



Pickleball Lighting Buyers Guide

Brite Court Sports lighting is the leading supplier in North America for Tennis and pickleball lighting products and design. Also being the ONLY company that provides every category of lighting options as outlined by USA Pickleball Association. Additionally, for anyone building out a new facility or retrofitting an existing facility should purchase the USA Pickleball Construction manual which can be found at:

<https://usapickleball.org/what-is-pickleball/court-diagram/pickleball-construction-manual/>

Let's begin by identifying the importance of indoor lighting for Pickleball, whereas both aesthetics as well as performance are critical factors. In terms of performance lighting is as important as ANY piece of equipment used to play the game, as without clear visuals of the ball, spin of the ball, depth perception, visual projection the bounce, rise and drop of the ball are all critical. Playing in a poorly illuminated space is no better then playing with a hole in your paddle.

Similar to the tennis industry indoor facilities are often defined by the quality of lighting/. Brite Court often is called to upgrade a facility's lighting simply because the club/facility need a better environment to retain members/customers. Players are more likely to play and stay with a facility with great lighting vs one with marginal or substandard lighting.

We are seeing simply way too many new pickleball facilities make uninformed lighting decisions which is typically driven by lighting contractors or distributors not understanding the fundamentals of the game and/or illuminating the game. These are not warehouse or retail, these are competitive environments that require very specific lighting characteristics.

Whoever is advising you or you are purchasing your lighting from it is important you qualify their experience, pickleball lighting projects they have completed as well is their fixture(s) actually designed and engineered for pickleball. You can literally count the amount of lighting suppliers with this experience on one hand. The same applies for Tennis which is a 100% crossover lighting solutions, meaning tennis and pickleball have the same lighting endgame as well as solutions just a different scale.

We get 5-10 tennis and pickleball facilities every year that contact us because they bought lighting from an in experienced supplier where either the lighting design was poorly conceived, or the fixture specified was substandard.

Also be very careful in that every pickleball facility is different. Unlike tennis where facilities are typically built specific to tennis new construction or in order to accommodate the larger courts and higher elevation of play also allows for higher mounting options for lighting. Whereas pickleball with the smaller courts and often lower ceiling height requirements makes repurposing existing building a very common option. With Pickleball, unlike tennis, are seeing fewer new buildings erected and more warehouse, retail, and other conversions. In NJ there is commercial pickleball court that was an old 7-11 store that was gutted and a single pickleball court was constructed in that space. It is really all-over the map on types of space that can accommodate pickleball, which is a great thing as it can greatly reduce the start-up cost.

Below we will discuss in detail and demonstrate the variables of the three lighting options outlined by the **ASBA (American Sports Builders Assoc.) and USAP (USA Pickleball)**. We have designed nearly 600 Tennis and Pickleball lighting projects over 20 years. Our indoor pickleball lighting fixtures are ALL designed and engineered from the ground up specifically for tennis and pickleball. No other lighting designer or supplier has designed more or has anywhere near the expansive tennis and pickleball lighting options as Brite Court, whereas Tennis and Pickleball accounts for 80% of our lighting revenue.

Both the ASBA (tennis) and USAP (Pickleball) lighting standards as published in both their court construction manuals and are basically identical in terms of lighting terminology and definitions of use. While lighting placement may vary, the fundamentals do not. With that said I will refer to official guide-lines as the USAP construction manual for Pickleball. You will also find we have our own set of

guidelines, approach and recommendations as this guide is far more expansive and detailed than any of the official construction manuals.

There are three types of lighting outlined by the USAP: **100% Direct lighting, 100% Indirect lighting and a combination called as you might suspect Direct/Indirect lighting**, however Direct/Indirect lighting is recommended as the best light source by USAP and the ASBA.

Note: most of the references moving forward will refer to LED, with high performance LED now being about 10 years old, there are few reasons you should be re-using older Fluorescent, Halide or Induction technology.

Direct Pickleball lighting

Here is the USAP description of “Direct” lighting from the USAP construction manual: *“Systems direct the light downward onto the court surface. This produces better 3-D definitions (modeling), it has greater potential to produce glare”*

This refers to a lighting fixture that is aimed down or has a slight angled tilt. Direct lighting should be your absolute last choice, in our opinion it really should not even be a consideration, which we will discuss, but it is the lowest cost of the solutions. Direct lighting comes in many shapes and forms in terms of fixtures. Direct lighting is generally and more often a budget solution and more likely manufactured in large quantities and often lower quality components since this is the most competitive genre of LED lighting and has the most manufacture and retail competition. But frankly the quality of the downlight will be the least of your considerations if this is the direction you are leaning. Regardless of the quality of the fixture or even the performance of the fixture DOWNLIGHT has the worst projection of light compared to the other two classifications (indirect and Direct/indirect). Downlight also has the greatest chance for having intrusive glare.

It should be noted that the USAP stipulates/recommends that no Direct lighting fixture should be above the inbounds playing surface of the court unless it is 30’ or higher. That is really for two reasons: to mitigate glare and so the fixture does not become an obstruction to the flight of the ball. While most Pickleball facilities unless converted Tennis court will not have 30’ ceilings lower elevation simply intensify glare in most cases and fixture may become obstructions.

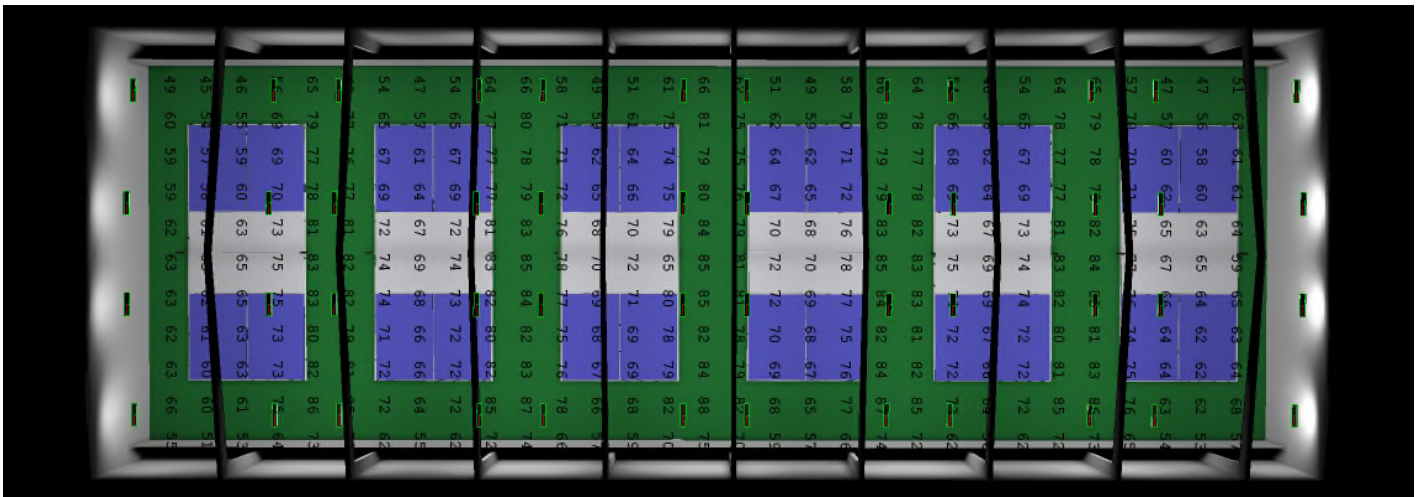
Taking the height challenges out of the equation, direct lighting often has other significant drawbacks:

1. **Cave Effect-** When you have a downlight below the ceiling 100% of the light is aimed down and Pickleball court surfaces have extremely poor reflective values for very little of the down light is reflected back towards the ceiling. This creates “The Cave Effect” which is exactly like it sounds, the ceiling will be dark making the space feel more like a cave. This has several visual impacts:
2. Ability to see ball spin is almost always compromised as with direct light the ball is primarily only illuminated on the top of the ball.
3. When looking up the light output of the fixture is often very intense due to the ceiling being dark above the fixture mounting height. Think of it this way go outside with a LED flashlight which often have a very intense light output these days, during the daylight hours have someone aim that flashlight towards your eyes from say 10’ away, most likely you can stare directly at the light output with little to no discomfort or visual loss (like seeing stars from glare). Now take that same flashlight outside under the darkness of night and repeat, you will likely find staring into that same light at night provides discomfort and significant visual effects. And when you look away from that light it takes your eyes time to re-adjust to the ambient light surroundings. In sports with small fast-moving balls, you do not have the luxury for your eyes to adjust. This can also be a safety issue if you are unable to react or you become unstable due to the glare.
4. All downlights will generally have a limited beam of light, 90% of LED chips have a native 120-degree beam angle or less. So, imaging the LED Chip(s) in the light fixture, those chips are less than ¼” diameter (usually 1/8” or smaller). Let’s call that the light output and regardless of how many chips are in the fixture they are all functionally the same where as the LED Chips will in most cases only account for maybe ¼ of the actual size of the fixture. So, we have a small output that expands as it gets further away. The beam of light on the floor is much larger than it is at the fixture, the further away the wider the foot print. Whereas downlights illuminate the floor very well. What down light does not do well is light the airspace the ball travels through. All downlight fixtures output cone shaped light at each level of elevation, that cone is narrower at higher elevations,

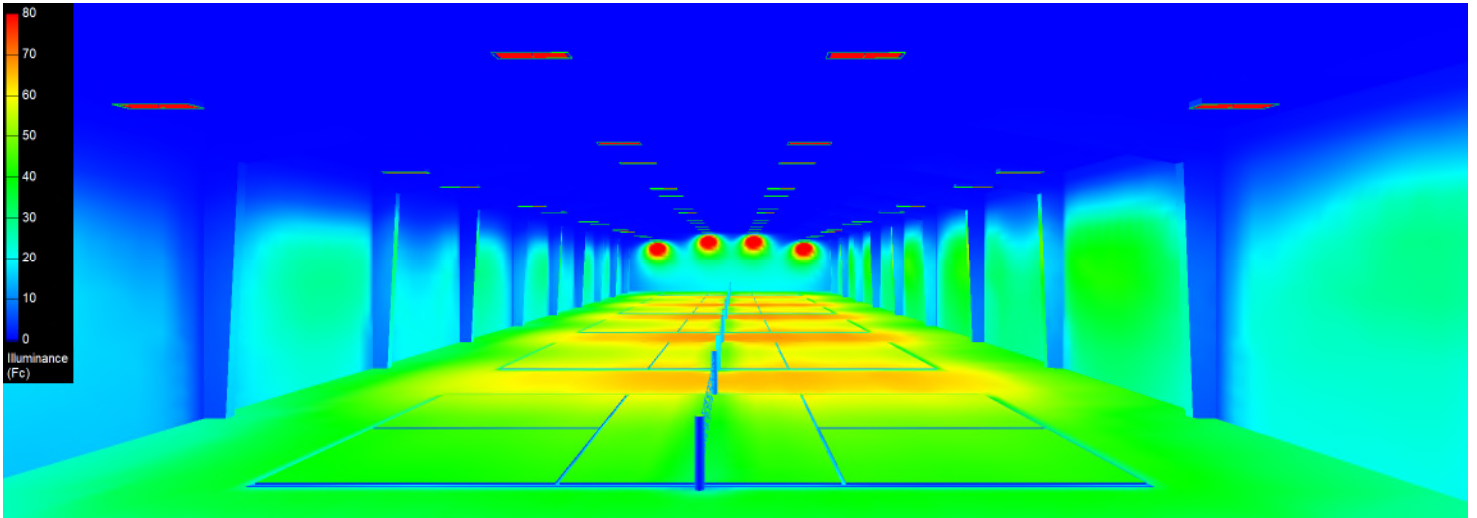
whereas at some point in the air space above the court there is NO light other than what has reflected off the floor (which has less than a 20% reflective value). This is highly problematic when the ball elevates high enough and exits the beam of light, the ball will be in darkened airspace when in between the narrow upper cones of light. Depending on the height of the fixtures this can happen even just above eye level. Note: lighting is only as good as the darkest area or path the ball will travel through and this is NEVER shown to you in Photometrics.

5. How the ball is illuminated is very important aspect of proper lighting. We discussed the beam of light above. Take that same flashlight and hold it above a ball, you will see that only the TOP of the ball is illuminated, keep that same flashlight aimed down and move it to the side, now the top and ONLY the top sides of the ball are illuminated. How this affects the player is when the ball is below eye level you see the illuminated ball which provides you great perception including seeing the spin, however as that ball gets to eye level you start to no longer see the illumination on the ball as you now only see the shadowed sides and lower half of the ball, pair that with down light glare, a darkened cave light ceiling as you can see (literally) downlight becomes a significant handicap to the players.
6. Especially with LED these days Glare is a significant concern. Light output of any fixture is measured in lumens (the illumination of the space is measured in footcandles in North America and LUX in the rest of the world) A typical down light at 25' will have 15,000-20,000 lumens that is all coming out of a few tiny LED chips. That 15-20K lumens can be put in a 2'x4' fixture (Typically a linear fixture) it can also be put in an 8" fixture (most commonly called a UFO fixture). As you can imagine there will be difference in glare especially with a more condensed output surface. It is important to understand that the worst visual glare is when you look at the light source and you are within the beam of that light. Step outside of that beam and the intensity dramatically reduces. So overhead down lights at eye level you will almost always be looking into the beam of the light when looking up.
7. Shadowing is a big issue with ALL direct down lighting. Similar to playing outside in the sun, shadows will be dominant and will alter your depth perception and clarity of the court and ball.

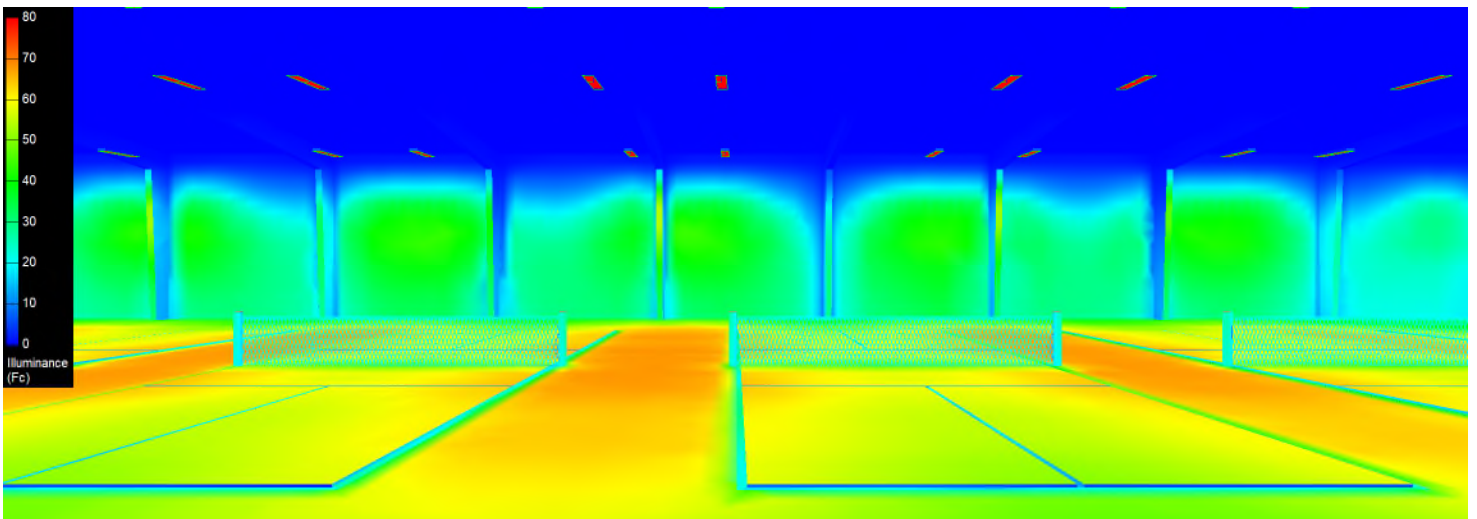
Picture below is a photometric of a 6 court pickleball facility, 20 eave 25' ridge using 160W 19K lumen generic Linear highbay fixture. Fixture are located 1' below beams 6" outside the inbounds area of the court. Also note the wall and ceiling color is 80% reflective bright white in color. Court and floor are .1 reflectance.



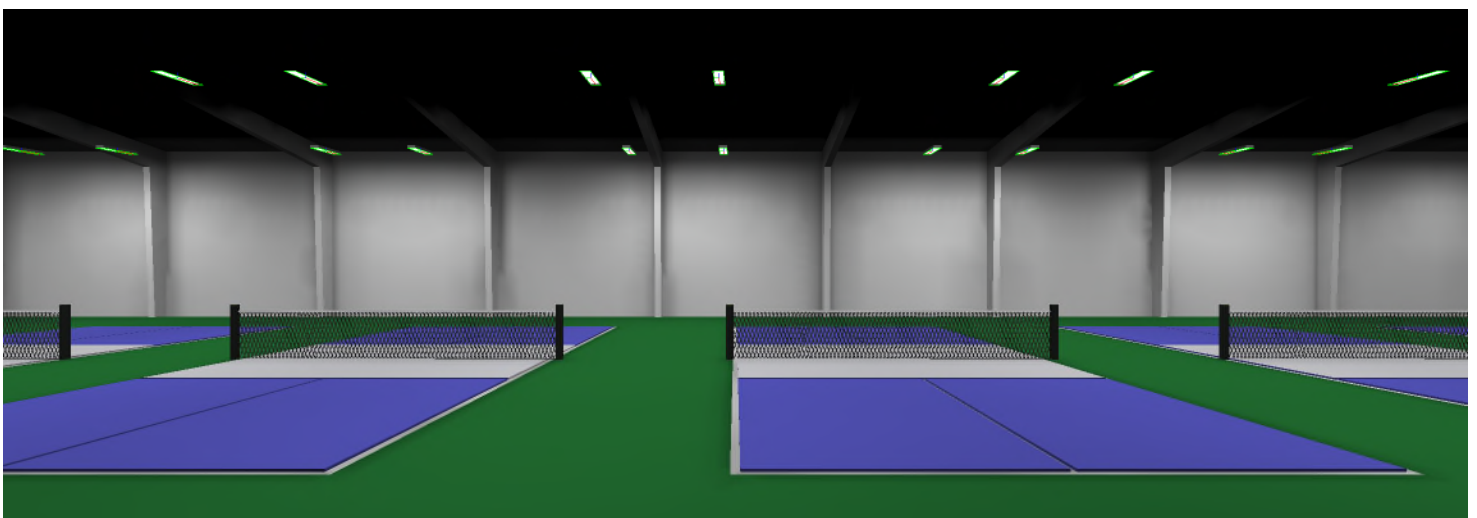
Below is the Pseudo Color scale of the lighting of the above model which is the nuance you do not see on a typical photometric rendering. In the picture below you can see on the far wall how the downlights create scalloped hot spots and how the light really drops off between the fixtures. Also note the dominance of the blue area which is 10 footcandles or below. It is simply not a very good environment for pickleball.



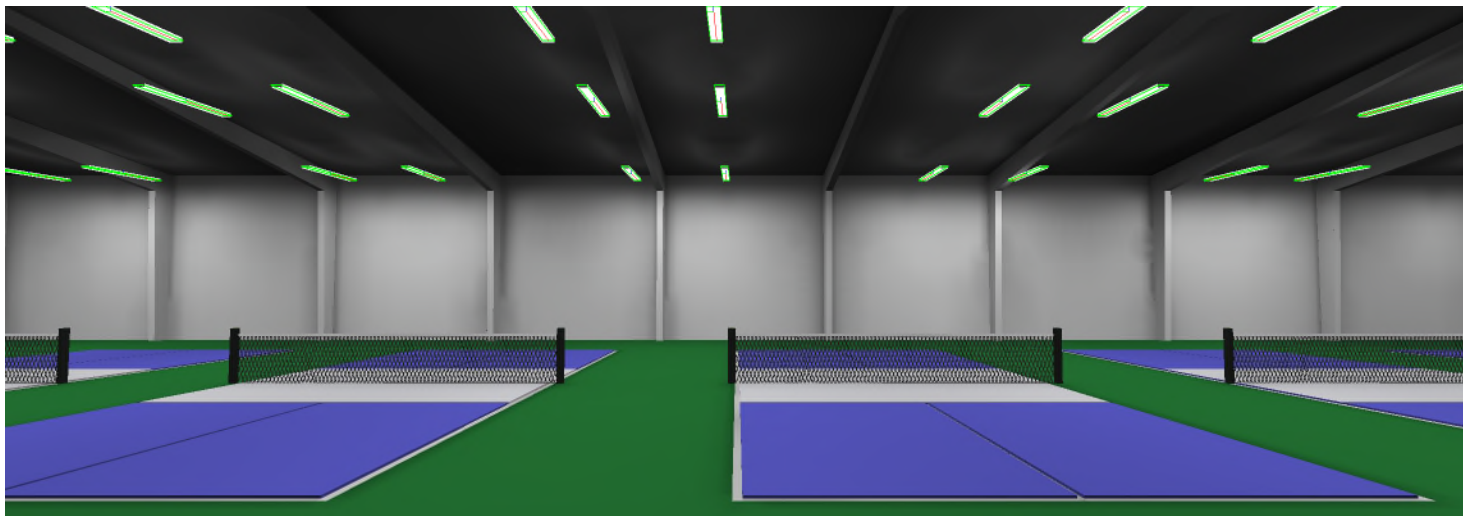
Below is a player's view. Notice the scalloped light on the far wall. This demonstrates the cone shape of the LED down lights. With the fixture located just outside the court the beam is not wide enough to fill the middle of the court which is also demonstrated in the above photometric which the lowest light levels are in the middle of the court. Also pay special attention to the very dark ceiling.



You can also see here how dark the ceiling is and the scalloping on the far wall.



Below is the same model as above except this demonstrates the difference using the Brite Court External domed lens system on our 150w downlight. As you can see there is some ceiling illuminance and less scalloping on the far wall. This is due to the neat 180-degree beam.



On a LED direct fixture glare is almost impossible to mask, you can do it with heavily diffused fixtures that have lower light output but that require that you installed 2-3 times the qty of fixtures even then you still have the same modeling of the light on the ball, that does not change the fact the ceiling is still dark and only the top and top sides of the ball are illuminated. I should also add that with direct down lighting the beam of the fixture is generally not wide enough to illuminate the walls surrounding the courts so your backdrops will be similar to the ceiling they will be shadowed for the most part. Lensing the fixtures will help mitigate the glare but that is about it, as a flat lens on a fixture that has the LED chips that is recessed into the fixture the beam angle is still narrow and limited with no horizontal illuminance.

If Direct downlighting is something you must use, Brite Court has developed a proprietary high impact Linear LED down light that widens the beam to near 180-degrees, eliminates glare, expands the downlight illumination of the ball. This has been achieved with our multi chambered domed diffused lens system that is exclusive to Brite Court direct fixtures.



As you can see this fixture uses multiple heavily frosted lenses are dome shaped and protrude beyond the face of the fixture. That lens acts as an optical lens and now redistributes that narrow beam of light to a much wider beam that now throws some of the light horizontally to the fixture since the lens extends beyond the face of the fixture. This expands the footprint, dramatically widens the beam. Again, it does not resolve the cave effect that is present in ALL direct lighting installations.

LED Indirect Pickleball Lighting

The USAP Construction manual defines indirect light as follows “systems have fixtures aimed upward at a highly reflective ceiling. This produces highly uniform illumination and provides the least amount of glare, but since it is essentially “shadowless”, it provides little modeling, which may make it difficult for players to detect spin or direction of the ball”

Indirect lighting is a good choice whereas indirect light is 100% aimed up at the ceiling where the light then reflects off of the ceiling filling the room with uniform light at all elevation levels. However numerous conditions in the room must be right in order for indirect lighting to be effective and efficient. When considering Indirect lighting it is also important to understand what makes it so different not so much how the light is delivered which is very important but how it impacts the players visibility and game. Because 100% of the light is being reflected off of another surface to generate the illumination of the room, those surfaces should be extremely reflective and colorless (white).

Regardless of the reflected surface also understand that Indirect lighting also creates what is called the “COUDY DAY EFFECT” just as it sounds it feels like you are outside on a very cloudy day. This does diminish contrast and sharpness of vision, The court lines will be a grey white in color, the court colors will be dulled as will all the other colors in the room. However indirect light provides great uniformity at most elevations of ball flight. However, without any direct light on the ball the ball will not be as crisp as it would be with

Direct or Direct-Indirect light. Between 100% direct light and 100% indirect lighting, Indirect is hands down the better solution. Older players will find the softer indirect lighting more relaxing especially if they wear glasses compared to 100% direct lighting.

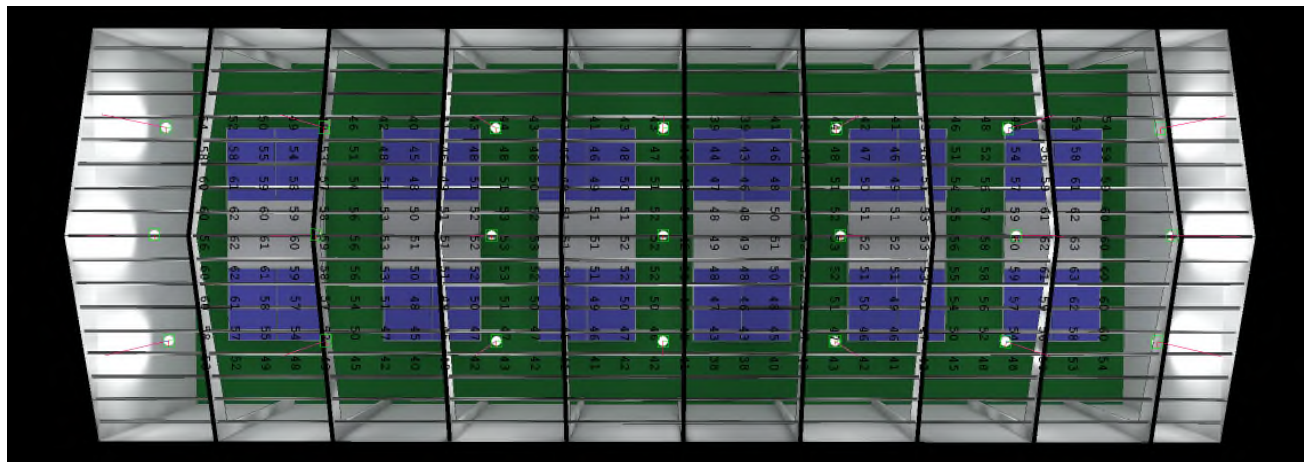
Below is the Aspen Racquet Club in Wooster, OH this was a USTA outstanding facility of the year winner using our LED HEX indirect



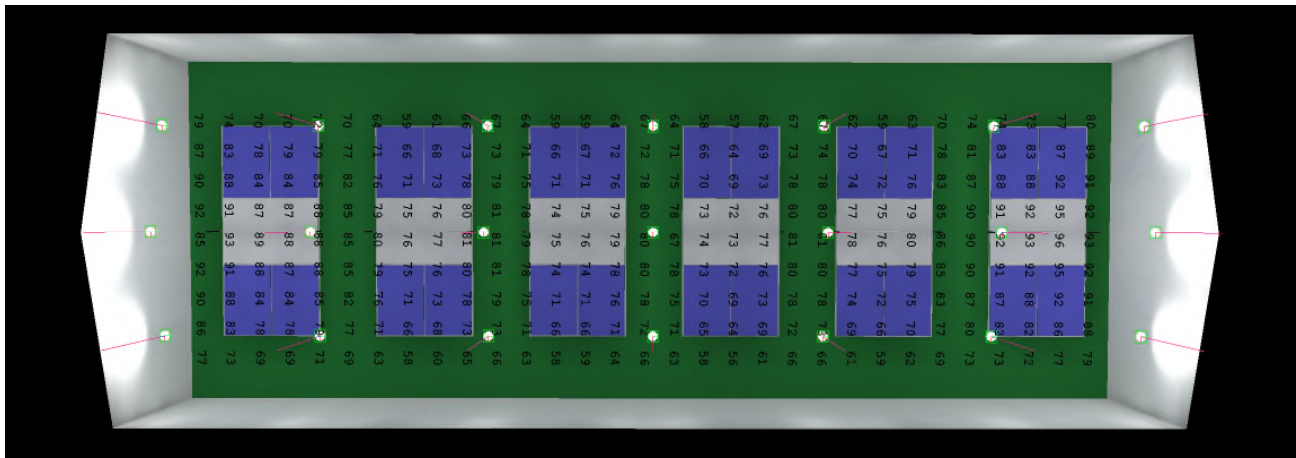
Below are some aspects of Indirect lighting that should be considered

1. The ceiling must be highly reflective preferable with an 80% reflective value or greater.
2. There should be little to no exposed frame structure at the ceiling. Any vertical beams and purlins at the ceiling can result in up to a 35% reduction in light levels. When indirect light hits a vertical surface a significant portion of that light ends up deflecting horizontally thus trapping that light at the ceiling, reducing lighting levels significantly at floor to eye level. This is a very common problem in steel buildings. You may say well the beams and purlins as insulation are bright white but it is simply a lighting deflection issue with the vertical surfaces. See the modeling below.

Pictured below are photometric modeling with indirect lighting with exposed beams and purlins resulting in an average of 50.7 footcandles.

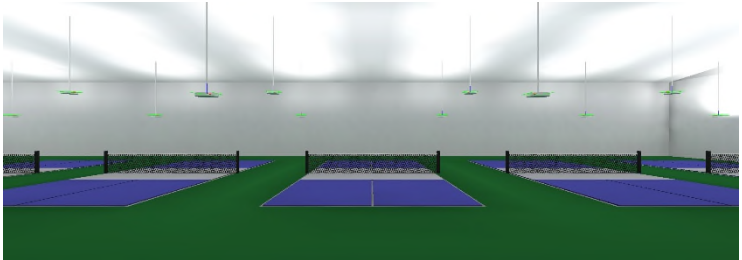


Pictured below is the same photometric model as above with a reflective liner installed covering the beams and purlins. Average light levels 76.1 Footcandles.



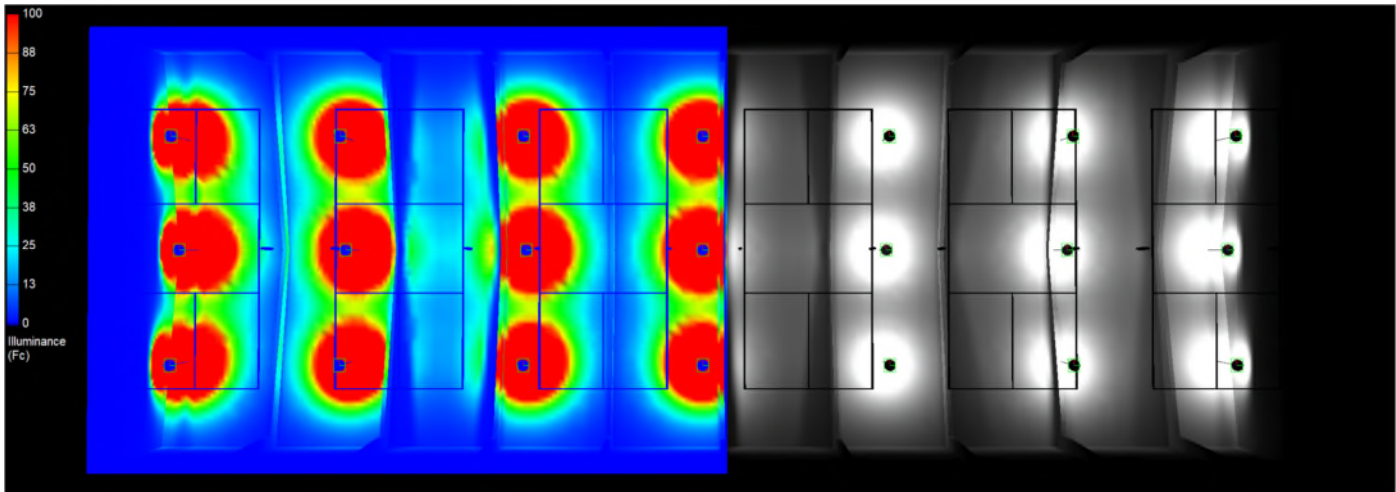
As you can see the exposed beams and purlins resulting in the above models having a 33.4% loss in light levels simply from the light being trapped at the ceiling on the beam and purlin model.

- 3. Unlike tennis which is the #1 user of high-performance indirect lighting, tennis facility's typically have much higher ceilings than Pickleball. Indirect lighting needs to have a 10'-14' drop from the ceiling, at the very least 8' drop. To demonstrate, take that flashlight we discussed above in Direct lighting.

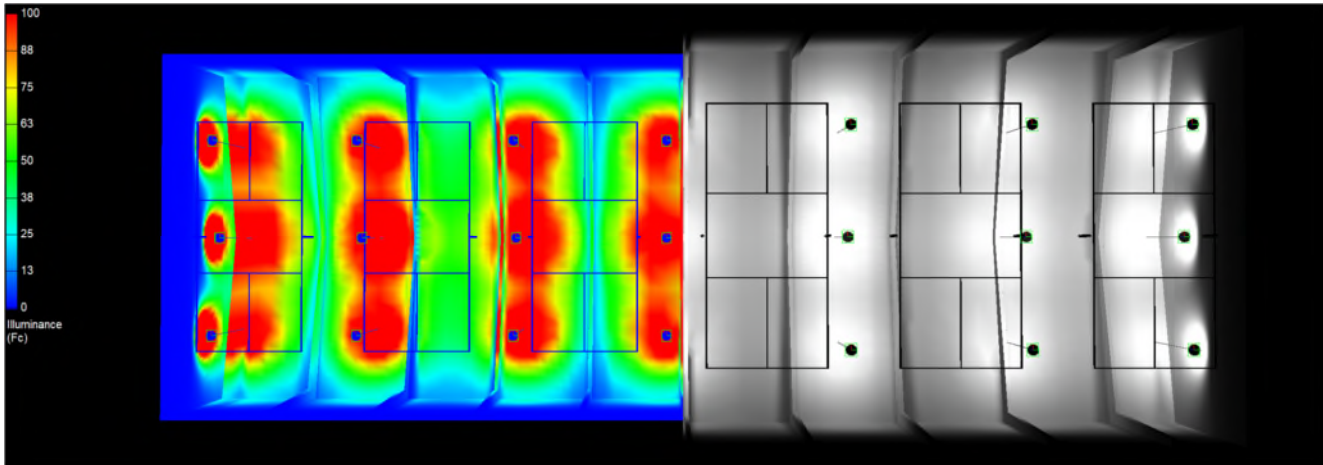


Now hold that flashlight 3" over a table and you will have a small INTENSE circle of light. Now raise that flashlight to 12" and you will see the circle of light increase in diameter and not be as intense. What happens in a building when the indirect fixtures are too close to the ceiling it creates a small intense hot spot on the ceiling and since the beam does not have the opportunity to expand, some of the reflected light is then also trapped by the fixture after it reflects off of the ceiling.

Pictured below are LED Indirect fixtures at 6' below the ceiling viewed from below the floor looking up at ceiling

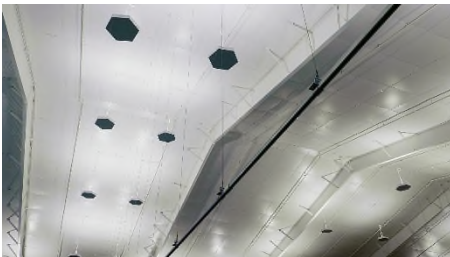


Below are the same LED indirect fixtures at 12' below the ceiling



Indirect lighting is a widely used lighting system in the tennis industry, however conditions have to be optimal for the indirect fixtures to perform. Installing a reflective fabric liner is the most common solution for creating a reflective ceiling, however that can be spendy, expect to cost about \$1.50-\$2.00 per sqft. Simply put the biggest challenge in pickleball facilities is not enough ceiling height to allow for the proper drop and then if you do install a liner, you also lose some elevation there as well.

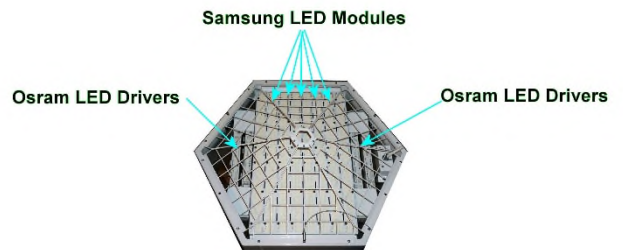
INDIRECT LED YOU MUST READ THIS WARNING



With the coming of age of LED lighting in general in 2013 the tennis industry was the 1st to dive in and really start using high performance LED for indirect lighting. Unfortunately, way too many of those early adopters learned the hard way that buying LED lighting from suppliers with little to no experience in LED indirect lighting can be costly decisions. Countless tennis facilities even to this day are experiencing massive failures of their LED indirect lighting after only months to a couple years after installation. What was/is happening until late 2014 (when we developed our LED HEX indirect fixture) there were NO

LED fixtures that were actually engineered for indirect use, local contractors and distributors when presented with indirect lighting request from tennis facilities they simply took the latest in most cases Chinese Highbay down light and inverted them up to the ceiling. They were clueless in what the results of that would be in most circumstances. You see the #1 criteria of LED fixture design is Thermal/Heat management since the #1 killer of ALL electronics is heat. All downlights are engineered for thermal management in the down orientation. Since heat rises, all heatsinking was then provided to dissipate that heat out of the back/top of the fixture. So now if you invert that down-light fixture up to the ceiling the heat management and heat sinks are now on the bottom of the fixture reducing the fixture ability to manage the heat. In so many cases those direct now indirect fixture simply cooked them selves to death.

In 2014 we developed our LED HEX indirect fixture it was designed and engineered exclusively for indirect use. Seeing all those LED fixtures failed that were sold by others and in 100% of the cases who ever sold them to the tennis facility simply ran from the problems leaving the owners no choice but to spend thousands of \$\$\$ to replace the lighting system they recently had installed. When we developed our LED HEX knowing what was happening to all these facilities, we reached out to DLC (Design Light Consortium) they are the agency that evaluates and list every LED fixture in the US, fixture have to go through rigorous testing before being approved by DLC. We reached out to them and told them about what was happening with all these companies selling LED down-light fixtures for indirect use only to be failing. They agreed with use there needed to be oversight for this type of lighting. Using our LED HEX, DLC along with UL, ETL and CSA which are all



Safety certification agencies (all electronics in North America have to be tested and approved by them in order to be electrical code compliant), they created a specific testing criteria and listing/certification for LED indirect lighting. So now for any LED indirect fixture to be compliant it must be tested, approved and then listed/certified to be used in the indirect orientation. Our LED HEX fixture was the 1st fixture to be approved in the indirect orientation and has now been in service for 8 years with a warranty rate of less than .5% (we have never had a single fixture failure in 8 years the HEX has 4 drivers in each fixture our only warranty in 8 years is less than 12 drivers under warranty and 0 LED module failures).

So be careful when buying LED indirect lighting. You can count on 1 hand how many manufactures actually make a LED Indirect Highbay fixture that is actually a certified indirect fixture and most of those LED indirect are only a year or two old so not really been tested in real world installations for reliability.

Any company offering you LED indirect fixture need to be able to provide you the listing certificate from DLC and that certificate MUST state it was tested and approved for the category of **“SPECIALTY LED INDIRECT HIGHGBAY”**. Below is our DLC certificate. Also below is our CSA Certificate (which is UL equivalent). Pay close attention both certificates specifically say ‘INDIRECT’ on them. Make sure you accept no less from any vendor selling you indirect lighting.

Model# DID-HEX24I-8400-50K-U-WC-XX-D10-XX

Manufacturer: 1st Source Lighting
 Brand: 1st Source Lighting
 Technical Requirements Version: 4.2
 Date Qualified: 10/25/2017
 Product ID: PFBG8Y16

Specified Indirect Certification

Categorization

Main: Indoor Luminaires
 General Application: High-Bay
 Primary Use: Specialty Indirect High-Bay

Classification: Standard
 Is Parent Product: Yes
 DLC Family Code: UJUBEQ
 Dimming Status: Dimmable
 Listing Status: Listed

View Notes

Tested Data | Reported Data | Zonal Lumens | Spacing Criteria | Version History | Family Data

Light Output: 57927.9 lm
 Wattage: 406.3 W
 Efficacy: 143 lm/W
 Power Factor: 0.95
 CCT: 5190 K
 CRI: 84.3
 Total Harmonic Distortion: 15 %

CSA Group

Supplement to Certificate of Compliance

Certificate: 70074531 Master Contract: 262911

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

Product Certification History

Project	Date	Description
70146296	2017-09-08	Update report to add alternate LED module manufactured by Samsung Electronics Co. Ltd., model SI-B8x521560WW.
70074531	2016-05-27	cCSAus certification of Indirect, Suspended-mount luminaire, intended for dry location, model DID-HEX24I.

This shows that the LED HEX is Safety Certified for indirect use. With out a specific Indirect Safety Certification No LED fixture should be used Indirect.

Sadly, a high percentage of the indirect fixtures sold into the Tennis and Pickleball industry DO NOT have these credentials. This is critical information that the Racquet Sports industry need to stand behind, if for no other reason but to guide their membership in proper lighting construction methods and standards. ALED-Brite Court were the pioneers of LED indirect lighting. Now our LED HEX is the most installed certified LED indirect fixture in North America.

Our fixtures are Made in the USA by a 25-year-old manufacturer that also offers a 10-year warranty. Our manufacturer has been making our Tennis and Pickleball lighting for us for 22 years now. With 600+ tennis and pickleball projects designed, no other company comes even close that that.

Any LED fixture it is a must that that fixture be 100% field serviceable. Unfortunately, so many Led fixtures if they fail in whole or in-part they must be taking down shipped back the manufacture, then you wait for repair to have them ship it back in weeks to months. All Brite Court indoor LED fixtures are 100% Field serviceable.

Maintenance required for LED indirect fixtures



(Pictured left is a halide indirect fixture with about 1” of dirt and bugs that had built up inside after 2 years) As discussed above, thermal management is very important and because indirect fixtures face upwards, they will collect dirt and dust along with bugs landing and dying in them. That dirt will block the light as it builds up, more importantly that dirt will create a thermal blanket which is not healthy for any indirect fixture. So regardless of whose LED indirect fixture you use you should plan every 2 years or so to clean those fixtures. So looking at the LED indirect fixture, understand how difficult it can be especially if those fixtures have drivers in a vented

compartment as that will require you to dismantle and open that compartment up to clean as your drivers need to breath so you need to keep dirt build up to a minimum.

Our LED HEX fixture was designed with easy cleaning in mind. The LED module and drivers are on the same plane meaning none are compartmented, this allows easy access to each component for cleaning and replacement. Our fixture can simply be cleaned with air blowing the fixture out. Because of the easy access it only takes about 3 minutes to replace a driver or LED module and this can be done with the fixture in place.



Also note: be careful of any indirect fixture that uses fans (computer fans) to keep them cool. The last thing you want are \$10 computer fans protecting your expensive lighting as there is no warning that the fans have failed. Also, with numerous fixtures in a room the collective noise of those fans is very annoying

LED Direct/Indirect Lighting for Pickleball

Best of Both Worlds... The USAP defines Direct/indirect lighting as follows “A **combination of Direct/indirect system may provide the best set of lighting characteristics for indoor facilities. Generally, aim for 30% to 40% of total light distribution from the indirect component, which will make the facility appear spacious and open. The direct component will improve modeling and ball definition**”



In 2001 Co-founder of ALED/Brite Court Gary Fowler developed the 1st new Technology Tiered Direct/Indirect tennis lighting system for the tennis Industry That lighting system has been installed at some of the highest profile tennis venues in North America, from private courts, club courts, municipal, countless NCAA courts, the Williams (Serena) Tennis Center, all of the McEnroe Tennis Academy's, as well as the Canadian National Tennis Centre (the Rogers Cup in fact use both our HEX indirect and Direct/indirect systems are installed in their tennis buildings). It revolutionized performance lighting for the sport. In 2013 when LED became a viable technology for high performance lighting, he went back to the drawing board and developed a proprietary LED Direct/Indirect lighting system for Tennis and Pickleball.

Direct/indirect lighting truly is the best of both worlds, and it is the #1 choice for 90% of the pickleball facilities that buy our systems.

Direct/indirect lighting simply fills the room with light, eliminating all shadows and delivering the most uniform lighting throughout the entire room. From wall to wall, floor to ceiling, even in the corners are filled with light that the stand-alone systems cannot fill.

Below is a picture of the Pickleball Zone in Bend Oregon. As you can see the room is filled with light.



To best demonstrate the distribution of light from our LED Direct/Indirect system below is a picture of the Summit tennis and pickleball courts in Kalispel MT. In this picture there are 4 tennis court but only one court is turned on. Look at the ceiling and how the light washes over the ceiling. Look at the back wall and how well it is illuminated all the way from the floor to the ceiling, as well the court itself is evenly lit.

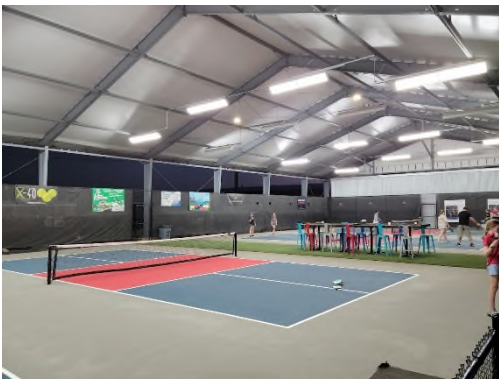


With light distribution as demonstrated above, it shows that the ball would be well illuminated at all elevations of flight.

- When the ball is below eye level the ball is illuminated on the top and upper sides.
- When the ball is at or slightly above eye levels the sides of the ball are illuminated on the sides.
- Then as the ball elevates the light then shifts to illuminate the underside of the ball.

So the ball is illuminated at ALL elevations of flight. This will improve your ability to see spin, your depth of field will be improved, the ability to follow the ball and identify ball, speed, landing and bounce will be enhanced. This will also improve your reaction time, style and the ability to control the ball with your own strike of the ball. The ball and the court lines will be better defined and truest to color. The overall room and space will appear larger as well providing unparalleled aesthetics.

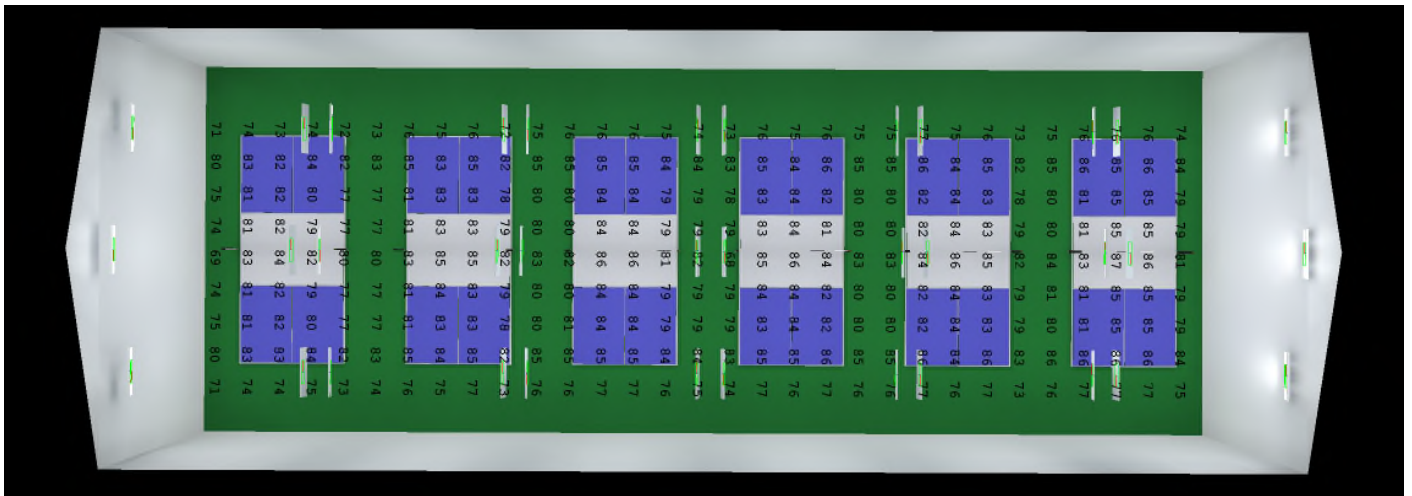
The Direct/Indirect is the most versatile of all the pickleball lighting options in that it does not care what your ceiling is like, it can be installed as low as 16' with no height limitations.



Our Direct/Indirect LED is one of a kind created specifically for tennis and pickleball (just like our LED HEX indirect). It is a 35,000 lumen 8' long fixture (the only 8' long LED fixture made for any sport). The fixture is 8' long for two main reasons, to take that 35,000 lumens and spread it out over an 8 sq-ft area as well provide a wide distribution. Like our LED Direct fixture our Direct/indirect fixture has a triple dome shaped lens system that provides a near 180-degree output of light allowing it to spread the light from the ceiling to the floor. With its adjustable mounting bracket system, it is a fully aimable fixture for use and aiming on the fly at any height. To our knowledge it is the only true direct indirect fixture in the Racquet Sports Industry. Like our other Brite Court indoor fixtures it is made in the US with a 10 year warranty and 100% field serviceable.

This is a glare free system with a special dome shape heavily diffused lens that protrudes beyond the face of the fixture to redistribute the native 120-degree beam of the LED chips to a wide near 180-degree light output.

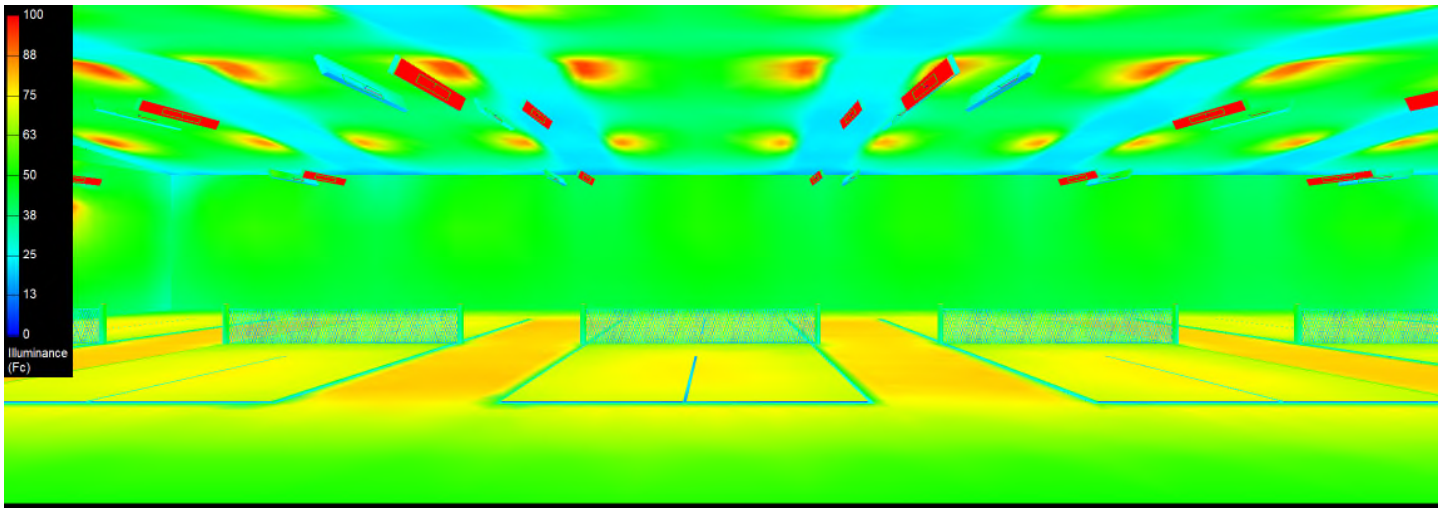
Below is the Brite Court Direct/Indirect system which includes six 250w 8' Brite Court D/I fixtures per court



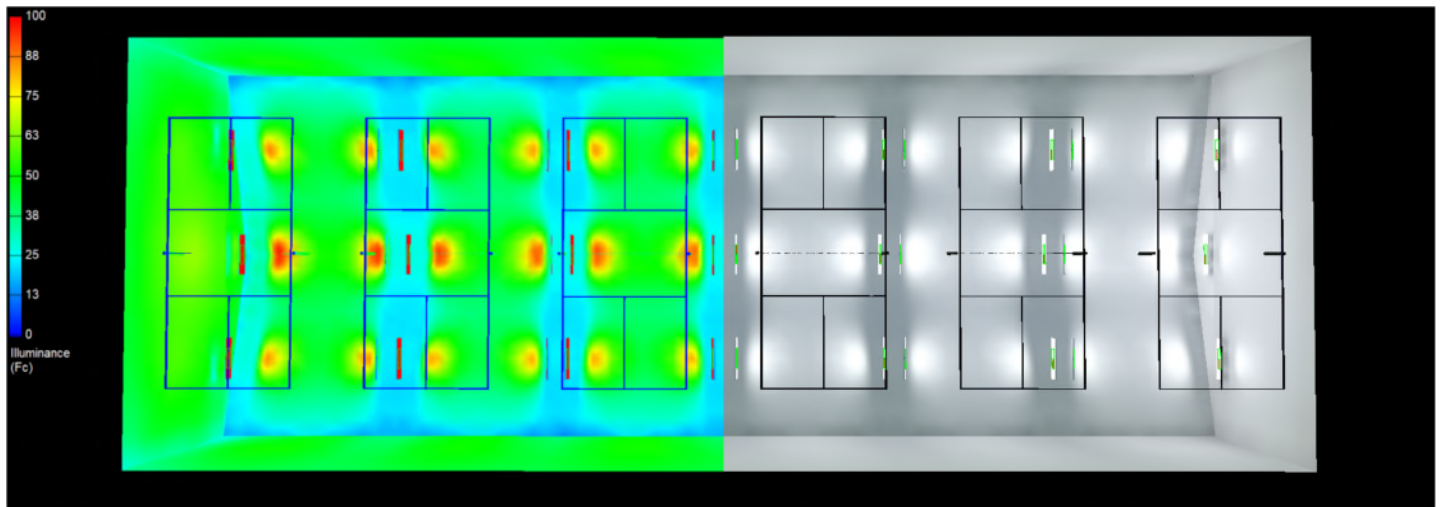
Rendering of the Direct Indirect system demonstrates the illumination of the entire room including the ceiling above the court



Below is the Pseudo modeling of the same model as above showing the expansive distribution of light.



Below View is floor looking at ceiling from below the floor



It should be very clear why the USAP and the ASBA both acknowledge that Direct/indirect lighting provides the best illuminance for these sports.

Lighting Management

With the current high cost of energy/electricity and the expectation it will be exponentially increasing in cost, it is important to consider lighting management. The three lighting options above all respond differently to dimming or turning light off on court that are vacant.

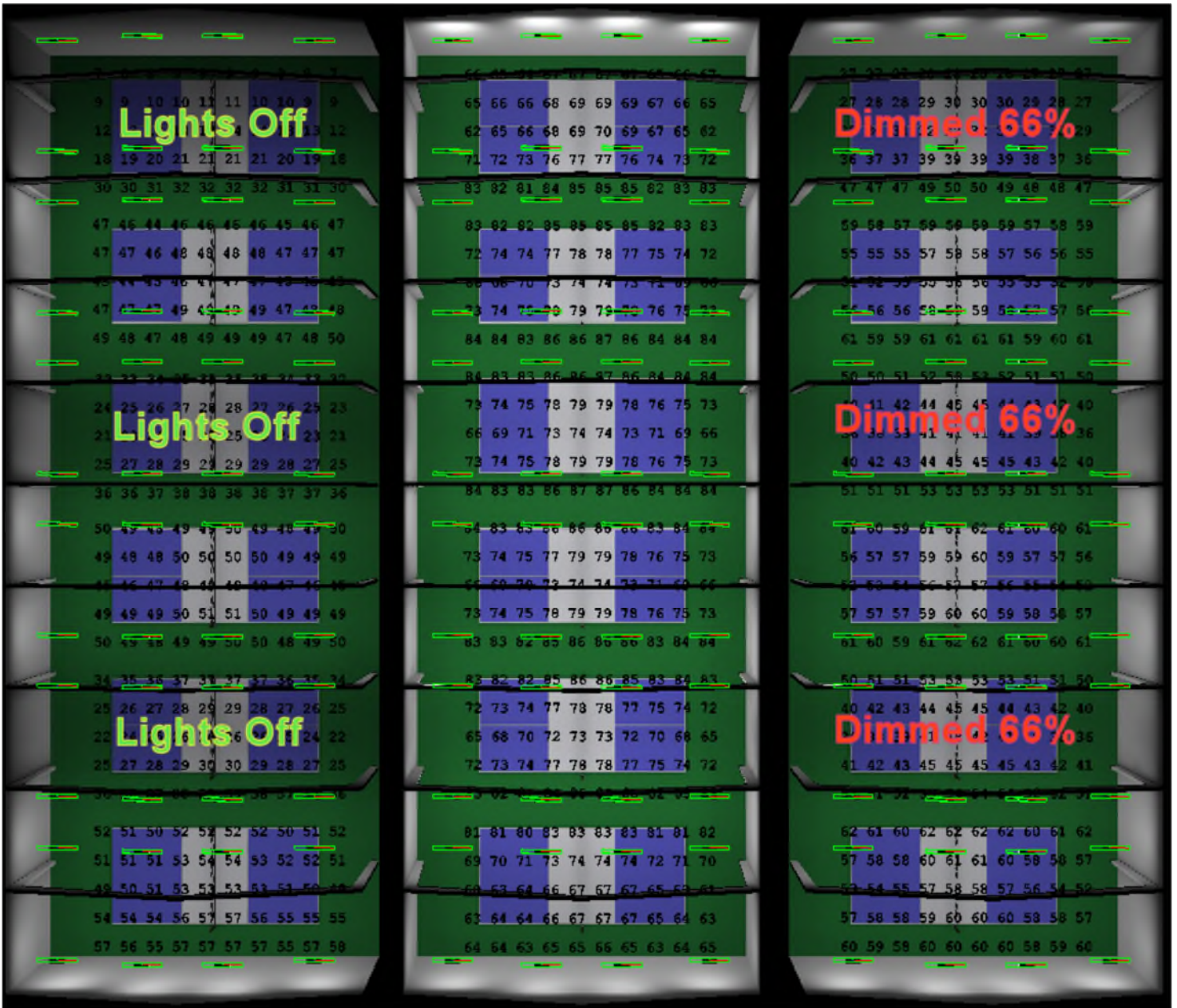
Below are 3 identical buildings: Left courts 2-4-6 lights are turned off, Middle all courts are on 100%, Right courts 2-4-6 are dimmed to 33%. Note: all facilities are different actual results may vary in your facility based on room and environment variations.

Direct Lighting Management

This first Model is using 100% down (direct) lighting: Direct lighting is not directional to the court it is adjacent to the court whereas "direct" lighting has a fair amount of bleed into adjacent courts and space. As you can see in the left building with courts 2-4-6 off the adjacent courts with the lights still 100% "ON" has significant light loss compared to those courts that are still "ON". The Building on the right courts 2-4-6 are dimmed to 66% to 33% lumen output, similar to all off model the light levels on adjacent courts that are still "ON" are dramatically impacted.

Direct lighting is not a feasible option if you intend manage the lighting on your courts by dimming or turning off adjacent courts.

Middle building is 100% "ON"



Right is the calculation summary of the above modeling. Look at court 3 right in the middle of the room with courts 2 and 4 Turned "OFF" (left building) and same courts dimmed to 33% on building on the right. You can see court 3 light levels dropped from 78 on middle building with all "ON" to 48-avg. ftc (footcandles) with courts 2-4-6 off, that is a drop of 39%. Then on the court on the right with courts 2-4-6 dimmed to 33% 58-avg. ftc is a 26% drop in light levels. Considering customer experience is the most important factor, your members/customers are not going to be happy with these significant drops in light levels. Direct lighting management in a pickleball environment is not a practical solution for lighting management.

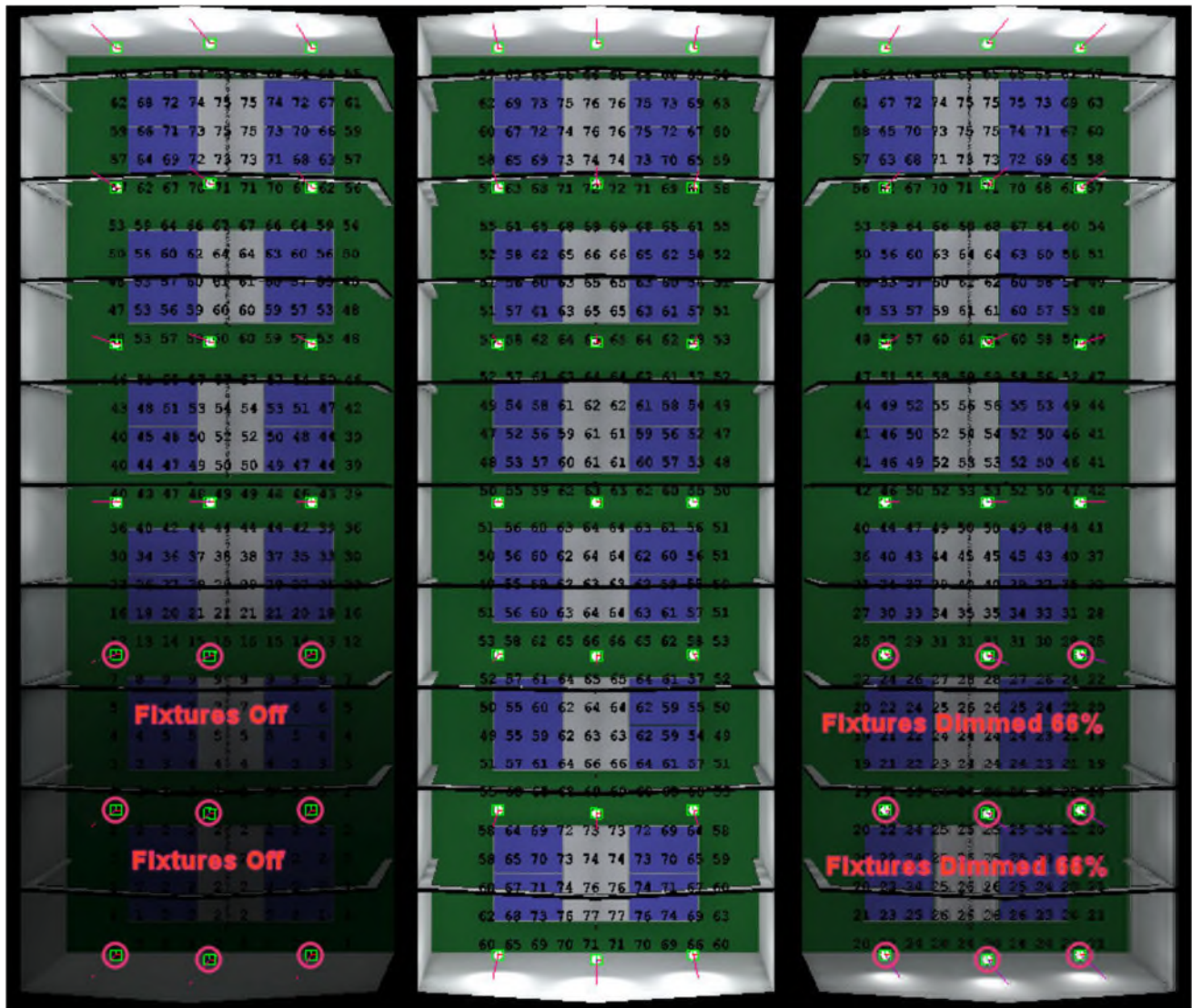
Calculation Summary			
Label	Units	Avg	Max/Min
Court 1	Fc	53.34	1.18
Court 11	Fc	69.46	1.38
Court 111	Fc	58.70	1.19
Court 2	Fc	30.50	1.77
Court 22	Fc	77.36	1.32
Court 222	Fc	45.86	1.50
Court 3	Fc	48.82	1.13
Court 33	Fc	78.20	1.30
Court 333	Fc	58.36	1.19
Court 4	Fc	29.60	1.81
Court 44	Fc	78.42	1.32
Court 444	Fc	45.52	1.47
Court 5	Fc	46.96	1.16
Court 55	Fc	77.96	1.32
Court 555	Fc	57.08	1.22
Court 6	Fc	16.42	4.57
Court 66	Fc	71.36	1.37
Court 666	Fc	34.52	1.85

Indirect Lighting Management

Lighting management for 100% indirect lighting is marginal at best as indirect lighting has little to no directional light properties. Indirect light is aimed at the ceiling designed to reflect back, but what actually happens is that light when it hits the ceiling simply explodes and the light is distributed throughout the room. So much of the indirect light is deflected to outside that particular court area. Because courts share indirect fixtures there is no individual court management and light control impact 2 or more courts. Even if each court had it's own set of indirect fixtures because indirect lighting is not directional is still problematic. Note: **Left Building 1st three rows of indirect lights are turned off, Building on right 1st three rows are dimmed to 33%.**

Calculation Summary			
Label	Units	Avg	Max/Min
Court 1	Fc	1.82	2.00
Court 11	Fc	68.70	1.33
Court 111	Fc	23.48	1.30
Court 2	Fc	5.08	4.50
Court 22	Fc	59.72	1.41
Court 222	Fc	23.06	1.47
Court 3	Fc	27.10	3.67
Court 33	Fc	58.98	1.35
Court 333	Fc	37.04	2.00
Court 4	Fc	48.10	1.46
Court 44	Fc	56.98	1.36
Court 444	Fc	50.22	1.44
Court 5	Fc	57.36	1.43
Court 55	Fc	60.60	1.35
Court 555	Fc	57.82	1.42
Court 6	Fc	66.54	1.36
Court 66	Fc	67.82	1.33
Court 666	Fc	66.78	1.36

You can see the results that the two courts (3-4) closest to the courts with the lights off have a significant loss whereas court 3 has on the left model a drop of 54% and Court 4 has a 16% drop in levels. So basically, any rows turned off will impact up to 3 courts over. On the right building that has the fixtures only dimmed to 33% on the 1st three rows Court 3 lost 37% and court 4 lost 12%. However anytime you turn off or dim a single row of fixtures you lose the use of two courts which makes management very challenging with indirect lighting. Note this model all courts are side to side add in courts on the ends and that single row turned off will impact light levels up to 4-6 courts.

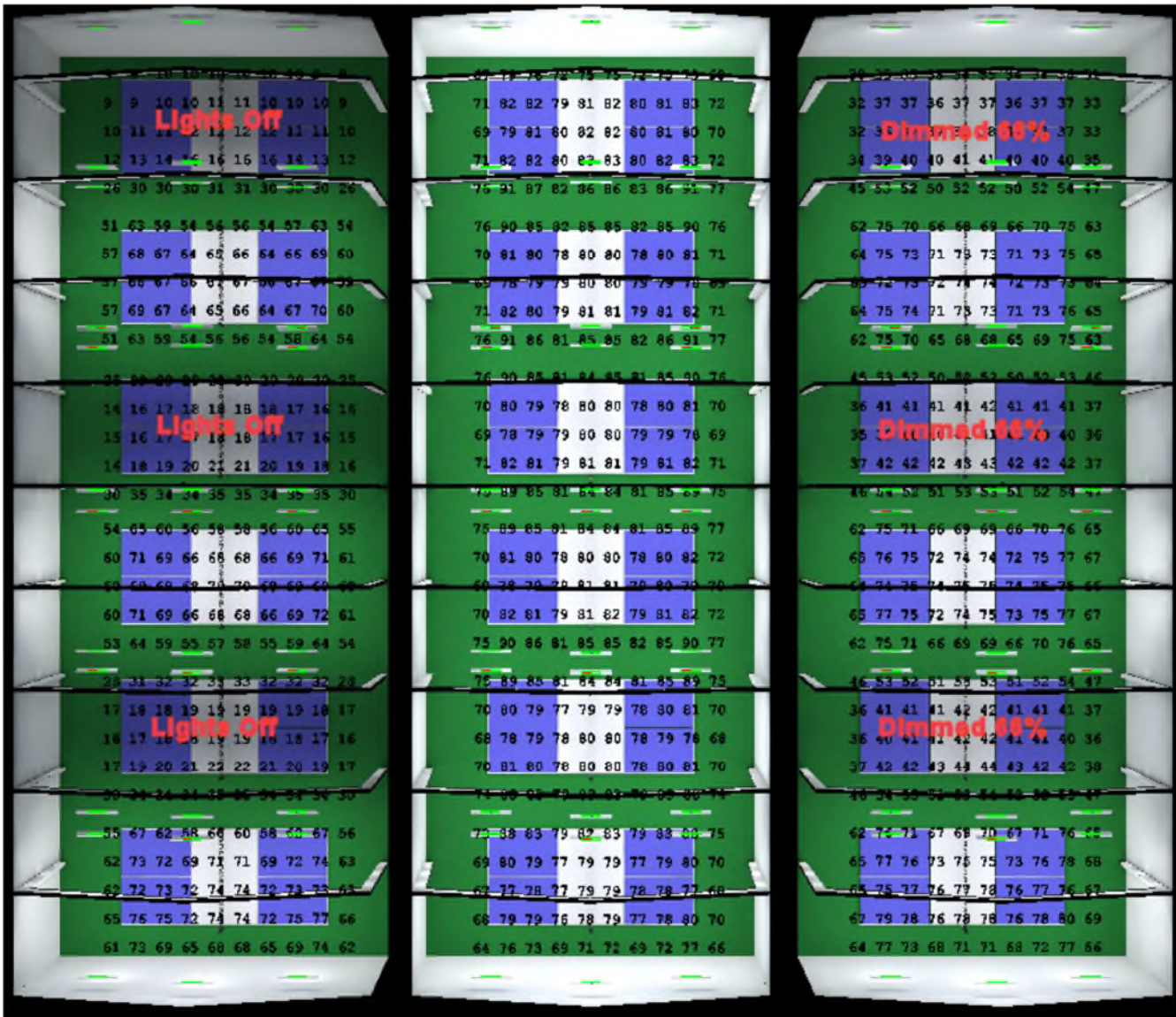


Direct/Indirect Lighting Management

Once again Direct/Indirect not only provides the best possible illuminated environment it is also the most manageable of the three lighting solutions. You can actually manage each court individually with minimal impact on adjacent courts. Looking at the modeling below: Building to the left with courts 2-4-6 turned off, court 1-3-5 still maintain very playable light levels. For example, court 3 on the left model at 63-ftc only dropped 21% with those fixtures "OFF" compared to the middle ALL ON courts where #3 was 80-ftc, However on the building on the right where courts 2-4-6 were dimmed to 33% court 3 only dropped 9% from 80-ftc to 71-ftc maintaining tournament level lighting with 3 court dimmed by 66%.

The small drop in light levels is hardly even noticeable to the human eye if at all visible.

Calculation Summary			
Label	Units	Avg	Max/Min
Court 1	Fc	68.18	1.40
Court 11	Fc	76.26	1.38
Court 111	Fc	72.80	1.29
Court 2	Fc	24.08	2.19
Court 22	Fc	79.18	1.31
Court 222	Fc	45.00	1.53
Court 3	Fc	63.62	1.36
Court 33	Fc	80.22	1.30
Court 333	Fc	71.24	1.24
Court 4	Fc	22.90	2.33
Court 44	Fc	79.90	1.30
Court 444	Fc	44.50	1.54
Court 5	Fc	61.60	1.37
Court 55	Fc	80.24	1.32
Court 555	Fc	70.04	1.23
Court 6	Fc	14.86	3.44
Court 66	Fc	79.16	1.36
Court 666	Fc	39.10	1.80



Understanding LED Lighting Technology

High performance LED really hit the mainstream 2012-2014 and like many technologies developed in the US, Asian manufactures soon were to dominated this industry, turning LED in to a commodity throw away technology in many cases. However, demands from some industry's warranty the development of more high performance, high quality serviceable LED lighting products domestically here in the US and Canada. The Sports industry especially the racquet Sports industry was one of those that demanded and required those quality and use specific lighting products.

The biggest benefit to LED is energy efficiency and impressive lumens to watt light output that fluorescent and HID could not quite deliver. The challenge with LED is to manage the light output in a way to mitigate glare which is the #1 challenge with sports lighting and why it has bee our mission to developed LED fixture for each individual sport and focus on these challenges.

I think most people today understand the efficiently benefits of LED but what is most misunderstood is the reliability and external influences that impact reliability. Too often the lighting sales person will make wild claims on great LED is, with claims of years or decades of maintenance free lighting.

The anatomy of an LED fixture is quite simple, it is comprised of:

- LED module that is basically a circuit board with multiply LED chips attached is the light source of the fixture
- LED driver, LED chips are powered via low voltage in a voltage scale of milliamps. The Led driver is basically a transformer that takes your line voltage from the building, generally 120v-480V and then converts that voltage to the required milliamps the LED chips require.
- Thermal management and or heatsinks, The #1 design element of EVERY LED fixture is the ability to shed heat, the driver being a transformer can generate excessive heat in the transformation of high/line voltage to low voltage. Because Heat is the #1 killer of ALL electronics it is a critical priority in all LED fixture design. Note: Some LED fixture use computer fans to cool the LED components. This suggest the thermal design of the fixture is substandard. Avoid LED fixtures that use fans for component cooling. Besides, fans in fixture collectively will create a noticeable hum as well the last thing you want is a \$10 computer fan protecting your expensive LED lighting. A well-designed LED fixture will not require active cooling. 90% of LED fixtures these days are designed and rated to operate in a maximum 50C (122F) ambient environment. Whereas if your ambient temps exceed this the manufactures will suggest you may experience premature failure as well not be covered under warranty. Be aware of this as there are several fixtures still on the market with a 40C (104f) rating. In the early days of LED most fixtures were 40C but that also led to premature failures being very common back then (only 10 years ago). Every LED fixture spec sheet will list the max operating temps make sure you qualify this metric on all fixtures.
- LED Fixture Bodies are generally made of aluminum for the above heat management reasons as aluminum is one of the best heatsink materials. You should avoid fixture made with Steel or plastics which are both lower cost materials but neither shed heat as well as aluminum.

What is the expected life of the LED Driver?

This is the discussion that no one talks about with the consumer. LED drivers have a typical life of 50,000-75,000 hours. Whenever you see LED life published that typically has nothing to do with the LED driver life. Since LED modules typically last longer than the drivers that is what the consumer is most often told the life is, the driver life is omitted as it is the weakest link of any LED system. The LED driver to the LED lamps is like the ballast to a fluorescent lamp, simply a transformer and both constructed very similar. Basically, **LED drivers convert higher voltage; alternating current to low voltage that the LED operates on, it is a key element of the LED system. However as mentioned above it is also the weakest link. Drivers often fail prematurely due to high internal operating temperatures. Battery-like components called electrolytic capacitors are often the cause of failure. Electrolytic capacitors have a gel inside them that gradually evaporates over the lifespan of the driver. High ambient and operating temperatures speed the evaporation of the gel and shortens the life of the capacitor, causing the driver failure, and hence your fixture failure.** So the life of your drivers will mostly be determined by heat management, hours of operation as well as quality of manufacturing and internal components (not all drivers are created equal).

What you should realistically expect for Driver maintenance. These are generalized projection for ALL LED fixtures as a whole?

- first 5 years 0%-2% driver failure.
- 5-10 years more frequent failures another 1%-10%
- 10-15 years likely total driver replacement (assuming 10-16 hours per day of operation).

The above are general estimates hours of operation, qty of starts and several other factors can extend or shorten the life of your Drivers.

Fixture design can have a significant impact on the estimated maintenance and driver life as discussed, making this very important consideration. Also having LED fixtures that are engineered for the use, locations and ambient environments is important. This is also why whatever LED fixture you select is 100% field serviceable I would say 80% of the LED fixtures on the market today are not field serviceable and have to be serviced by the manufacture which require removal and shipping along with waiting to get your lighting back in operation. Unfortunately what many in the tennis industry learned when buying low cost non specific LED lighting solutions for their courts is if you experience failures from heat issues most likely it is not covered by warranty and if it was the issue will likely repeat in short order. This can be very expensive to have to replace your LED lighting system only months or a couple years after installation. Regardless you will be on the hook for labor and lifts to service the lighting as well.

What is the expected life of the LED Module?

LED Modules are generally far more reliable than their driver counterparts. LED modules can handle the heat a little better, in most cases should outlive your drivers 2:1. That is not to say though that you will not have any small qty failures. Also understand that a failed LED module require 8%-10% of the chips on the module or fixture to have failed. Again a poor designed LED fixture can accelerate the end of life if any LED component and be your worst maintenance and financial nightmare. Like in any industry there are high and low quality components and you generally get what you pay for.

When you see statements like the life of a particular LED fixture is say 100,000 hours, understand that BY NO MEANS does that suggest your LED fixture will last 100,000 hours. That is a determined factor based on lab testing of the fixture and its components that they anticipate the fixture will have LOST 30% of its light output, whereas for ALL LED fixtures at 70% lumen output all LED fixture are considered to be at END OF LIFE. That 100,000 hours only references, maintained lumen output, it has ABSOLUTELY NO relevance to actual fixture component life. Those lab-test are also done in ambient controlled environments.

Here is a great example: our LED Direct/Indirect fixture has a rated life of 250,000 hours, I guaranty you it will not last that long, again assuming it did last 250,000 hours only means that it will have lost 30% of the maintained lumens at that time. Again this has no relevance to driver life or performance.

Will Led fixtures last 100,000 hours with no servicing? The answer is YES THEY CAN, but say have 50 fixtures many of those by 100,000 hours will have require maintenance like driver replacements or fixture replacement. It is best to simply assume from a quality fixture that typical low maintenance life should be 50,000-75,000 hours before significant maintenance or replacement is required, and prior to 50,000 hours expect some component replacement. This is precisely why you want field serviceable fixtures that do not have to be returned to the manufacture for repairs. Also note based on the history of lighting technology improvement, in 12-20 years there will likely be new technology to either retrofit your existing fixtures or replace them. Because we have had the same manufacture since 2001 we can still service the fixture we sold in 2001, in fact we just retrofitted our 20 years old fixture with our LED's in 3 tennis clubs which was much lower then replacing those fixtures and now the lighting is renewed for another 10-20 years.

LED Warranty's

LED warranty should be no less than 5 years and some for example like for the Brite Court Fixture as high as 10 years. Warranty's are only as good as the manufacture that backs it, with so many LED fixtures imported from Asia there is little warranty support and infrastructure here in the US. Over the course of 5-years it is almost a given that you will have a warranty claim or some failed components, it is baked into the cake. But many warranty's make it very difficult to make a claim and have fine print. As discussed above the cost to rent a lift to take a fixture down, ship to the manufacture (at your expense), wait weeks or months to get it repaired and returned, rent a lift again, can cost you a much as buying a replacement fixture. This is also a reason why buying American is a good idea as you have much better recourse for satisfying warranty claims.

Warranty on Brite Court fixtures is un-matched by any other Lighting supplier. First for our indoor racquet sports fixture warranted 10 years from a 25-year old US manufacture, no forms to fill out just a phone call to a real person who will typically ship your parts out in 24 hours. You replace the components and return the failed ones. However we take this one step further, WE SHIP SPARE DRIVERS with every order so you have a spare on hand at the moment you need it. By the way, we use Samsung LED modules and Sylvania/Osram or Philips Drivers. These components can be bought and ordered at most local lighting distributors or online. All our indoor fixtures are field serviceable and only takes 3-5 minutes to replace a driver or a module.

Lighting standards and footcandle/LUX levels for pickleball

This in one area we take exception to with the ASBA and USAP and needs some updating by these organizations. There are multiple published lighting standards. There is the North American from the ASBA and International from the ITF. Light levels for pickleball are identical to tennis, which is logical. The problem is the standards are outdated and are based on old lighting technology and other technology factors. When we started in the Tennis lighting industry in 2001 the average maintained levels in most indoor tennis was under 50fc (footcandles) and many 40fc and under, often due to fast depreciation of HID lighting. Even at the NCAA level 50-60fc was very common. It is important to understand that light meters DO NOT measure light the same as the human eye does, the cones and rods in your eye respond differently to old vs new lighting technology light quality. It is estimated that if you have say two rooms both at 100fc one room is HID lighting (halide) and the other LED the LED room will appear 20-25% brighter to our eyes however the light meter will not respond in kind.

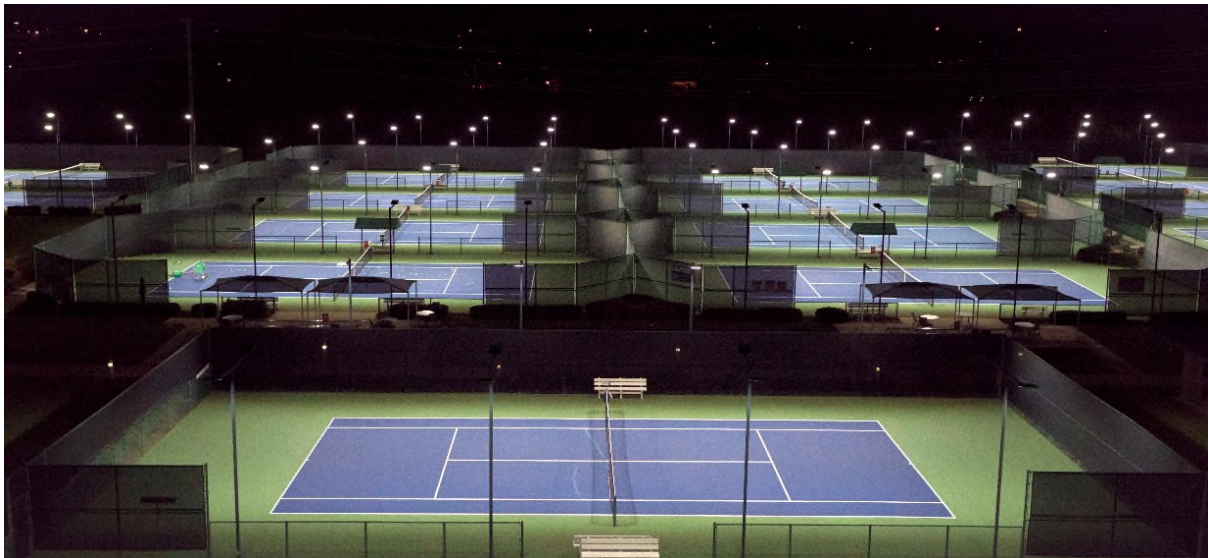
Having designed upwards of 600 tennis and pickleball lighting projects at all levels from club to NCAA and domestic and international professional facilities 50fc to 70fc is very good for recreational play and 65-85 for tournament, NCAA and professional play.

On a special note: Both the ASBA and USAP suggest that professional tournament lighting needs to be 125fc. That is a 50-60 year old standard that existed back then in part because TV cameras required high light levels to film. Having worked with Fox Sports, ESPN and others by today's standards anything 40fc and above is adequate for filming. Also keep in mind the National Electrical code has what is called "Power Density" requirements. This is watts per sqft that all facilities must adhere to. In many cases to achieve 125fc you will likely exceed the power density code unless you have spectator seating for 5000 or more or get an exception from your local electrical inspector.

Summary

With 22 years of designing lighting for racquet sports it has been our mission to deliver the best lighting available. We are the ONLY company to develop design and build from the ground up Pickleball and Tennis specific lighting products to be included in each category of acceptable lighting types for USAP. Especially with pickleball, no two facilities are alike and there is NO single lighting fixture solution even though other lighting suppliers that have only one solution may try to convince you their fixture fits all facilities. There are so many factors that determine what is best for you and your Pickleball facility, from ceiling height, building construction, court spacing, type of clientele (age and skill level), so many factors need to be considered before you decide on the lighting source and type. Keep in mind, pickleball is exploding, and the cost to entry is much lower than say building out a tennis facility. Because of that and the wider appeal and growth/demand of pickleball, the density and saturation of pickleball facilities will likely result in many locations (cities/regions) having numerous pickleball facilities servicing the same small demographic. With that said be forward thinking, lighting is one of the most important buildout considerations, choosing the wrong lighting can have long term impact on your membership or lack of if other new facilities install better lighting. Choosing improper applied lighting can also result in a failed lighting system. Lighting is not the only consideration in that regard. It is important whom ever you are buying or having design your lighting be very experienced with a solid history of delivering world class sports lighting for this sport.

Brite Court also designs and provides Outdoor Pickleball lighting



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