what the athletes want. Autonomy, an essential human desire as described by the self-determination theory, states that people want their actions to be their own (Hollembek & Amorose, 2005). 82% of athletes indicated that having a choice in training offers some support to their motivation and allowing them to choose their method of training can help their need for autonomy to be satisfied. A way these training areas can vary are designing them for large group training or individual training. 68% of participants said they trained best with others, but there were many who said that it depended on whether it was skill training or conditioning and strength training. Another way that this can translate into design is for swimmers to have a variety of pool sizes to choose from, different pool options, and many areas for different cardio options that the athlete can choose from.

3.1.2.3.2. Team Branding and Goal Visualization

Personal achievement, pride, and a sense of belonging was the source of many athlete's inner motivation. Additionally, 71% of athletes indicated that they had a greater amount of intrinsic motivation

than extrinsic motivation. Adding strong team branding through the building and providing athletes with a visual of their goals can fuel the drive of athletes and create an encouraging atmosphere. 42% of respondents said that having strong team branding and a visual representation of goals was most vital for a successful training facility. The interview participant noticed the difference in atmosphere between a university's facility that had little branding compared to a building that "oozed" school pride. A training area that helps athletes feel proud to be a part of that school or organization can be a strong recruiting technique. Visualizing goals is also significant as over 60% of respondents said they remembered their personal goals and reminded themselves of how hard they worked to keep their motivations high. Ways to implement this can be utilizing team colors in materials, displaying logos for the organization, and strategically placing decals and displays of the organization's goals.

3.1.2.3.3. Natural Light

Natural light plays key roles in managing stress, making the environment more pleasant, and promoting practices of mindfulness. The professional athlete states how monotonous and draining being under constant artificial light can be. Multiple sources in the literature review mention light and its positive effects. Light improves the emotional state of users, their outlooks, their health (Connellan et al., 2013), and helps users feel more relaxed and focused (Ergan et al., 2019). Light also reduced levels of stress in users (Connellan et al., 2013), which in turn reduces the likelihood of physical injury (Appaneal et al., 2014) and athletic burnout (Li et al., 2013). Light is also a component of biophilic design and Buddhist contemplative spaces, both of which are said to promote practices of mindfulness (Thampanichwat et al., 2023), which support an athlete's wellbeing (Schinke et al., 2018). Training facilities can be designed to have large windows, skylights, and lots of fenestrations to help user's feel these positive effects. Though natural daylight is preferred, a high level of luminosity is a factor in positive environments (Ergan et al., 2019) and should be implemented when natural light is limited.

3.1.2.3.4. Connection to Nature

Helping the athletes feel connected to nature can improve their experience in a training facility. A view of nature is described as a space with lots of greenery, the incorporation of water, a lack of manmade features, and a great amount of curved lines (Ramadan & Kamel Ahmed, 2019). Views of

nature helped in reducing people's anxious and stressful emotions (Ulrich et al., 2008). Nature was a notable component of Japanese architecture, which people most associated with wellness. Views of nature are also included biophilic design and Buddhist contemplative spaces, the two other architecture types commonly associated with mindfulness (Thampanichwat et al., 2023). Bringing nature to the built environment through indoor plants is also beneficial (Connellan et al., 2013). Over 60% of athletes indicated that they spent time outdoors to take care of their mental health. Inviting nature into training facilities can help athletes care for their wellness. A large amount of fenestration can blur the line between the indoors and outdoors. Athletic facilities can incorporate indoor plant or garden areas, have designated parks and landscaping areas outside if the weather permits, or if limited nature is available or suitable for the location, images and pictures of nature are also helpful for users (Ramadan & Kamel Ahmed, 2019).

3.1.2.3.5. High Air Quality and Temperature Control

Though an athlete can control much of their performance, external factors do impact the performance of athletes. Some of these elements that can alter performance include "temperature, pollution," and humidity (Kuok Ho, 2021). By understanding the effects of air quality and temperature on athletic performance, it can help create optimal conditions for training within the facility. 25.9% of respondents stated that indoor air quality was the most important design feature for a high quality facility. A high rate of pollutants in the air can affect the function of the heart and lungs which are vital to athletic performance. These pollutants can also create the onset of respiratory illness and reduces the body's capability to train. High temperatures increases the body's heat, leading it to produce more sweat and dehydrating the athlete. On the other end, cold temperature can affect how much oxygen the body is able to consume (Kuok Ho, 2021). By ensuring that training and competition areas have optimal humidity, temperature and good air quality, the athlete is able to perform at their best. To apply this to design, passive temperature strategies can be implemented in areas of extreme temperature to control temperature without great energy expenditure. This step of the protocol should also be heavily considered when selecting HVAC and air handling systems to reduce the number of pollutants that building users come into contact with.

3.1.2.3.6. Designated Area for Mental Training

An athletes mental state is vital when questioning how to improve their performance (Schinke et al., 2018). “Staying mentally healthy” was the greatest obstacle in successful training for athletes who participated in the survey (Naranjo Mata, 2023). 60% also selected that mental health issues were contributing to their burnout. Participating in sports at an elite level is not easy and athletes experience mental distress at higher rates compared to others. Reducing the stigma regarding athletes mental health is necessary, but difficult, as many have been praised for a long time for overcoming pain, showing no weakness, and refusing to ask for help (Schinke et al., 2018). This model must be stopped so that adequate mental health care is provided for athletes. For facilities to be better equipped for handling the mental health issues for athletes, space should be programmed for designated areas where professionals are able to offer their help, but this feature may be difficult to implement in facilities for organizations that have lesser resources. A more accessible way to include areas for mental health is implementing small unwinding spaces and equipping these areas with resources to help.

3.1.2.3.7. Communal Spaces

Many lifelong relationships are created in the world of sports and people love to feel a part of something. Relatedness is another innate desire that people have (Hollembek & Amorose, 2005) and connecting with those within one’s circle is a great way for this need to be fulfilled. The thing that participants depended on the most when motivations were low was their training partners and teammates. This was also the most selected response when asking what athletes did to take care of their mental health. The culture of training groups and teams are vital to its success, especially in regard to team sports. Communal spaces can also extend to coaches, faculty, staff and even the community in public competition facilities. Creating passion within the community for a sports team or organization helps create a passionate fanbase and this can all start in a gathering space. To translate this into design, large areas furnished to invite people can be a welcoming communal space, along with providing large rooms for team gatherings and spaces within locker rooms for teammates to connect.

3.1.2.3.8. Healthy Materials and Surfaces

Physical injury disrupts training, reverses progress for an athlete, and is a deterrent for being successful in sport. 21% of survey respondents said that physical injury was their greatest obstacle in successful training with 72% said that physical injury contributed to their burnout. The selection of athletic surfaces and materials used within a building can influence the health of its users. The health of humans can be affected by material choices used for a building because of certain chemicals, pollutants and contaminants that the materials release into the air. This reduces the air quality and risks people's well-being (Esslinger, 2020). Similarly, certain choices for playing surfaces can increase the likelihood of injury in athletes. Certain studies have indicated that there are more injuries on field turf than on natural grass fields, with this number increasing significantly when reaching the professional level, such as the NFL (Taylor et al., 2012). Another example of this is the amount of impact felt on different running surfaces. Grass and synthetic track surfaces had lower levels of impact force recorded for participants compared to when they were running on concrete. Athletes must be able to accommodate this extra impact to avoid injury during training (Ferro-Sánchez et al., 2023). To combat these negative effects, designers must complete in-depth research to ensure the materials and surfaces selected for a building do not affect the health of its users. Examples of this include reducing materials that contain high amounts of volatile organic compounds, such as certain "carpet tile, vinyl wall coverings, [and] paints," (Esslinger, 2020) in all areas of the building, but especially in designated work out areas where these compounds will get inhaled at higher rates. For surfaces, this can include researching what brand of turf produces the least number of injuries or ensure sufficient thickness with synthetic track surfaces so the impact from the concrete underneath is felt less.

3.1.2.3.9. Intentional Layouts

The layout of the building is crucial in helping it achieve its purpose. To help the performance of athletes, floor plans must be intelligently planned out. A good layout may change from sport to sport. For example, sports where warm up happens in the same area they compete in will look different compared to when athletes need to warm up elsewhere. The interview participant voiced issues they had experienced when warm up areas were kept too far from areas of competition. Though this may allow

better programming for other users of the building, it can potentially reduce the performance of the athlete. Survey results show that there are differences in opinions between what proximities within the programming are most necessary. An example of an intentional layout is stacking a warm up area and a competition area vertically instead of placing the warm up area far away so that athletes have to travel lesser amounts between their warm up and competition.

3.1.2.3.10. Intentional Use of Colors and Materials

Color and material choices can drastically alter the feel of an environment and change how users feel within it. There are many documented physical and psychological responses that the body has to different colors (Ramadan & Kamel Ahmed, 2019). When attempting to manage the health of building users, colors can be a valuable asset. The color red can heighten and stimulate strong emotions, blue is connected to tranquility and calmness while showing to boost productivity levels, and green is believed to soothe stress and present a healing environment to briefly summarize some of the effects that colors have (O'Connor, 2011). By understanding each color's impact, they can be designed into spaces to help the room execute the desired outcome. Materials also have a similar effect. An efficient use of natural materials, such as wood, stone, leather and bamboo, can simulate a natural environment and create comforting and authentic feelings. The characteristics of materials, such as porosity and gloss, should be correlated with a room's function to reduce future maintenance (Ramadan & Kamel Ahmed, 2019). A way to apply this step is by using a red color scheme in warm up areas to stimulate and arouse athletes prior to competition, or by using a large amount of wood in recovery spaces, as wood has been proven to decrease mental activity (Ramadan & Kamel Ahmed, 2019) which can help in restoring the athlete's mindset after demanding training.

3.1.3. Conclusion

Within the world of design, powerful things can be accomplished. For athletic facilities to keep up with the growth in popularity, demands and expectations in the world of sport, new information must be integrated into their designs. By directly taking feedback from the athletes, information regarding sports performance, and techniques used to improve the experience of the user within a building, a design protocol is made to create a prosperous environment for athletic development. Centering the athlete in

the basis of design for these training facilities ensures that their needs are met and their well-being is considered. By promoting the longevity and outlook of these athletes, it can help their careers and performance succeed in the highly elite levels of talent there is currently present. Athletes are the foundation of the sports that so many people love- by prioritizing this group, it can be assured that the dominance in culture and love of the game continues for decades to come.

3.2. Project Location – Large Scale

This project will be located in Calgary, Alberta, Canada. The Calgary metropolitan area currently sits at a population around 1.3 million people and is one of the largest cities in Canada and the largest in its province. The city sits where the Bow River and Elbow River join and here the city began in the 1800s with the construction of Fort Calgary. Many Indigenous groups called this place home before Calgary ever formed and help create a diverse population, where minorities make up 41% of the population. The metropolitan area is financially successful having “the highest GDP per capita of major Canadian cities” (*Our City*, n.d.). An area with a cold climate was selected because it makes sense to have a large indoor track and field training facility since athletes are unable to train outside for most of the year.

3.3. Project Location – Small Scale

When selecting where in Calgary the project should be located, proximity to the Canada Olympic Park was necessary. The Canada Olympic Park has recreational and high performance training areas for winter sports, like downhill skiing and ski jumping, cycling, and gymnastics. The Canada Sport’s Hall of Fame is also located in the area. To be in the same vicinity as the park, the project is located near the Paskapoo neighborhood in the suburbs of Calgary. Because the design protocol states that a connection to nature is desired, having proximity to the Bow River and being in an area with lesser development would create stronger implementation of this protocol.



Figure 25. Project site location with Calgary context.
This figure shows the project site location in context with some notable areas in Calgary, Canada. Source: The satellite imagery in this figure was produced by Google Earth Pro (2024) *Calgary satellite* $51^{\circ}04'16.4''N$ $114^{\circ}10'39.1''W$.

3.4. Project Site

The project site address is 1020 Short Rd NW, Calgary, AB, Canada. The project site is located on the Bow River and is a short 8 minute drive from the Canada Olympic Park. There is little development around the site and there is open grass and vegetation there currently. Many different elements of the site were analyzed to gain a complete understanding before designing the building.

First, satellite imagery was used to see what was on and around the site. To have a great connection with nature, it was ensure that there were few buildings in the site's vicinity. Next, the topography of the site was analyzed. The site is fairly sloped, with its high point at 3575 ft in elevation and low point at 3535 in elevation. There is greater slope in the southern portion of the site, but the topography allows for the entire site to be outside of Bow River's flood plain. When looking at the access points of the site, there is only one that serves it by car. This is Short Road NW and it can be accessed by Sarcee Trail SW, which runs along the west side of the site and is a larger expressway.

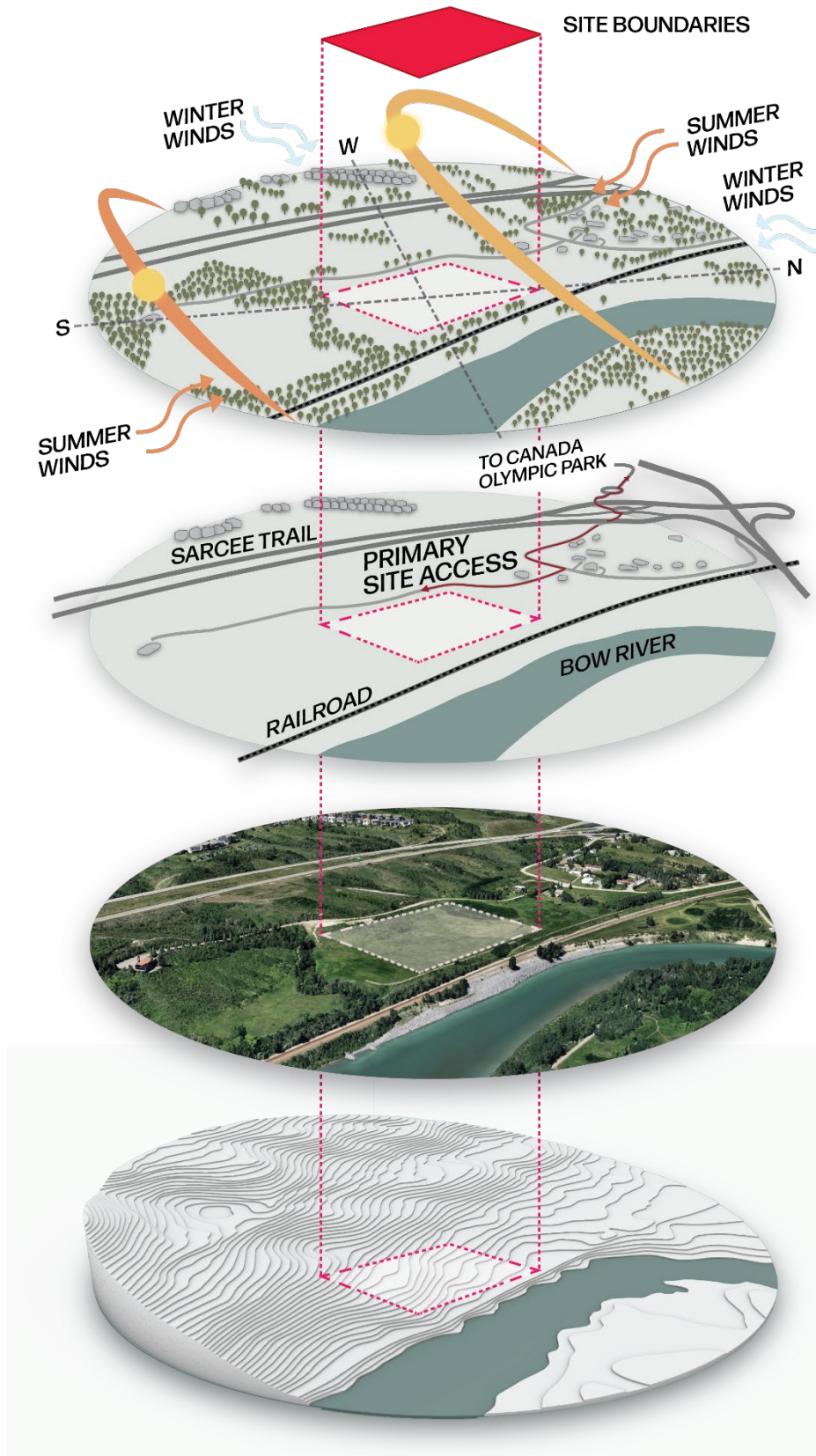


Figure 26. Site analysis diagram.

The site is located in a continental climate zone with long winters. The sun paths are shown in the top graphic of figure 26 and because Calgary is located so far north, the sun paths move a great amount. The summer winds hit the site slightly outside of the north-south axis. The winter winds hit the site from the west and the north. All this information gained by analyzing the site will be vital when beginning to develop the form of the building.

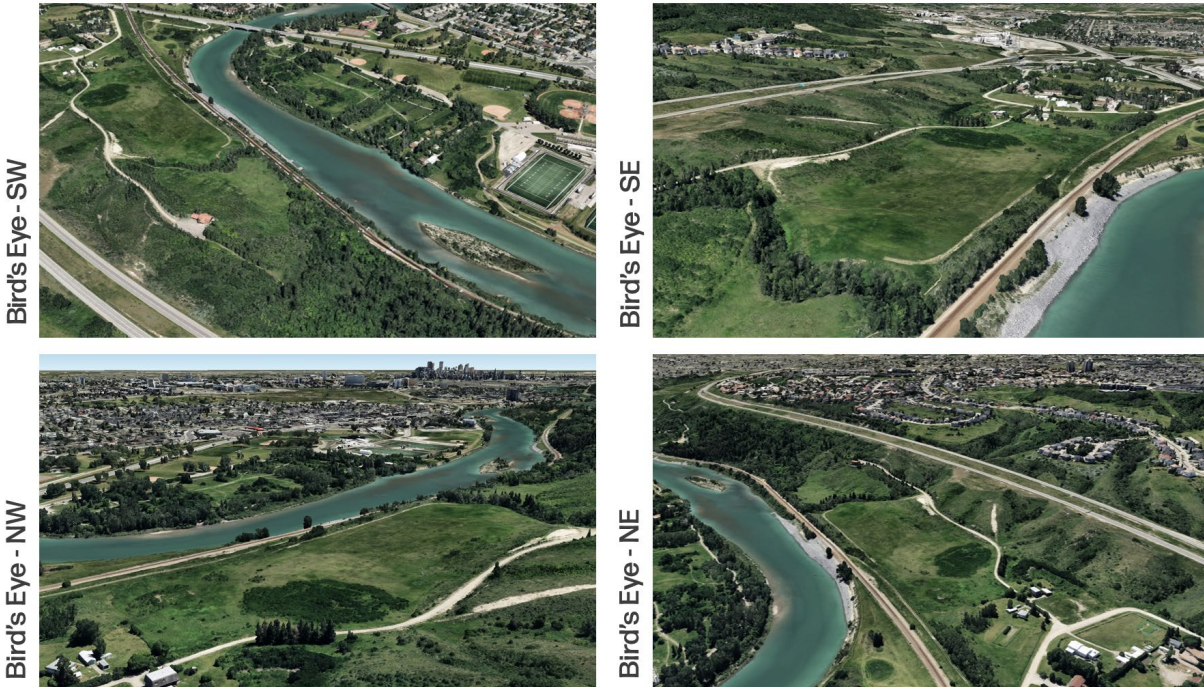


Figure 27. Aerial views of site with surrounding context. This figure shows aerial views of the site location. Source: The satellite imagery in this figure was produced by Google Earth Pro (2024) *Paskapoo neighborhood aerial views from multiple directions*.

3.5. Precedent Studies

Each of these precedent studies were selected as they added supplemental information and inspiration for creating an environment that optimizes athletic performance. Though this project type is specifically an indoor track and field training facility, other sports training facilities were also included.

3.5.1. Northwestern University Ryan Fieldhouse and Walter Athletics Center

Ryan Fieldhouse Walter Athletics Center is the main athletics building for Northwestern University in Evanston, Illinois. This building finished construction in 2018 and was designed by Perkins & Will (Castro, 2018).



Figure 28. Ryan Fieldhouse and Walter Athletics Center north facing façade.
Source: This figure was produced by James Steinkamp in *Northwestern University Ryan – Walter Athletics Center / Perkins+Will, 2018*.

One of the main purposes of this athletic complex was to aid in recruiting and provide an all-in-one stop that enhances the day-to-day life of its student athletes. Taking full advantage of its site location, this building has panoramic views of nature from Lake Michigan and makes use of natural light in every area possible (Wakefield, n.d.), which are two components of the design protocol created during the research phase.

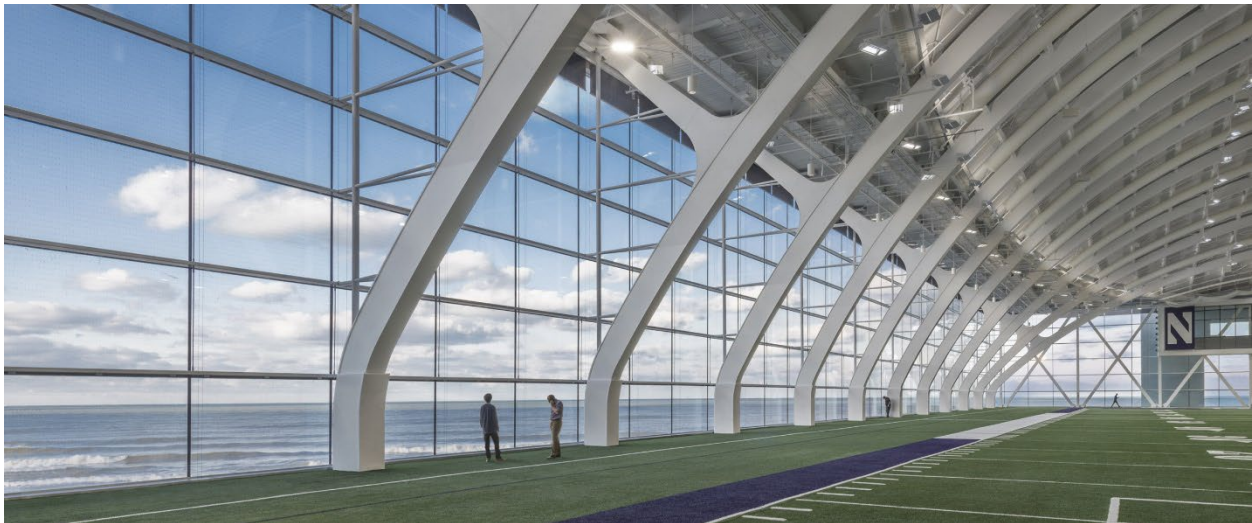


Figure 29. Ryan Fieldhouse overlooking Lake Michigan.
The indoor football practice field in Ryan Fieldhouse displays nice views of Lake Michigan. Source: This figure was produced by James Steinkamp in *Northwestern University Ryan – Walter Athletics Center / Perkins+Will, 2018*.

Within the indoor football practice, the spans supporting the roof structure are spaced in relation to the ten yard lines seen on football fields. Opinions from all the university's sports team were taken into consideration to ensure the athlete user group's needs were addressed in the design. Branding was an important component integrated into design, sharing the story of Northwestern athletics (Wakefield, n.d.) and showing school pride in every area possible.

Vice president for athletics shares how "these facilities [were] truly transformational for [the] Wildcats and [the] university" (Castro, 2018). Programming within this building includes a "nutrition center and dining facility, two sports performance centers, a cutting-edge sports medicine and athletic training hub, locker rooms for eight varsity teams, and office space for coaches and administrators" (Castro, 2018).

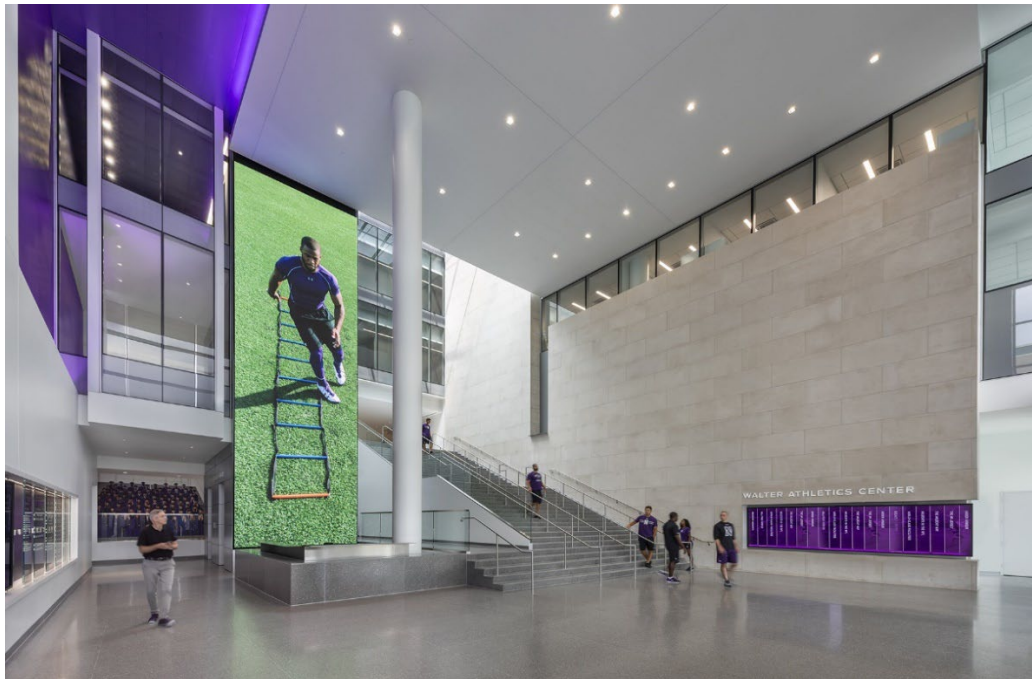


Figure 30. Walter Athletics Center entrance lobby. This lobby showcases a 3-story LED screen that shares marketing and imagery for all of the university's sports. Source: This figure was produced by James Steinkamp in *Northwestern University Ryan – Walter Athletics Center / Perkins+Will, 2018*.



Figure 31. Hallway inside of Walter Athletics Center.

This hallway displays how branding can be incorporated into regular spaces to optimize the experience of building users. This hallway shows Northwestern's 'N' logo and its brand pattern. Source: This figure was produced by James Steinkamp in *Northwestern University Ryan – Walter Athletics Center / Perkins+Will, 2018*.

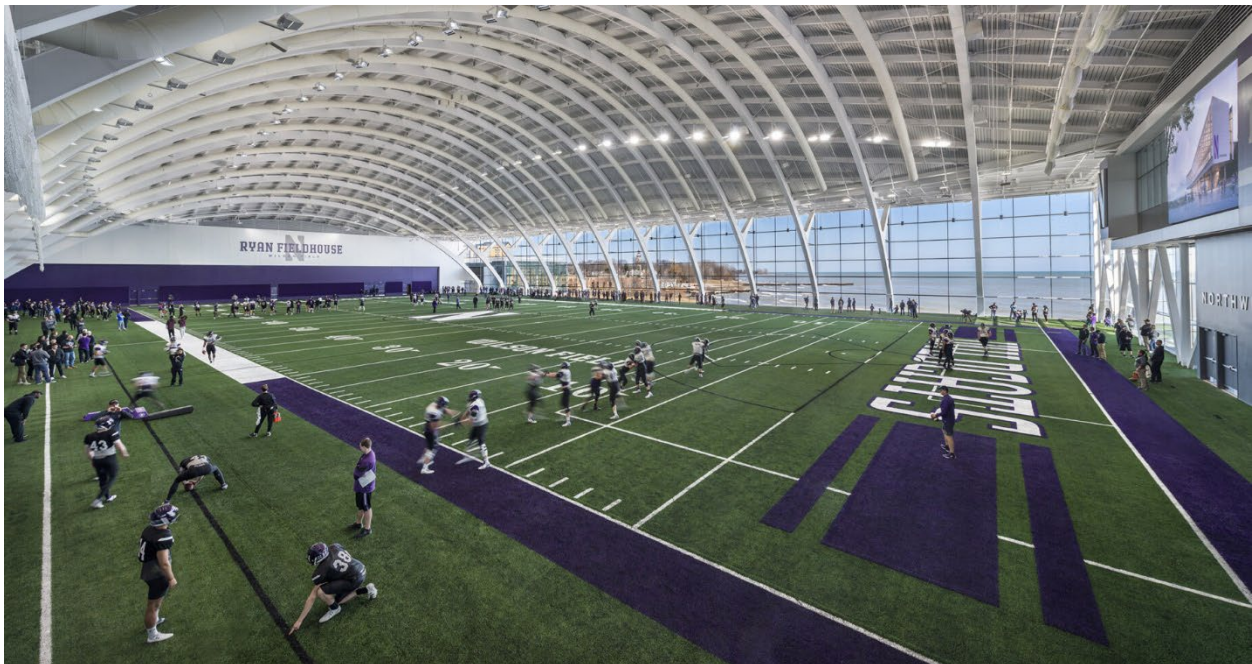


Figure 32. View of Ryan Fieldhouse showcasing the entire practice area.

This interior view displays some of the university's branding aspects as well as the inspiration of the ten yard line in the design of the spanning structures for the roof. Source: This figure was produced by James Steinkamp in *Northwestern University Ryan – Walter Athletics Center / Perkins+Will, 2018*.

This project demonstrates how incorporating athlete’s opinion in design and including design aspects not typically prioritized in this building type, such as natural light and views of nature, can create a successful design solution that clients desire. Ideas for incorporating branding are also displayed in this precedent study. Another aspect from this project to highlight is their use of taking inspiration from the sport itself, such as the ten yard line markings for their spanning supports and incorporating it into design. This can create a more meaningful design and shows that this building type can also be architecturally beautiful.

3.5.2. Ocean Breeze Track and Fieldhouse

The Ocean Breeze Indoor Athletic Facility is a high quality track and field competition facility that also serves as a practice facility and fitness center for the community. This complex is located in Staten Island and was built apart of an initiative to add recreational parks to each borough of New York. The building program includes “a 200m hydraulically banked track that can convert from six banked lanes ... to eight lanes ... seating for 2,500 people, concessions, meeting rooms, restrooms and service area ... [and] a fitness center” (ArchDaily, 2016).



Figure 33. Ocean Breeze Track & Fieldhouse exterior view. This exterior view displays the raised aspect of the building to combat water from storm surges and high tides. Source: This figure was produced by Alexa Hoyer in *Ocean Breeze Track & Fieldhouse / Sage and Coombe Architects, 2016*.

Being a certified IAAF facility, this indoor track facility is the first of its kind in the U.S. This building takes steps away from the stereotypical design of simply enclosing a 200 meter track (*About Ocean Breeze*, n.d.) and incorporates interesting design aspects to create a unique environment for training and competing.



Figure 34. Interior view of competition area. This view shows the competition area receiving natural daylight to create an open and airy environment. Source: This figure was produced by Paul Warchol in *Ocean Breeze Track & Fieldhouse / Sage and Coombe Architects, 2016*.

Some design principles present in this study that help promote athletic performance include natural light, views of nature, multiples areas of training, and high temperature control and air quality. Natural daylight was promoted in this design with the incorporation of “skylights, windows, light shelves and clerestories,” reducing the use of artificial lights by a substantial amount (*About Ocean Breeze*, n.d.). The large windows also expose building users to the surrounding natural environment which consists of “sand dunes, wetlands, grasslands, and shrub forest” (*About Ocean Breeze*, n.d.). The main track can be raised for competition with six lanes, or flattened to be an 8 lane track, giving building users options for how to use the space. The building’s “cool” roof allows the building’s temperature to remain more controlled and all of the building’s systems are highly efficient (ArchDaily, 2016).

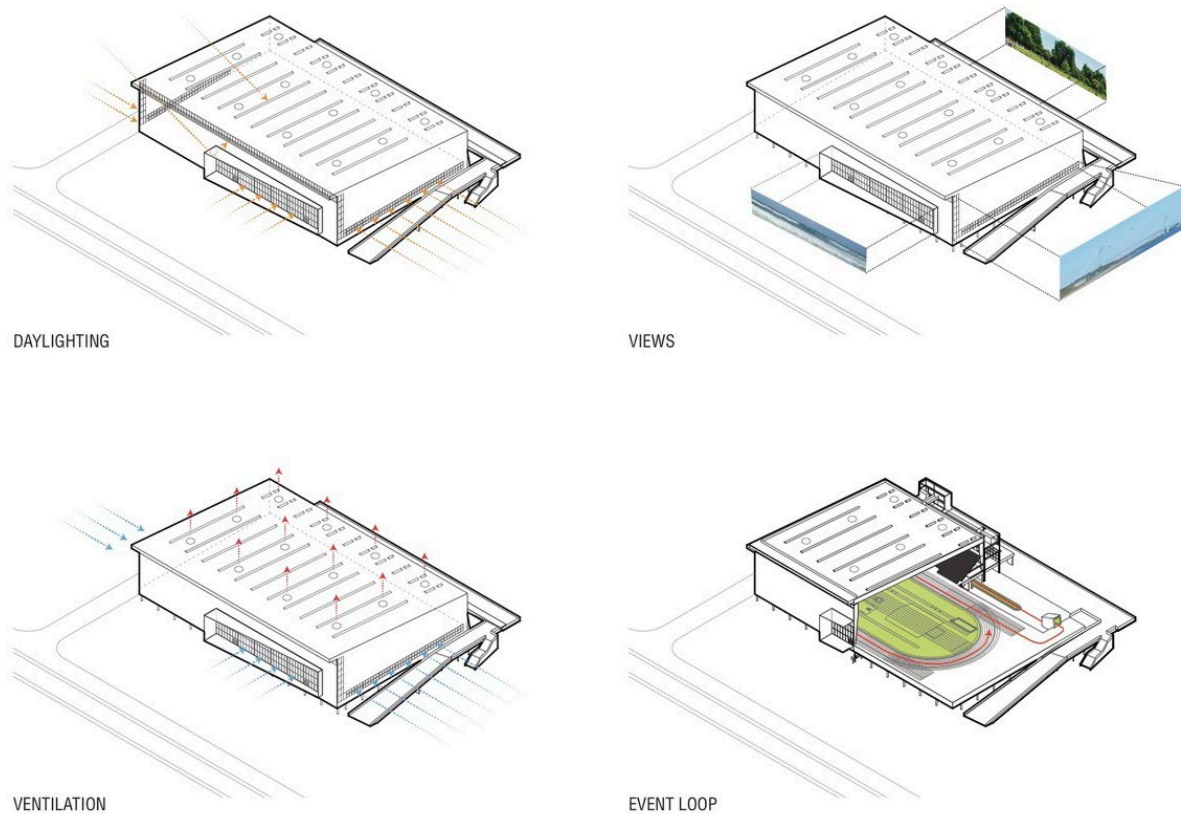


Figure 35. Ocean Breeze Track design feature diagram. These diagrams display design aspects for this track and field facility. All features display how daylighting, views, ventilation, and the process of competition can be incorporated into this building type. Source: This figure was produced by Sage and Coombe Architects in *Ocean Breeze Track & Fieldhouse / Sage and Coombe Architects, 2016*.

This building also incorporates heavy usage of color within areas of circulation which can help influence how the building users react to a space. The green stairwell in this project that leads to the competition area can be replicated with assorted colors that are proven to obtain the desired moods or emotions prior to competition.

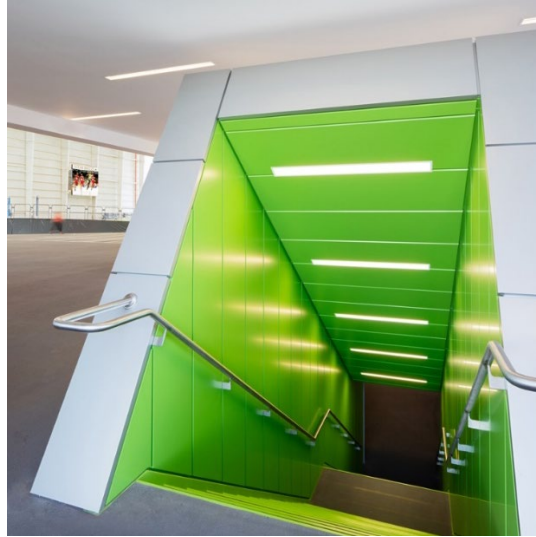


Figure 36. Ocean Breeze's green stairwell. This stairwell takes competitors from the warm up to competition area and displays a method of how intentional color usage can be incorporated into a design. Source: This figure was produced by Paul Warchol in *Ocean Breeze Track & Fieldhouse / Sage and Coombe Architects, 2016*.



Figure 37. Ocean Breeze's warm up area. This image shows ocean breeze's warm up area, with the red staircase towards the back gives direct access to the competition area. This displays another area where athletes may complete their training. Source: This figure was produced by Paul Warchol in *Ocean Breeze Track & Fieldhouse / Sage and Coombe Architects, 2016*.

Another unique detail of this study is some of the artwork included in the design. There is a high jumper graphic added onto a wall of glass which consists of smaller icons of athletes, animals, nature items, and the facility's logo. This shows a creative way to add more character and meaning to a space to specify the purpose of the building.



Figure 38. Ocean Breeze window graphic.

A high jumper graphic consisting of smaller icons that are of meaning to the building and its design. This piece of art can be seen from the interior and exterior of the building. Source: This figure was produced by Alexa Hoyer in *Ocean Breeze Track & Fieldhouse / Sage and Coombe Architects, 2016*.

Ocean Breeze Track and Fieldhouse is a fitting example of how to incorporate numerous design strategies to make an athletics building higher quality, better for users, and well known within the sports community. This project will be a notable example to use during the design process as it is the specific building type being created and is a successful design.

3.5.3. St. David’s Performance Center

After doing substantial amount of research in architecture literature and precedent studies, St. David’s Performance Center was one of the only examples found that noted intentionality for creating a training center focused on helping the athletes’ wellbeing. This training facility used a holistic perspective on athletic performance as a basis for design (Abraham, 2021).



Figure 39. St. David's Performance Center
Exterior view of St David's Performance Center. Source: This figure was produced by Gensler Architects in *Designing performance centers to promote well-being for athletes, 2021*.

St. David's Performance Center serves as the training headquarters for the Austin FC, which is a Major League Soccer team. This building was designed by global firm Gensler, who worked closely with the clients to create a result that was beneficial to the franchise as a whole and assisted athletes' in discovering what was necessary for them to compete to their highest level. This study presented five aspects for an athletic performance center, which includes a "culture of well-being... , connections between trainers and players... , indoor-outdoor connections... , [use of] materials and branding to motivate and inspire... , [and] support for the next generation of athletes" (Abraham, 2021). There are many similarities between these aspects and the design protocol created through researching sports performance and directly taking feedback from athletes. It should be noted that there is no evidence or reasoning shared in this precedent study stating why these aspects are important for performance centers.

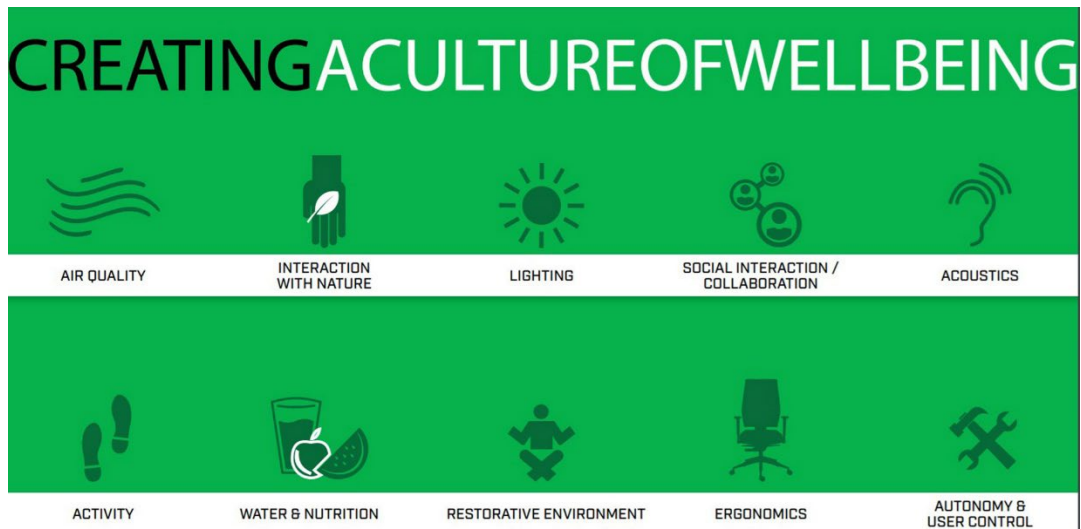


Figure 40. Components for a “culture of wellbeing.” This figure displays components to consider when designing for wellbeing. Source: This figure was produced by Gensler Architects in *Designing performance centers to promote well-being for athletes, 2021*.

This design incorporates team branding and colors wherever possible, manipulates the building form to allow for natural ventilation, lighting and views to the outside, and creates adjacencies that allows staff to monitor athletes and ensure their health (Abraham, 2021).

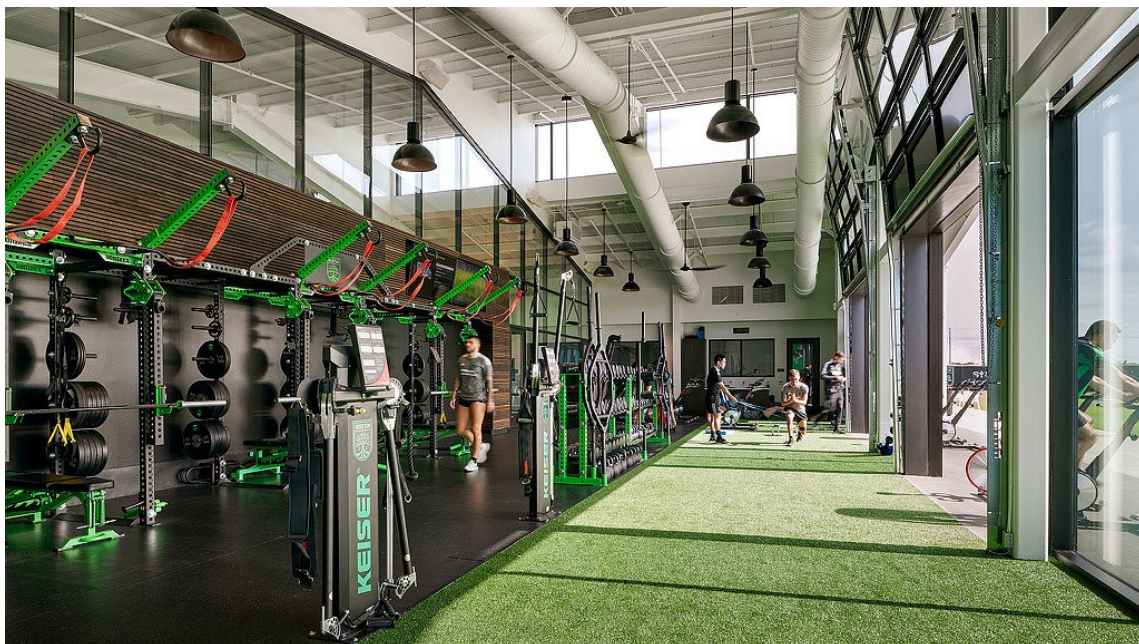


Figure 41. St. David’s Performance Center weight training room. This weight training room highlights how natural light can be brought into an interior space and extended throughout the building. Source: This figure was produced by Gensler Architects in *Designing performance centers to promote well-being for athletes, 2021*.

This project is a vital precedent study as it is one of the only examples found which intentionally takes the athletes’ performance and wellness into account during the design process. A unique method that displays this consideration is incorporating glass and openings between spaces where there is normally no interaction, such as the trainer’s room and weightroom, to stimulate relationships between athletes and trainers. It also demonstrates more ideas of how to incorporate and manifest the team branding into areas where training occurs. Designers for this project state the necessity to consider factors in an athlete’s health and performance when designing these facilities so that “the team and the entire franchise [see] benefit[s] from a holistic approach” (Abraham, 2021) which is the goal for the project.

3.6. Building Programming

Using precedent studies and research, initial building programming was created to understand the general size of the project that will be designed. The initial building programming is shown in table 1.

Table 1. Initial building programming.

Program Element	Areas/Quantities
200m track	17,750 SF
Long jump runway	2 at 2,600 SF each
Triple jump runway	2 at 2,600 SF each
Pole vault runway	2 at 3,400 SF each
High jump area	2 at 4,000 SF each
Competition throwing rings	5,400 SF
Additional warm up lanes	5,250 SF
Training turf	12,000 SF
300m track	12,500 SF
Additional training track lanes	3,000 SF
Training throws ring	3,750 SF
Weight rooms	2 totaling 18,000 SF
Altitude training room	2 totaling 2,000 SF
Athletic training area	5,000 SF
Nutrition area	1,000 SF
Equipment room	2,000 SF
Locker rooms	4 totaling 10,000 SF
Spectator seating	10,000 SF
Concessions	600 SF
Administrative area	10,000 SF

Note: ‘SF’ signifies square feet.

4. RESULTS

4.1. Final Project Description

The Athletics Canada High Performance Training Center is the building designed to showcase the implementation of the design protocol and research into sports architecture. This building is a year-round indoor track and field training facility designed for Athletics Canada, the overseeing organization for all Team Canada track and field athletes. It is located on the Bow River in Calgary, Canada in a minimally developed area. The building has a gross square footage of 503,046 square feet. It has two levels and uses a double tee precast concrete structure for level 1 and a steel structure with large trusses for level two. Some general program elements include a competition area for indoor track and field meets, training areas for all events, administrative areas for coaches and Athletics Canada staff, and any additional athletic support spaces needed for athletes in training.

4.2. Implementation of Design Protocol

The design protocol for a holistic environment for athletic performance created from research and survey results was used as a basis for design and helped guide decision making during the process. This portion of the paper will describe how each step was implemented into design. The implementation of the design protocol will also be elaborated upon when sharing the project design and documentation.

4.2.1. Implementing Multiple Areas for Training

Including multiple areas for training where athletes can choose between was an aspect of the protocol to reduce the likelihood of burnout (Hollembek & Amorose, 2005). This was implemented into design in the building program, floor plans and interior design of the spaces. To apply this to the program, two of each major training spaces were added. When adding these spaces to the floor plan, different areas of the building were used to provide a change of location and environment. By adding multiple areas in the floor plan, the interior design of these spaces were able to vary to create a unique sense of space for the different training areas. This translates to athletes who are using the building being able to choose the environment in which they train, supporting their intrinsic motivation, and varying the feeling they get when they are in the training spaces.

4.2.2. Implementing Team Branding and Goal Visualization

Team branding and goal visualization was implemented into the interior design of spaces in the building. Team branding was implemented by carefully choosing the color of materials, implementing branding in wall graphics, or including design features that has the team's or organization's logo. For goal visualization, large wall graphics for used in training spaces that included motivational quotes and successful athletes who have competed for Team Canada. This was an important aspect of the protocol as noted by survey responses and can help support the intrinsic motivation of athletes.

4.2.3. Implementing Natural Light

Natural light has positive effects on levels of stress and emotional outlook of users (Connellan et al., 2013) which can reduce the likelihood of physical injury (Appaneal et al., 2014) and emotional burnout (Li et al., 2013). To implement lots of natural light into the building, structural systems were selected to allow for the exterior walls to contain substantial portions of glazing. The structural system for level 1 is a precast double tee concrete system. Level 2 has more of a typical steel structure with large steel trusses to cover the span of the building. Both of these systems allow for curtain walls on the exterior and provide connection points for the curtain walls to be supported by the structure. All of the training areas within this building are situated on the exterior so they have access to this natural daylight.

4.2.4. Implementing a Connection to Nature

Interior spaces having a connection to nature help in reducing user's stressful and anxious emotions (Ulrich et al., 2008). Connecting users to nature through indoor plants is also beneficial to their experience (Connellan et al., 2013). By choosing the structural systems noted when describing how natural light was implemented into the design, a connection to nature can also be created. Having substantial amounts of glazing allows for views to see the natural elements outside and feel connected to the outdoors. The site location was chosen to be on the Bow River and in an area with minimal development so that views to the outside were of nature and not of other buildings. In areas where there weren't optimal views of nature, indoor plants were added to still feel connected to nature. Indoor plants were also added in recovery areas and training areas of the building where a calmer sensation was

desired. Another way a connection to nature was created was by adding nature backgrounds to the wall graphics in training spaces.

4.2.5. Implementing High Air Quality and Temperature Control

Temperature and air qualities such as “temperature, pollution” and humidity can affect an athlete’s performance (Kuok Ho, 2021). To ensure optimal environmental conditions for training, an HVAC system with good air quality and temperature control is needed. The mechanical room in the floor plan was placed to have direct access to all major training spaces in both levels of the buildings. This allows for all the large ductwork to be directly fed into the key areas of the facility.

4.2.6. Implementing a Designated Area for Mental Training

An athlete’s mental state is a vital component to consider when asking how to improve their performance (Schinke et al., 2018). To ensure athlete’s mental health is being cared for, a mental wellness area was included in the program. This would provide space for in-house sports psychologists and mental health specialists to interact with athletes whenever needed. This area was included in the portion of the building where athletes care for their physical health to indicate that caring for mental health is just as important. Mental health can also be taken care of in the Zen Room of the building. Many athletes indicated in the survey that spending time outdoors was a way to care for their mental health. Because a majority of Calgary’s climate is harsh and cold, it’s difficult for athletes to go outside. The Zen Room mimics an outdoor environment to help athletes receive the benefits of being outdoors year-round.

4.2.7. Implementing Communal Spaces

Many relationships are created in the world of sports and athletes indicate that they depend on their teammates and training partners when having difficulty completing their training. To garner relationships within Athletics Canada to benefit the organization as a whole, communal spaces were implemented into the program and floor plans. There is an athlete gathering space on the first level of the building near the stairs where most athletes enter the athletic support spaces. This is to encourage teammates and athletes to spend time with each other. There are also gathering spaces included in the Zen Room so athletes can socialize and connect while they are unwinding from their training.

4.2.8. Implementing Healthy Materials and Surfaces

By ensuring high quality materials and surfaces within athletic complexes, the likelihood of physical injury is reduced. Due to the time constraints of the project, it was difficult to go into detail about which materials were selected for the project. Athletic training surfaces for the tracks and turf were able to be selected. High quality surface options, such as Mondo track running surfaces or AstroTurf are examples of surfaces that have been highly researched to see how athletes respond to training on them. By taking the time and ensuring the quality of materials that are to be specified for the project, it can be assured that healthy materials are selected.

4.2.9. Implementing Intentional Layouts

Intentional layouts are an important aspect of good design no matter the building type. The goal for this step of the protocol is to make planning decisions with the athletes being the primary user group considered. Intentional layouts were included in this program by ensuring optimal adjacencies within the floor plans. Training turf, a full 100m track straightaway, and large weightroom were included on the inner portion of the 300m track. This gives athletes many of their training needs in one area of the building. A majority of the athletic support spaces are placed on level one of the building and the sequencing of the spaces are to mimic the training schedules of athletes. Placing oneself in the athletes' shoes when planning these spaces can ensure that the layouts help improve the flow of training.

4.2.10. Implementing an Intentional Use of Colors and Materials

Intentional use of colors and materials is another quality needed for any type of design. This step of the protocol ensures that the interior design of spaces matches their primary function, more specifically, whether the space is for training or recovery. More vibrant colors were included in training areas to encourage excitement and focus. Within recovery areas, natural materials and more subdued colors were preferred for their calming effects. One advantage to having multiple areas for training is that different interior design can create different sensations when athletes are training in that space. Survey responses showed that there is a variety of emotions that athletes desire to feel when they are training. By having two different training areas, a more excited and aroused environment can be created with bright colors and strong decals, or a calmer, relaxed environment with natural materials, muted colors,

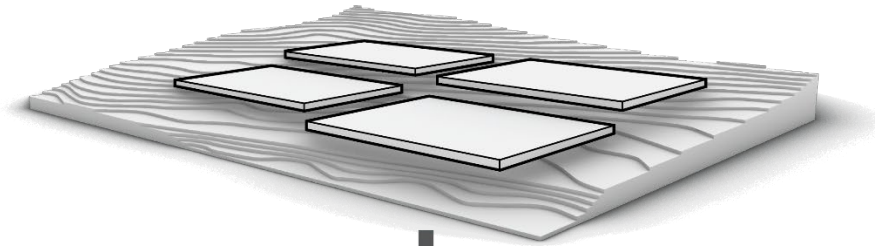
and indoor plants. Some specific examples of this within the program are the recovery room with the contrast baths and the altitude training room on level 2. Darker materials and paint colors were selected for the recovery room to create a restorative environment, signaling to athletes' bodies that training time is over and to begin relaxing. The altitude room on the second level is one of two in the building and has a wood accent material with lots of indoor plants. More natural materials for selected for this space to create a calmer training environment for those who prefer it.

4.3. Project Design and Documentation

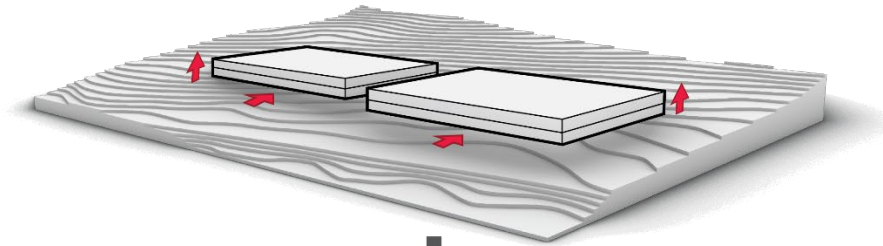
4.3.1. Drawings and Diagrams

Upon completion of the design protocol, site selection and analysis, and initial building programming, conceptualization of the building began. Building programming was used to determine the rough area sizes needed for this building, which were massed and placed within context on the project site. To make the building footprint more efficient, the mass areas were stacked. Running tracks have large footprints, so by stacking the two tracks of the building on top of each other, the larger areas of the building were able to be grouped. This created two main masses for the building. The masses were joined, then angled with each other to follow the general topography changes of the site. Angling the masses also optimized the building shape for maximum views of the Bow River. When adding roofs to the masses, they were curved to create more aerodynamic forms and to prevent snow loads from accumulating on the roof. The last step of developing the form was adding substantial amounts of glazing on the exterior walls. This allowed for natural light to enter the building and for users to have a great connection with nature. Figure 42 shows the visual progression of the form conceptualization of the project. Step five of the diagram is the form that was developed to create the final product.

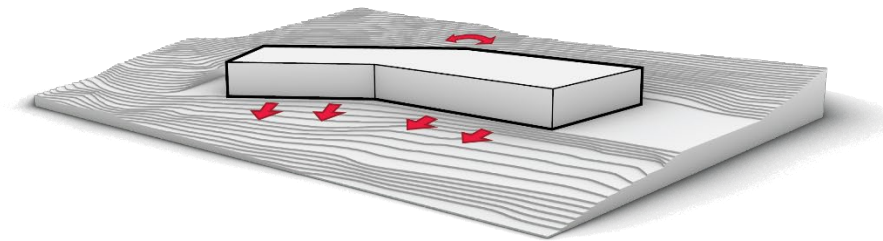
Utilize programming to determine mass areas



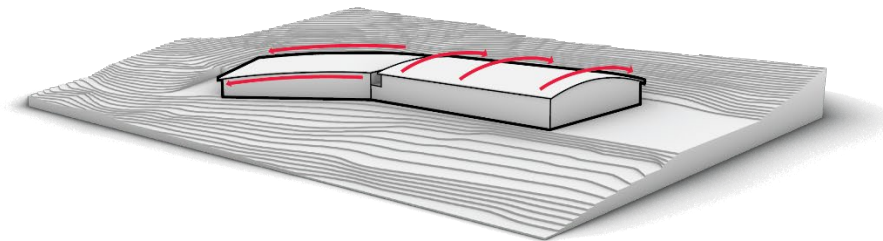
Stack masses to reduce building footprint and implement optimal adjacencies



Angle masses to fit site topography and encompass views of the river



Sculpt masses to create aerodynamic roof forms



Add glazing to allow for views of nature

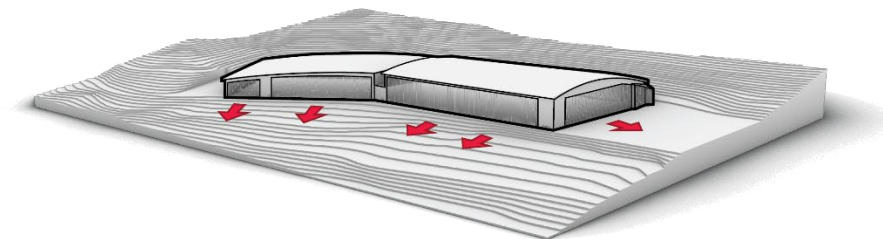


Figure 42. Building concept progression.

On the site plan, two main entrances to the building can be seen that serve the different user groups. The northern portion of the building is where the spectator main entrance is and it serves the portion of the building where the tracks are located. This entrance is closer to the main access point of the site and is located on level 1 of the building. Because of topography changes on the site, the ground condition isn't at level 1 throughout the entire building. When heading south on the site, the topography begins to slope upwards. The athlete and staff entrance to the building is located in the southern portion and because of the topography changes, this entrance was placed on the second level. A portion of level 1 would not have any access to daylight, so the service areas of the program were placed in this area. Most service areas needed access to the outdoors so larger items can be moved indoors. By adding a retaining wall near the southeast corner of the building, a service entrance was able to be placed on level 1 of the building. There are two different parking lots on the site adjacent to the main entrances, which creates 500 parking spaces for the building.

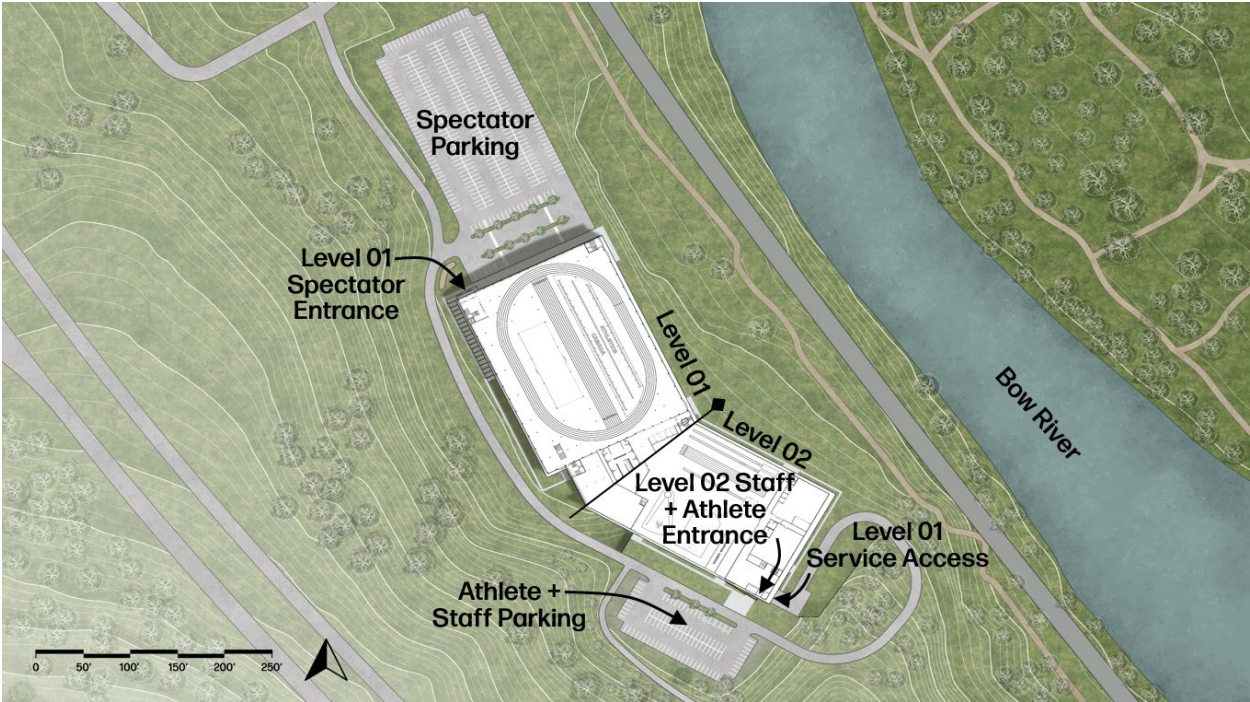


Figure 43. Project site plan.
Site plan for the Athletics Canada High Performance Training Center.

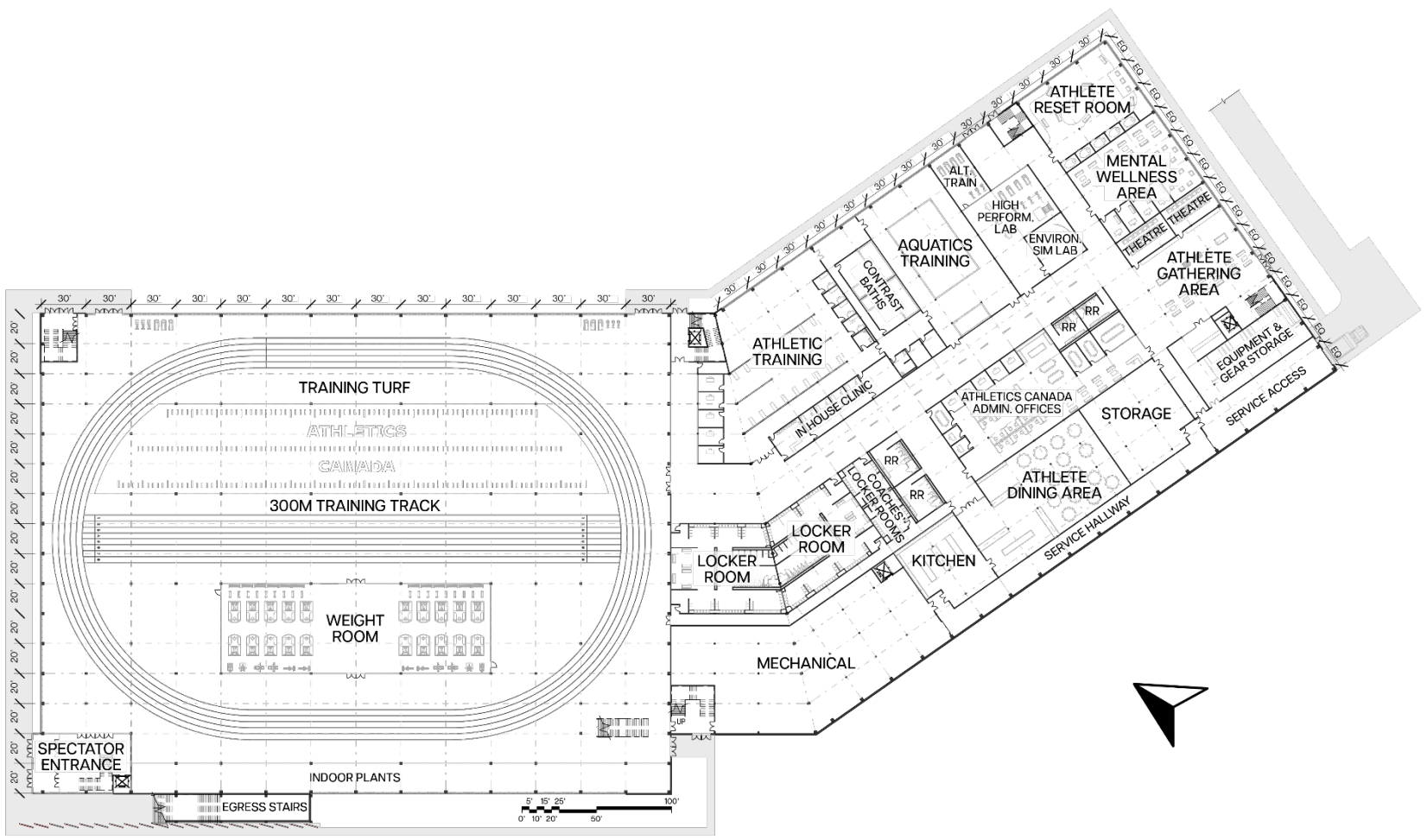


Figure 44. Level 1 floor plan.

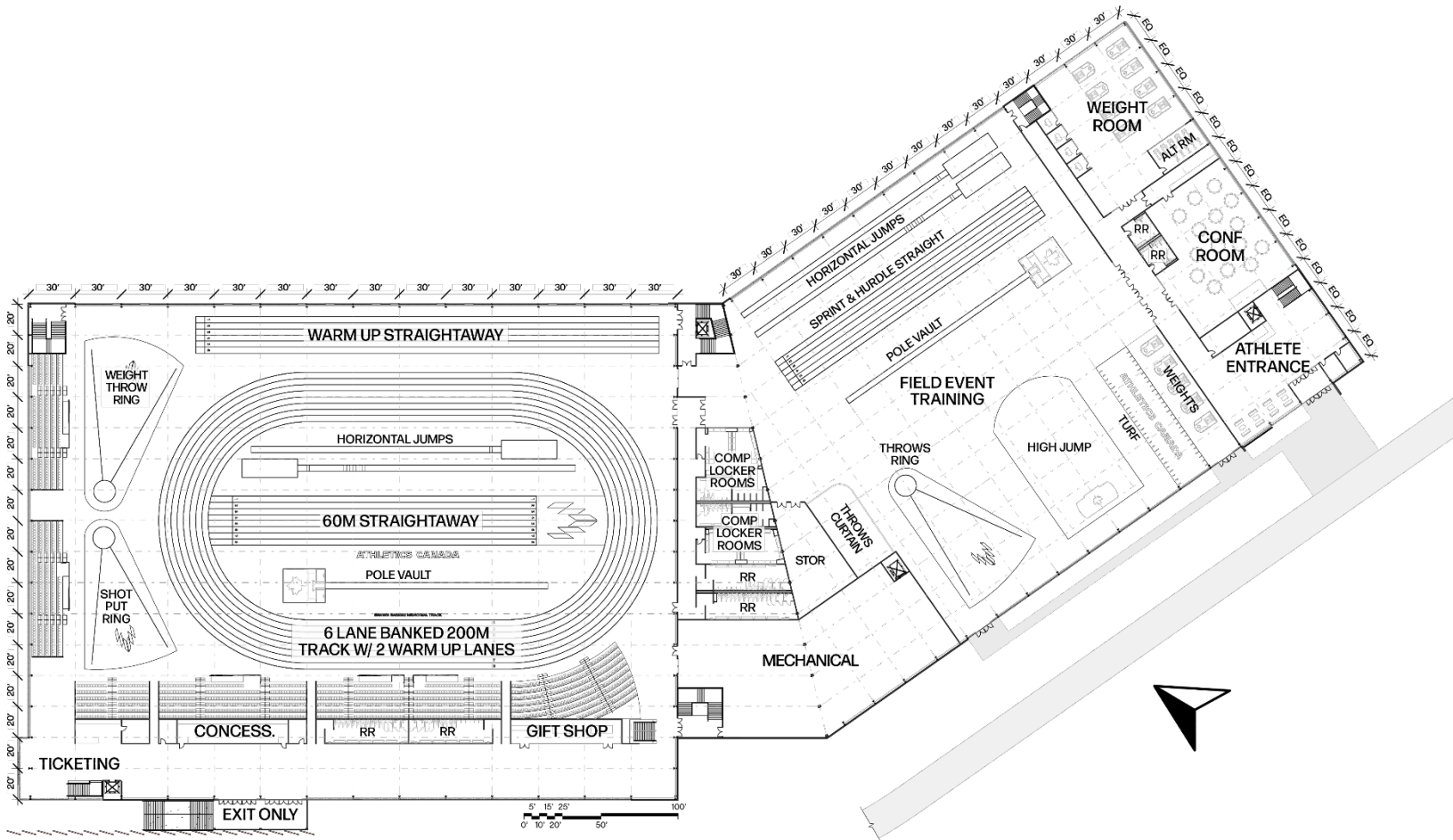


Figure 45. Level 2 floor plan.

When looking at the floor plans of the building, level 1 has the majority of the athletic support spaces. The spectator main entrance is located at the northwestern end of the building and immediately takes spectators upstairs to the competition area. The northern portion of the building is where the tracks are located and the 300m track was the largest component of this floor plan. Within the 300m track area is training turf, a 100m track straightaway, and the first weight room of the floor plan. Adjacent to the 300m track area are lockers rooms for the athletes and the athletic training area. Other athletic support spaces include an in-house clinic, aquatics training area, athlete dining area, high performance lab, one of two altitude training rooms, environment simulation lab, Zen room (athlete reset room), mental wellness area, and athlete gathering area. The Athletics Canada and coaches administrative areas are located on level one. The southern portion of the building includes the service areas of the building. The mechanical room is located where the two main building masses meet to give it direct access to all major training spaces. A service hallway gives the mechanical room easy access to outside for large equipment and serves the kitchen, storage room, and equipment room as well. Program elements such as the mental wellness area and Zen room were influenced by the design protocol. The 300m track was included to give athletes a choice for where their running workouts could be completed. The larger track is suited for longer running workouts as it has less tight of turns than a 200m track, subjecting athletes' bodies to less stress.

Moving to the level 2 floor plan, more examples are shown of multiple areas for training. The competition area is located above the 300m track. There is spectator seating along two sides of a banked 200m track to not block any views to the outdoors or natural daylight. Adjacent to the competition space is a ticketing area, restrooms, concessions and a gift shop. Each field event has its respective competition space. Field event athletes can chose to train in either the competition area or the field event training area, which is located adjacent. Each field event has a secondary training space located here and there is additional straightaways for sprints and hurdles training. Near the throws training ring is a smaller throwing area with curtain nets around the outside of it. This is intended for athletes who compete in outdoor throwing events, such as javelin or discus, to throw their implements into the net, giving them somewhere to train their event during the winter. Between the competition and field event training area

are locker rooms and restrooms designated for competing and training athletes. The southern portion of the building shows the second main entrance for the athletes and staff. There is an additional weight room and altitude training room on the second level as well. Tables 2 and 3 list all program elements and their sizes that are included in the final floor plans.

Table 2. Level 1 final building program.

Program Element	Areas/Quantities
Spectator entrance	2,476 SF
Entire 300m track area with 100m straightaway	101,436 SF
Training turf	18,618 SF
Weight room	10,652 SF
Athletic training area	9,771 SF
Recovery baths	1,650 SF
In house clinic	1,717 SF
Aquatics training	6,349 SF
Altitude training room	892 SF
Sports performance lab	2,727 SF
Environment simulation lab	883 SF
Athlete gathering space	4,235 SF
Theatres	2 at 660 SF
Mental wellness area	4,037 SF
Zen room	3,644 SF
Women's locker room	3,702 SF
Men's locker room	3,492 SF
Women's coach locker room	567 SF
Men's coach locker room	568 SF
Kitchen	2,325 SF
Athlete dining area	3,616 SF
Serving area	2,610 SF
Administrative area	7,080 SF
Storage room	3,459 SF
Equipment storage	3,167 SF
Receiving room	2,514 SF
Mechanical room	11,803 SF
Service hallway	3,504 SF
Stairs	3,507 SF
Restrooms	1,888 SF
Circulation	17,535 SF

Note: 'SF' signifies square feet. Square footage areas do not account for wall areas.

Table 3. Level 2 final building program.

Program Element	Areas/Quantities
Competition area	102,815 SF
Spectator seating	17,734 SF
Commentator booth	505 SF
Ticketing area	716 SF
Concessions	1,078 SF
Gift shop	1,078 SF
Competition area circulation	17,094 SF
Men's competition locker room	1,706 SF
Women's competition locker room	1,801 SF
Field event training area	64,544 SF
Curtain throwing area	1,686 SF
Weight room	7,068 SF
Conference room	6,131 SF
Conference preparation and storage area	588 SF
Athlete and staff entrance	756 SF
Mechanical room	12,058 SF
Restrooms	4,389 SF
Storage room	2,182 SF
Stairs	3,507 SF
Circulation	10,267 SF

Note: 'SF' signifies square feet. Square footage areas do not account for wall areas.

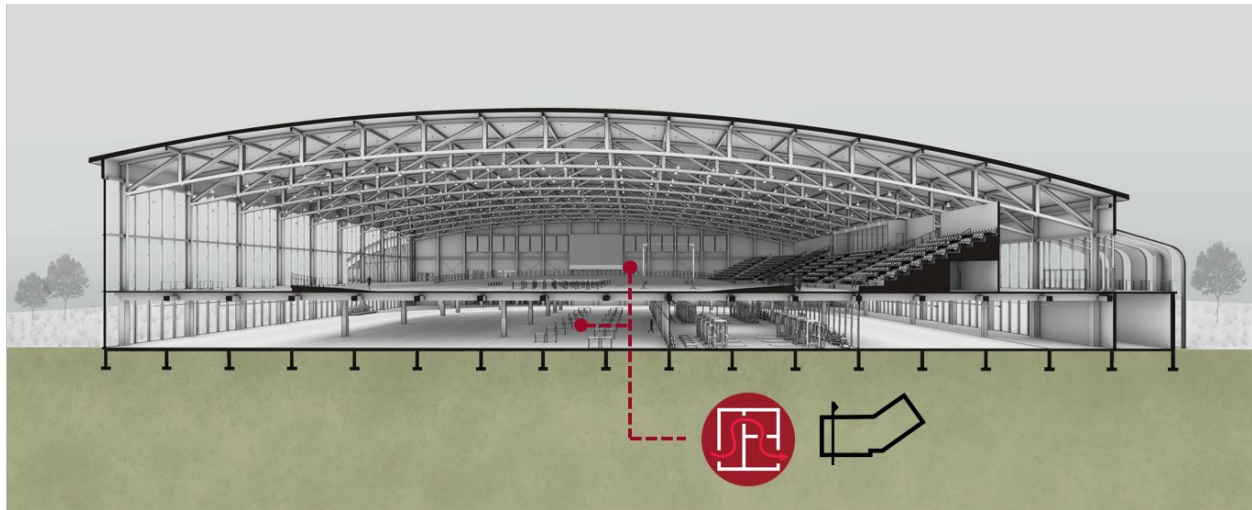


Figure 46. Section 1.
Section through the northern portion of the building.

When looking at the sections of the building, the interaction between spaces can be seen. Figure 46 shows the 300m and 200m track stacked on top of each other. Having the 300m track close to the

200m track vertically instead of horizontally minimizes the building footprint without having to sacrifice a crucial adjacency. Athletes will likely use the 300m space for warm up prior to competition and compete on the 200m track, therefore, these two elements need to be near each other.

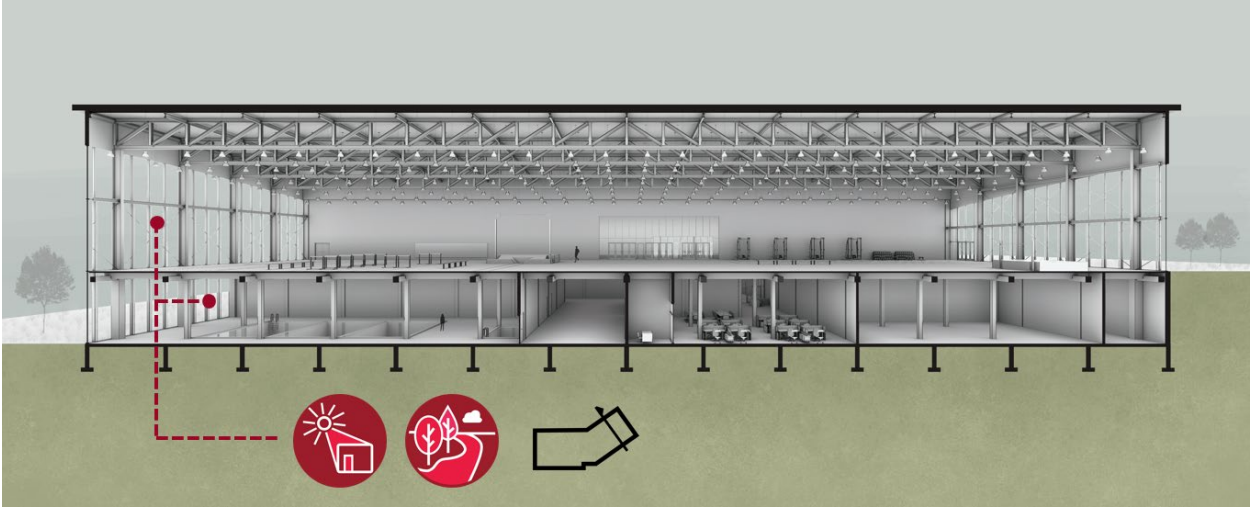


Figure 47. Section 2.
Section through the southern portion of the building.

Figure 47 offers a good visual for how the topography changes on the site by showing the ground condition being at different levels on opposite sides of the building. The sections show the precast double tee concrete structural system on level one and a traditional steel structural system with large steel trusses on level two. These systems require fewer structural elements on the exterior walls, allowing them to have large glass curtain walls. These curtain walls create a good connection with nature and increases how much natural light enters the building.

Figure 48 displays the different structural systems as a whole and offers another view of the interior spaces. All exterior walls can also be seen in this diagram.

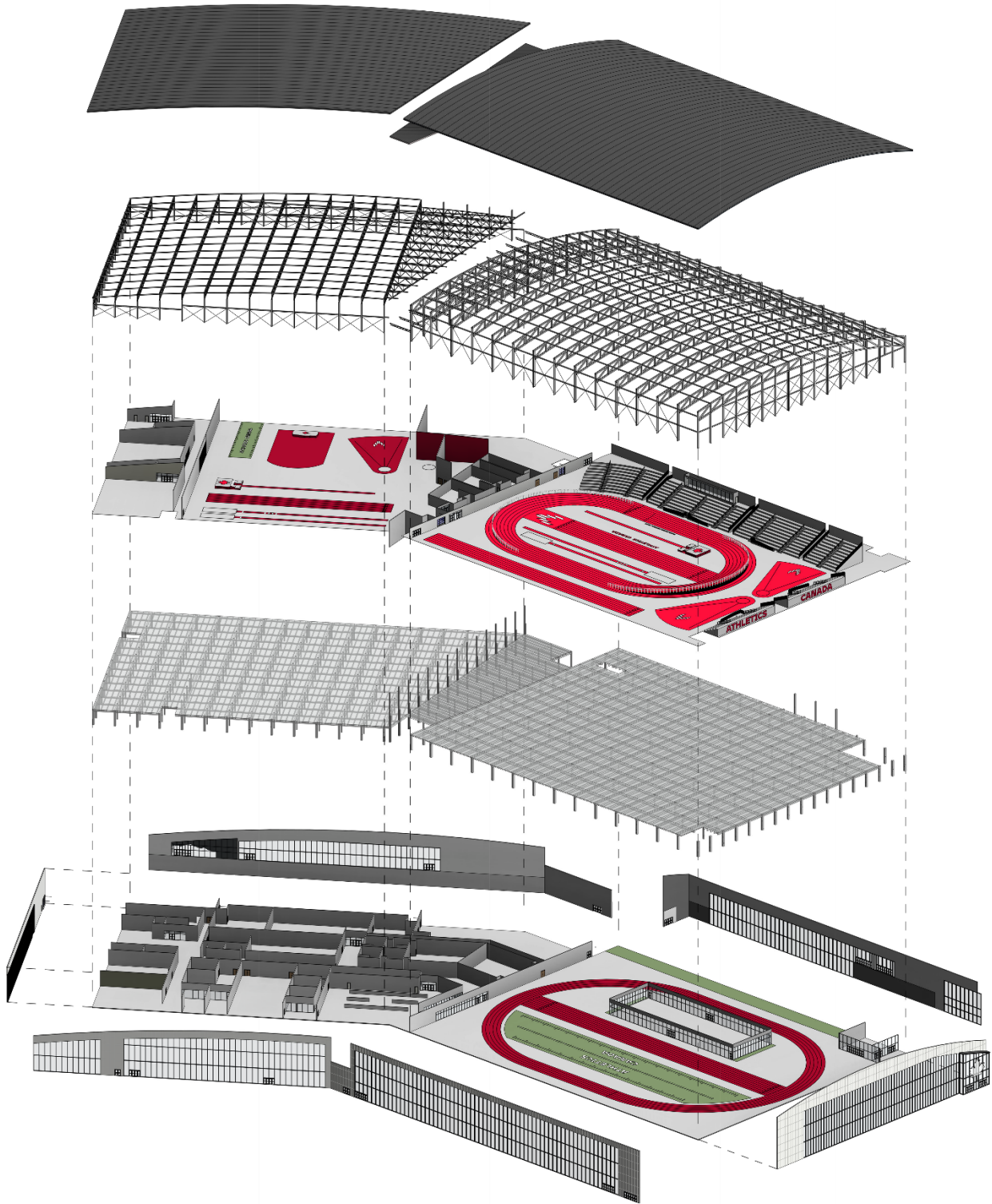


Figure 48. Exploded structural diagram.

Figure 48 displays all major structural elements of the building, the interiors spaces of each level, and all exterior walls. From top to bottom, the diagram layers show the building's roofs, the steel structure system, level 2 interior spaces, the precast double tee structural system, and level 1 interior spaces with the exterior walls shown outside of it.

4.3.2. Renderings



Figure 49. Exterior rendering.
Exterior render taken from outside of the spectator entrance.

Renderings of this project offer another visual for how the design protocol was applied to this project. Figure 49 is what most users will see when approaching the building. Winter conditions were selected for this rendering to show why an indoor practice facility is so important for a city like Calgary because most track and field athletes have to spend their time training indoors. The interior renderings will note which steps of the design protocol were implemented within those spaces in the figure notes.

Figure 50 shows the competition area of the building. The large curtain walls help natural light enter the space and allows for views of the river and outdoor vegetation, which were important aspects of the design protocol. Elements within the competition area include a hydraulically banked 200m track, competition areas for all field events, and spectator seating throughout. There are elements of Team Canada and Athletics Canada on the track and the walls to implement team branding within the space. The competition track is named in memory of Shawn Barber, the Canadian pole vault record holder who recently passed away.



Figure 50. Competition area rendering.
Design protocol elements implemented include multiple areas of training, strong team branding and visualization of goals, natural light, connection to nature, and healthy materials and surfaces.



Figure 51. 300m track rendering 1.
Design protocol elements implemented include multiple areas for training, natural light, connection to nature, and healthy materials and surfaces.



Figure 52. 300m track rendering 2.

Design protocol elements implemented include multiple areas for training, team branding and goal visualization, connection to nature, and healthy materials and surfaces.

The 300m track, located below the competition area, provides athletes with another area to complete their running training. The larger track subjects the athletes' bodies to less stress since they are running on less tight turns. Three of the four walls within the space are glazed to allow for views of the outdoors and for natural light. Figure 52 shows one of many wall decals added to training spaces within this building. The wall decals contain motivational quotes, successful athletes who have competed for Athletics Canada, and additional nature components in the background. Survey responses indicated that details like these are important in a high quality facility.

Figure 53 is a rendering of the weight room located on the inner portion of the 300m track. Because this room is not located on the exterior portion of the building, storefront walls enclose it to allow natural light from the 300m track area to enter the room. Team branding was implemented into the weight room equipment by selecting colors that match Athletics Canada's colors and design features, such as the Athletics Canada logo ceiling light features, which showcase the organization people are training for.



Figure 53. Level 1 weight room rendering. Design protocol elements implemented include multiple areas for training, team branding and goal visualization, and intentional layouts.



Figure 54. Level 2 weight room rendering. Design protocol elements implemented include multiple areas for training, natural light, connection to nature, and intentional use of colors and materials.

A unique design strategy was used for the level 2 weight room. By having two different training areas, the design can alter the environment and sensation of a space greatly and athletes can choose which environment they prefer. The second weight room was placed in the outside corner of the second level and has better access to daylight and views to the outdoors. Indoor plants were added above the weightlifting space and lighter, more natural materials were selected for the room. This creates a calmer training environment for the athletes who desire it.

An altitude training room is shown in figure 55, which simulates high altitude training conditions to improve the aerobic fitness of athletes. This is one of two included in the building. Wood was intentionally chosen as the accent material of the room to pair with the indoor plants and help bring the outdoors within. Choosing the colors and materials of the space greatly alter the feeling an athlete gets while training there.



Figure 55. Altitude training room rendering. Design protocol elements implemented include multiple areas for training, natural light, connection to nature, and intentional use of colors and materials.



Figure 56. Field event area rendering 1.
Design protocol elements implemented include multiple areas for training, team branding and visualization of goals, natural light, connection to nature, and healthy materials and surfaces.



Figure 57. Field event area rendering 2.
Design protocol elements implemented include multiple areas for training, team branding and visualization of goals, natural light, connection to nature, and healthy materials and surfaces.

Figure 56 is a rendering of the jumps area of the field event training space. Another wall decal is shown here with a motivational quote, Team Canada track and field athletes, and a mountain background. Equipment and track surface material colors match the Canadian flag's colors. This area is another example of where natural light and a connection to the outdoors was implemented into the facility's training spaces.

The throws area shown in figure 57 is within the field event training area and has similar design features as the jumps area. The dark red walls designate the curtain throws area and there are large nets that run along the exterior. Athletes who compete in outdoor throwing events, such as discus or javelin, can throw their implements into the net, giving them somewhere to train their event indoors during the winter.



Figure 58. Recovery bath rendering. Design protocol elements implemented include connection to nature and intentional use of colors and materials.

The design protocol is also implemented into recovery and athletic support spaces. Figure 58 shows one area where recovery baths are located. Recovery baths are a hot tub and ice bath in the same

area so that athletes can contrast bath and recover their muscles. Darker materials and colors were chosen for this area to calm the athlete and transition them from a training environment to a restorative recovery environment. Indoor plants were added to ease stress and anxiety while athletes recovered from their training.

One of the more unique program elements was the Zen room. Because of Calgary's harsh winter climate, athletes struggle to spend time outdoors. Survey responses indicated that many athletes care for their mental health by being outside. By mimicking an outdoor environment indoors in sports buildings, athletes can have the physical and psychological benefits of being outdoors year-round. Within the Zen room is an abundance of indoor plants, gathering spaces for athletes to spend time with each other, a platform where meditation and yoga can take place, and water features to create natural, ambient sound. This was another area of the building where natural materials were selected, such as wood and stone, for their calming effects.



Figure 59. Zen room rendering 1. Design protocol elements implemented include natural light, connection to nature, designated area for mental training, communal spaces, and intentional use of colors and materials.



Figure 60. Zen room rendering 2.

Design protocol elements implemented include natural light, connection to nature, designated area for mental training, communal spaces, and intentional use of colors and materials.

4.4. Conclusions

The design protocol created after surveying athletes and reviewing literature drove the design portion of this project. By understanding how design affects users, decisions can be made to achieve desired outcomes and create higher quality pieces of architecture. The Athletics Canada High Performance Training Center was designed to follow this protocol and begin pushing the boundaries of how athletic complexes should be designed.

Many conclusions were made during this research and project, but when it comes to how design affects the athletic performance of athletes, only the surface is being scratched. It should be noted that studies and research still need to occur to closely examine the relationship between the athlete and their training environment in regard to its architectural conditions. The design protocol within this project was developed through previous academic work, but the next step would be to run experiments to examine the performance of athletes in optimal and nonoptimal spaces to see what the effects are.

One of the challenges that arose in this project was redesigning athletic training spaces while still creating a feasible end product. When looking at this project as a whole, the program elements do step outside the standards of current buildings, but the designs of the areas themselves are still fairly typical. The idea of completely changing the design of training areas could have been pushed further and there is still more reimagining to take place. Despite these shortcomings, this project provides designers with a new way to apply existing design studies and research into a new building type, pushing the boundaries of this design sector.

Within the world of design, powerful things can be accomplished. By directly taking feedback from athletes, information regarding sports performance, and techniques used to improve the experience of users within buildings, a prosperous environment can be created for athletic development. By prioritizing athletes within the design of sports buildings, their wellbeing and performance can be improved. Supporting athletes, the foundation of sports, ensures that the cultural dominance and love of sports continues for many years to come.

REFERENCES

- About Ocean Breeze*. (n.d.). Ocean Breeze Athletic Complex. Retrieved September 29, 2023, from https://oceanbreezenyc.org/sports/2015/12/2/GRL_1202151505
- Abraham, J. (2021). *Designing Performance Centers to Promote Well-being for Athletes*. Gensler. <https://www.gensler.com/blog/designing-performance-centers-to-promote-athlete-well-being>
- Anderson, S. A., Haraldsdottir, K., & Watson, D. (2021). Mindfulness in Athletes. *Current Sports Medicine Reports*, 20(12), 655. <https://doi.org/10.1249/JSR.0000000000000919>
- Appaneal, R., Perna, F., & Madrigal, L. (2014). *Psychological susceptibility to injury*. <https://doi.org/10.4135/9781483332222.n158>
- ArchDaily. (2016, April 30). *Ocean Breeze Track & Fieldhouse / Sage and Coombe Architects*. ArchDaily. <https://www.archdaily.com/786519/ocean-breeze-track-and-fieldhouse-sage-and-coombe-architects>
- Augustyn, A., Lotha, G., Young, G., & Guar, A. (n.d.). *Colosseum*. Britannica. Retrieved November 8, 2023, from <https://www.britannica.com/topic/Colosseum>
- Castro, F. (2018, September 27). *Northwestern University Ryan—Walter Athletics Center / Perkins+Will*. ArchDaily. <https://www.archdaily.com/902625/northwestern-university-ryan-walter-athletics-center-perkins-plus-will>
- Connellan, K., Gaardboe, M., Riggs, D., Due, C., Reinschmidt, A., & Mustillo, L. (2013). Stressed spaces: Mental health and architecture. *HERD*, 6(4), 127–168. <https://doi.org/10.1177/193758671300600408>
- Eichberg, H. (1993). *New Spatial Configurations of Sport? Experiences from Danish Alternative Planning*. <https://doi.org/10.1177/101269029302800212>
- Ergan, S., Radwan, A., Zou, Z., Tseng, H., & Han, X. (2019). Quantifying Human Experience in Architectural Spaces with Integrated Virtual Reality and Body Sensor Networks. *Journal of Computing in Civil Engineering*, 33(2), 04018062. [https://doi.org/10.1061/\(ASCE\)CP.1943-5487.0000812](https://doi.org/10.1061/(ASCE)CP.1943-5487.0000812)

- Esslinger, G. E. (2020). *Human health and the indoor environment: An analysis of building materials and sustainable architecture*. <https://hdl.handle.net/2152/81291>
- Ferro-Sánchez, A., Martín-Castellanos, A., de la Rubia, A., García-Aliaga, A., Hontoria-Galán, M., & Marquina, M. (2023). An Analysis of Running Impact on Different Surfaces for Injury Prevention. *International Journal of Environmental Research and Public Health*, 20(14), Article 14. <https://doi.org/10.3390/ijerph20146405>
- Flowers, B. S. (2017). *Sport and Architecture*. Taylor & Francis.
- Gomes, T. N., Thuany, M., & Pereira, S. (2020). *Sports performance and systems theories*.
- Google Earth Pro. (2024). [Computer software].
- Gough, C. (2023, July 13). *Global sports market revenue 2027*. Statista. <https://www.statista.com/statistics/370560/worldwide-sports-market-revenue/>
- Hollembeak, J., & Amorose, A. (2005). *Perceived Coaching Behaviors and College Athletes' Intrinsic Motivation: A Test of Self-Determination Theory*. <https://doi.org/10.1080/10413200590907540>
- Indoor Athletics*. (2015, January 26). <https://worldathletics.org/spikes/news/the-history-of-indoor-athletics>
- Inside America*. (2016, January 27). <https://worldathletics.org/spikes/news/history-of-american-indoor-athletics>
- Kennedy, R., Cooney, I., & Miller, H. (2022, March 11). *The evolution of sports and stadia design—Holmes Miller | Architectural Practice*. Holmes Miller. <https://www.holmesmiller.com/blog/the-evolution-of-sports-and-stadia-design>
- Kuok Ho, D. T. (2021). A Review of the Association between Environmental Factors and Athletic Performance. *Sport Science*, 1, 21–30.
- Li, C., Wang, C. K. J., Pyun, D. Y., & Kee, Y. H. (2013). Burnout and its relations with basic psychological needs and motivation among athletes: A systematic review and meta-analysis. *Psychology of Sport and Exercise*, 14(5), 692–700. <https://doi.org/10.1016/j.psychsport.2013.04.009>
- Mack, G. (2002). *Mind Gym: An Athlete's Guide to Inner Excellence* (1st edition). McGraw Hill.
- Naranjo Mata, S. (2023). *Examining Emotions and Motivations as Factors in Training and Competition*.

- Nippert, A. H., & Smith, A. M. (2008). Psychologic Stress Related to Injury and Impact on Sport Performance. *Physical Medicine and Rehabilitation Clinics of North America*, 19(2), 399–418. <https://doi.org/10.1016/j.pmr.2007.12.003>
- O'Connor, Z. (2011). Colour psychology and colour therapy: Caveat emptor. *Color Research & Application*, 36(3), 229.
- Oudeyer, P.-Y., & Kaplan, F. (2007). What is Intrinsic Motivation? A Typology of Computational Approaches. *Frontiers in Neurobotics*, 1, 6. <https://doi.org/10.3389/neuro.12.006.2007>
- Our City. (n.d.). <https://www.Calgary.ca>. Retrieved January 8, 2024, from <https://www.calgary.ca/content/www/en/home/our-city.html>
- Pawlikowska-Piechotka, A. (2021). Sport facilities and their social meaning—In the past and present. *Sport i Turystyka. Środkowoeuropejskie Czasopismo Naukowe*, 04(2). <https://doi.org/10.16926/sit.2021.04.14>
- Pushparaj, R. (2021). *Evolution of sports and their architectural structures and complexes*. DARCH 2021 Proceedings. https://www.ocerints.org/darch21_e-publication/papers/12Roshini%20Pushparaj.pdf
- Ramadan, A., & Kamel Ahmed, E. (2019). Spatial Design Stimuli to Promote Wellness through Buildings' Design. *International Journal of Architecture, Engineering and Construction*, 8(4), Article 4. <https://doi.org/10.7492/IJAEC.2019.023>
- Schinke, R. J., Stambulova, N. B., Si, G., & Moore, Z. (2018). International society of sport psychology position stand: Athletes' mental health, performance, and development. *International Journal of Sport and Exercise Psychology*, 16(6), 622–639. <https://doi.org/10.1080/1612197X.2017.1295557>
- Sheard, R. (2001). *Sports architecture*. Spon Press.
- Taylor, S. A., Fabricant, P. D., Khair, M. M., Haleem, A. M., & Drakos, M. C. (2012). A Review of Synthetic Playing Surfaces, the Shoe-Surface Interface, and Lower Extremity Injuries in Athletes. *The Physician and Sportsmedicine*, 40(4), 66–72. <https://doi.org/10.3810/psm.2012.11.1989>

- Thampanichwat, C., Bunyarittikit, S., Moorapun, C., & Phaibulputhipong, P. (2023). A Content Analysis of Architectural Atmosphere Influencing Mindfulness through the Lens of Instagram. *Sustainability*, *15*(13), Article 13. <https://doi.org/10.3390/su151310063>
- Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H.-B., Choi, Y.-S., Quan, X., & Joseph, A. (2008). A Review of the Research Literature on Evidence-Based Healthcare Design. *HERD: Health Environments Research & Design Journal*, *1*(3), 61–125. <https://doi.org/10.1177/193758670800100306>
- Wakefield, M. (n.d.). *Northwestern University Ryan Fieldhouse and Walter Athletics Center – Perkins&Will*. Retrieved September 22, 2023, from <https://perkinswill.com/project/northwestern-university-ryan-fieldhouse-walter-athletics-center/>

APPENDIX. DESIGN STUDIO SUMMARY

Table A1. Design studio summary.

Academic year	Fall semester	Spring semester
2 nd year	Fall 2020. Milton Yergens. <i>River Art Studio</i> and <i>Minneapolis Boathouse</i>	Spring 2021. Emily Guo. <i>Marfa Dwelling</i> and <i>Mixed Use Community</i>
3 rd year	Fall 2021. Ronald Ramsay. <i>Great Stone Barn</i> and <i>Agincourt Project</i>	Spring 2022. Regin Schwaen. <i>Native American Cultural Center</i> and <i>Fargo National Cemetary</i>
4 th year	Fall 2022. David Crutchfield. <i>Washington DC Capstone</i> .	Spring 2023. Kristi Hanson. <i>Imagine Minot</i> .

Note: This table shows a summary of all previous design studios and projects completed during undergraduate education.