Brooks Acoustics Corporation
49 N. Federal Highway Pompano Beach, Florida 33062 754.229.1450

Mr. Ian G. Bacheikov, Esq.
Akerman LLP
Three Brickell City Centre
98 Southeast Seventh Street | Suite 1100
Miami, FL 33131

23 December 2016
PJ2016-1214-L01

Subject: Acoustical Engineering Study – Carillon Hotel Trellis Bar Additional Sound Study

Reference: Carillon Hotel Trellis Bar Sound Study Report, The Audio bug, Inc., July 12, 2016.

Dear Mr. Bacheikov:

As requested, Brooks Acoustics Corporation (BAC) has conducted an acoustical engineering study to evaluate the potential sound emissions from a proposed outdoor Trellis Bar to be located at the Carillon Hotel, 6801 Collins Avenue in Miami Beach. The potential impact that those sounds may have on the surrounding neighborhood was evaluated.

This study was conducted in addition to a prior sound study report (please see Reference), which addressed sound traveling to the South Tower (Condominium use).

This study addresses sound traveling upward, as it may affect the Central Tower condominium residences above the proposed Trellis Bar, on Levels 11 through 16. Also addressed are potential mitigation techniques for ambient sound in the outdoor bar area that can be implemented as potential conditions in the variance. These mitigation techniques are proposed in addition to those given in the Reference.

An ambient baseline sound survey was conducted at a residence location for this study. The survey test position was on the bedroom balcony of Penthouse 16 on Floor Level 16, just above the proposed Trellis Bar area. This study was conducted in conformance with accepted standard test and analysis methods. The ambient baseline sound level, LA_{90} was 57 dBA, and included contributions by local road traffic, aircraft, surf, voices and the other activities occurring near the site.

The sound levels due to the proposed Trellis Bar are expected to be minimized by the sound control design features which are incorporated into the development. An acoustical analysis was conducted which accounts for the sound control design features which are included in the proposed facility.

The acoustical engineering analysis indicates that the expected sound level at the upper floor condominium locations will be reduced below the existing background sound levels due to the beneficial properties of the proposed mitigation features. These features include the level limiters on the speaker systems, as discussed in the Reference, and an optional sound deadening retractable shade awning incorporated into the proposed Trellis structure.

Based on this analysis, it is the opinion of BAC that with a reasonable degree of engineering certainty the proposed Trellis Bar will have **no negative impact** on nearby residences.

Sound Level Standards

The limit for allowable sound emissions is mandated by the City of Miami Beach Ordinance Sections (Article IV – Noise) 46-151 to 46-162. The Ordinance specifies the types of prohibited sound sources in Miami Beach.

Potential prohibited sound sources, such as a radio loudspeaker and shouting, which may be associated with the Trellis Bar, are addressed by the Facility Sound Management Program.

Facility sound management program

A facility sound management program was developed. This program has several major elements, which are designed to reduce the potential for impact on the surrounding residences. These features include:

1. Sound level limiters on outdoor ambience loudspeakers.

2. An optional acoustical awning which could be installed to cover the Trellis, to further reduce any sound emissions which may occur there.

1. The proposed outdoor loudspeakers will be installed with sound level limiters set for a maximum of 60 dBA (please see Reference). This low level will ensure that music from the bar will be inaudible at a distance, including at the residences above. It will also discourage loud, elevated speech levels from patrons, as it will be unnecessary to raise their voices in order to be heard over the music.

2. As an option, a retractable acoustical awning could be installed above the Trellis. This awning system is designed to further reduce sound emissions from the bar area by as much as 18 dB.

Sound survey test procedure

An ambient baseline sound survey test was conducted at the proposed mixed use site on the morning of Thursday, 22 December 2016. The surrounding area includes commercial and residential uses. The survey test was conducted by Bennett Brooks of BAC. Field measurements of sound levels were performed in accordance with the requirements of accepted standard methods of environmental sound measurement.

The **ambient baseline survey test position** was selected at a location above the proposed Trellis Bar which fairly represents the baseline sound with respect to residences. This test survey also complements the survey documented in the Reference. The **test position** was on the bedroom balcony of Penthouse 16, on floor Level 16 in the condominium use area of the building.

The microphone height at the test position was 5.3 feet. Photographs of the test site are given in Figure 1.

The baseline sound test was conducted on Friday, 2 December 2016, between 4 and 5 pm.

The temperature at 4:19 pm was 77 degrees F, with a dew point of 69 degrees F, and a barometric pressure of 30.11 inches Hg. The wind was out of the NNW at 1 to 6 mph. The sky condition was partly cloudy.

The field **acoustic measurement system** was a digital (Type 1) integrating logging sound level analyzer (Norsonic Nor 140). The acoustic measurement system was calibrated with equipment directly traceable to the U.S. National Institute for Standards and Technology (NIST).

The nominal accuracy for the measurement system is ± 1.5 dB. A listing of the test equipment used in this survey is given in Table 1.

During these tests, the Norsonic sound analyzer instrument continuously recorded the sound level every second and computed the baseline ambient average level, Leq. Also, the instrument stored a variety of statistical and spectral acoustic parameters for the test period, updating those values every second.

The acoustics measurement **test protocol** for the instrument system was set to ANSI standard A-weighting for frequency and slow time weighting. The test period was 10 minutes in duration. The internal clock of the analyzer was synchronized with the NIST atomic clock to within a tolerance of 1 second.

During the test survey, observation logs and notes were written identifying test procedures and also significant sound generating events.

Data analysis

In this analysis, the measured sound levels were A-weighted. Sound level measurements which apply A-weighting are designated by the symbol "dBA". Applying A-weighting to the measurement simulates the average human hearing sensitivity for a wide range of sounds, specifically, greater sensitivity to high frequency sounds (whoosh, whine), and lesser sensitivity to low frequency sounds (thump, rumble). Therefore, this weighting is stipulated for virtually all government and industrial regulations.

Sound Test Data Analysis -- Time history analysis

Detailed sound test results for each baseline ambient sound survey are given in the form of a **Time History Chart**, which shows the change in sound level over time for each test record.

Time history analysis of sound data can be very helpful for understanding the character of the tested acoustical environment. Simply stated, the sound level time history indicates the sound level that is measured at any given moment of time during the test period. In this analysis, the sound time history for the test is represented by a chart showing how the measured sound levels varied with time.

Test results

Baseline ambient sound test

The results of the sound survey show that the measured ambient sound level (LA_{90}) at the test position on the Level 16 balcony was **57 dBA**. This level was determined by local road traffic and other activities occurring in the area at the time. It is noted that this is identical to the ambient sound level that was reported in the Reference for the ground level elevation. It is expected that this would also be the baseline sound level for the other residences located in the building.

The measured time history plot for the test record on the Penthouse 16 balcony is shown in Graph TH2016-1222-001 nor, attached. Note that the highest measured sound level during the test period was 67 dBA, due to the passage of a helicopter.

Estimates of Trellis Bar sound levels at Central Tower Condominiums

Acoustical engineering calculations were made to estimate the sound levels at the Central Tower condominiums. These residences are located above the plaza of the proposed Trellis Bar, on floor Level 11 through 16. The source sound levels used for this analysis are based on the data documented in the Reference.

The expected sound level in the bar area is documented to be 75 dBA. As noted earlier, the proposed ambience loudspeakers will be limited to 60 dBA.

The locations of the condominium units are taken from the building elevation, as given in the Arquitectonica drawing A3.1.03, dated August 1, 2007, please see attached.

The proposed Trellis Bar will be located on the Ground Level, at an elevation of 15.3 feet. The nearest condominium level is on Level 11, at an elevation of 113 feet. The minimum distance between these two levels is 97.7 feet.

The reduction of sound levels with increasing distance from the bar area was documented in the Reference as 22 dB for 120 feet distance. Based on these data, the reduction in sound levels for the distance to condominiums on Level 11 is 20 dB.

The potential reduction due to the design feature of the Sound Management Program of the optional retractable acoustical awning is about 18 dBA, based on product data, attached.

Therefore, the total potential reduction for the nearest condominiums on Level 11 is:

20 + 18 = 38 dBA reduction

Based on source sound levels and expected sound management feature reductions, the worst case estimated sound levels on the Central Tower condominium balconies, at the Level 11 elevation, is as follows:

Source	Sound level
Voices (under optional awning)	37 dBA
Voices (outside optional awning)	55 dBA
Ambience loudspeakers (under optional awning)	22 dBA
Ambience loudspeakers (outside optional awning)	40 dBA

A sound level of 37 dBA is equivalent to a very quiet whisper. The sound level of 55 dBA is equivalent to a quiet conversation. The sound levels at residences further away (on higher floors) from the proposed Trellis Bar are expected to be even less, due to the greater distances involved.

Also, the estimated sound levels at the condominium balconies are below the measured ambient baseline levels in the area.

The balconies doors are expected to provide an additional 25 dBA of attenuation. Therefore, the activity at the Trellis Bar will be inaudible inside the Central Tower condominiums.

Please contact me if you have any questions concerning these findings.

Very truly yours,
BROOKS ACOUSTICS CORPORATION

Bennett M. Brooks, PE, FASA, INCE
President

Attachments

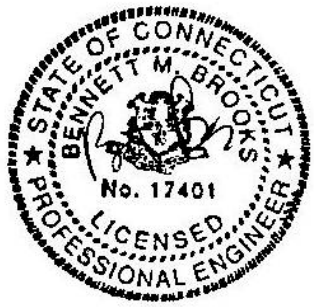


Figure 1, a. Proposed Trellis Bar area -- Viewing northwest toward North Tower building.

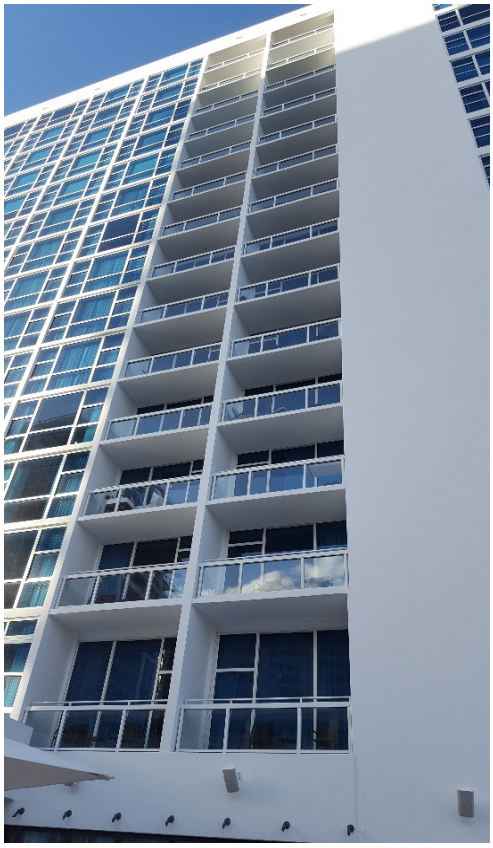


Figure 1, b. Proposed Trellis Bar area -- Viewing north toward North Tower building higher floors. Condo residences located on upper floors.

Figure 1, c. Survey Test Position -- Penthouse 16, bedroom balcony. Viewing southeast.

(d)

(e)

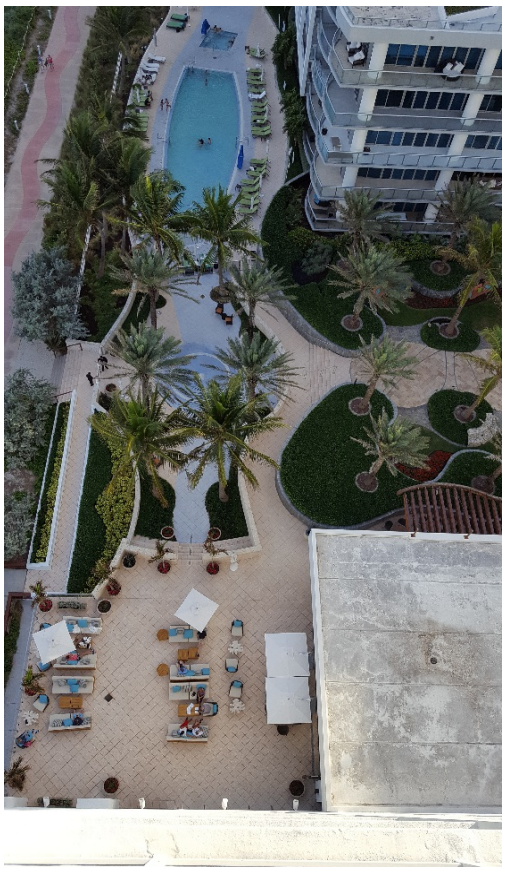


Figure 1, d,e. Survey Test Position -- Penthouse 16, bedroom balcony. Viewing west (d) and down toward the proposed Trellis Bar (e).

Carillon Hotel
Trellis Bar Sound Study
Miami Beach, FL

Table 1

ACOUSTIC INSTRUMENTATION SYSTEMS

22 December 2016

Data Acquisition Equipment

1. Norsonic Instruments - Digital Precision Sound Level Analyzer - Model NOR140, S/N 1403462*
   - Microphone - Model 1225, S/N 98505*
   - Acoustical Calibrator - Model 1251, S/N 32064*

Laboratory Playback and Analysis Equipment

1. Norsonic Instruments - NorXfer Analyzer Software, ver. 6.0
2. Lenovo - Computer workstation with SD interface
3. Microsoft - Excel 2013 Spreadsheet Program

* Note: Laboratory calibration certificates available upon request.

Carillon Hotel

Trellis Bar Sound Study

Miami Beach, FL

Ambient Sound Survey

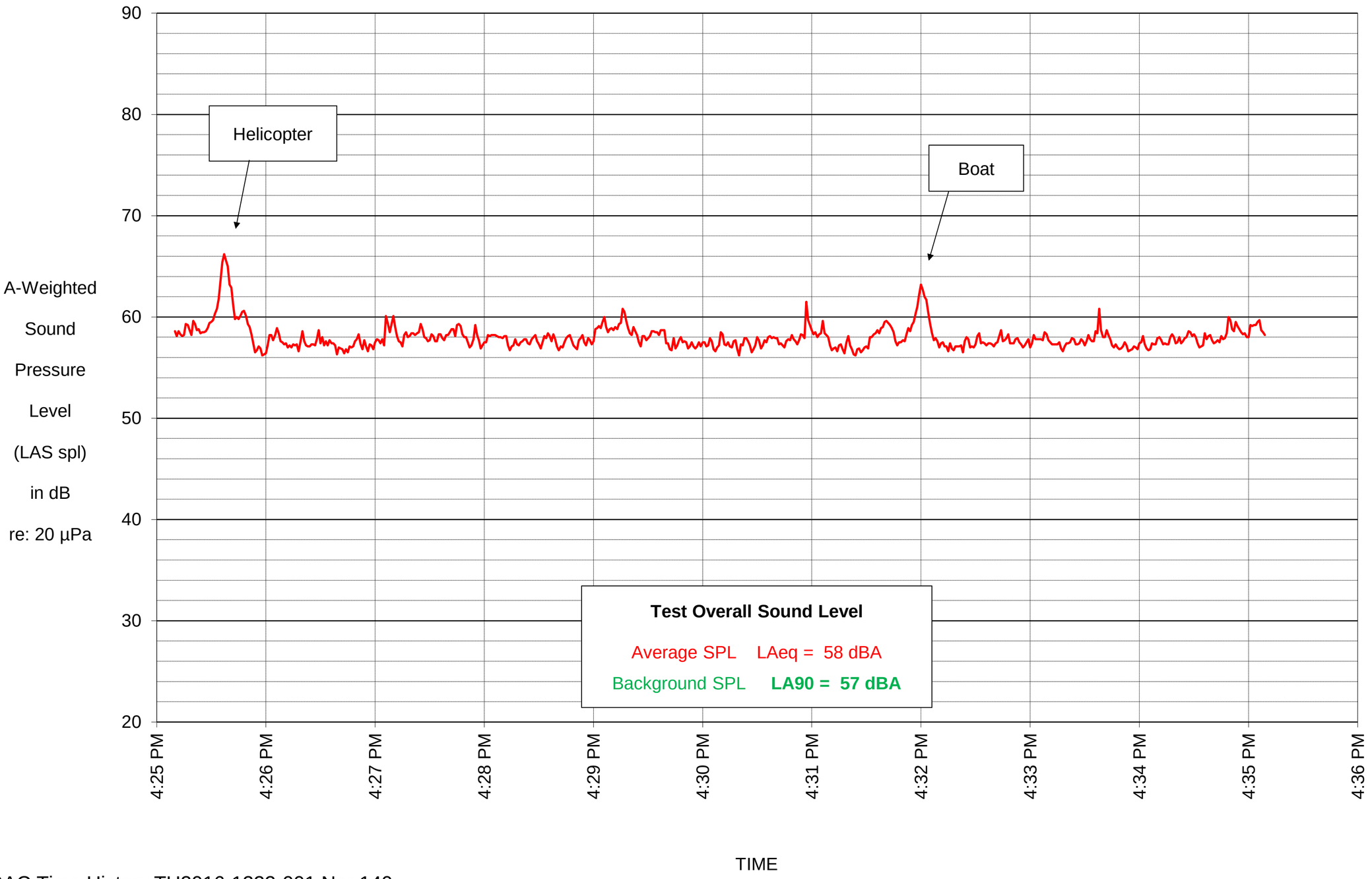
Condominium Residence - North Tower

Penthouse PH 16 - Bedroom Balcony

Date: 22 Dec 16

Time: 4:25 PM

Position: 1

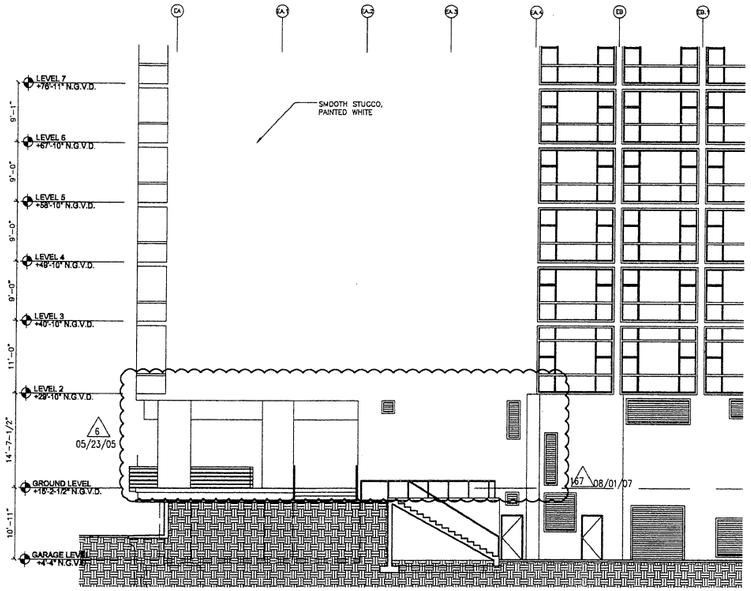


BAC Time History TH2016-1222-001 Nor 140

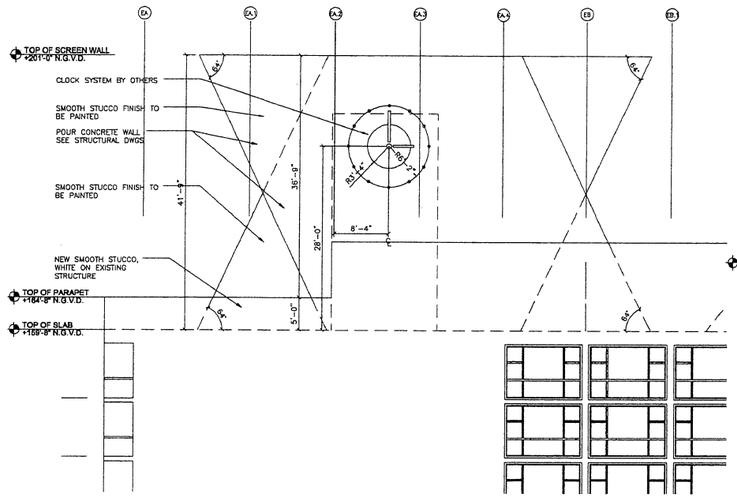
BAC Time History TH2016-1222-001 Nor 140

BAC Project Letter PJ2016-1214-L01

sfl601-021900-0001 8/30/2010 13:04:01



3 ENLARGED ELEVATION
SCALE: 1/8" = 1'-0"

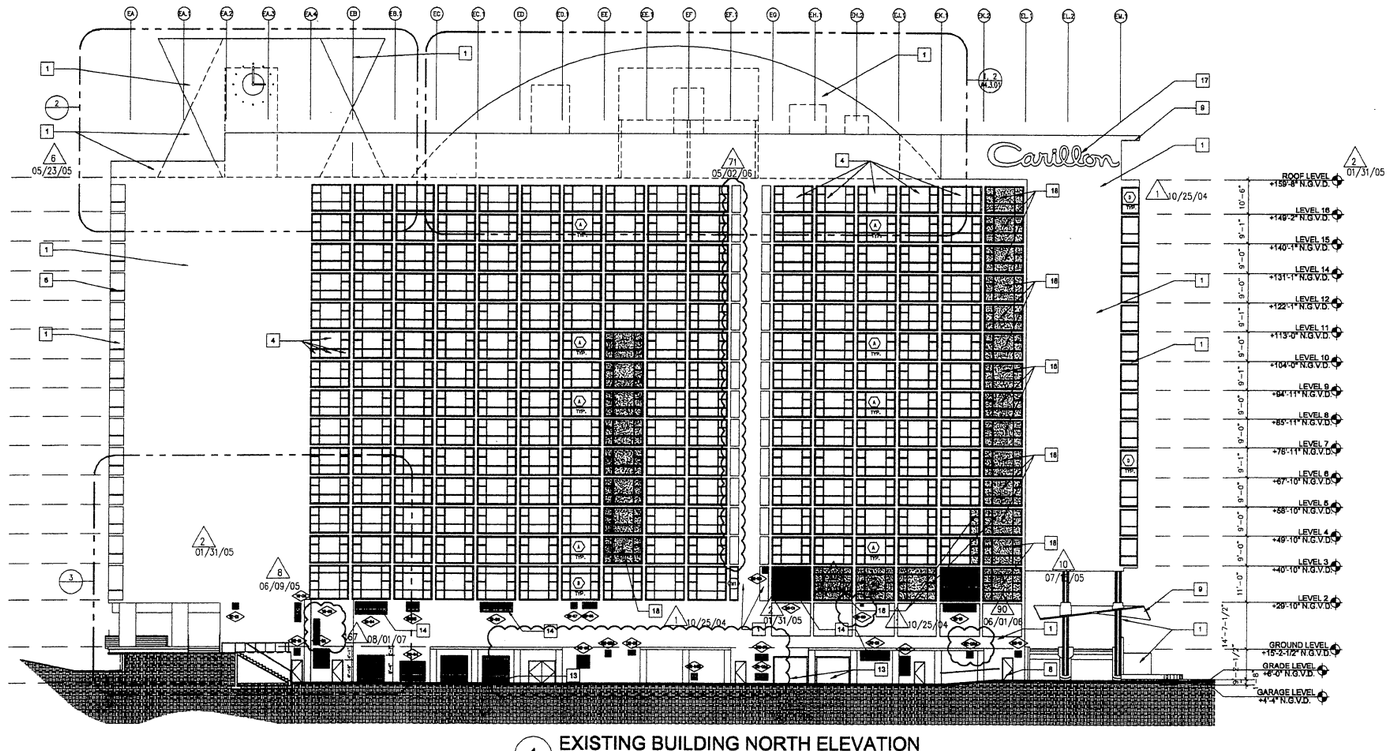


2 ENLARGED ELEVATION
SCALE: 1/8" = 1'-0"

ELEVATION MATERIAL LEGEND

1. PAINTED SMOOTH/LIGHT TEXTURE CEMENT PLASTER FINISH COLOR: WHITE
2. ALUMINUM BLIDING GLASS DOOR W/ KYNAR FINISH FRAME COLOR: CHARCOAL GRAY GLAZING COLOR: BLUE
3. ALUMINUM SPANDREL GLASS W/ KYNAR FINISH FRAME COLOR: CHARCOAL GRAY GLAZING COLOR: BLUE (FOR LOCATIONS, SEE ALSO PLANS.)
4. ALUMINUM FIXED GLASS WINDOW W/ KYNAR FINISH FRAME COLOR: CHARCOAL GRAY GLAZING COLOR: BLUE
5. ALUMINUM STOREFRONT SYSTEM W/ KYNAR FINISH FRAME COLOR: CHARCOAL GRAY GLAZING COLOR: CLEAR
6. GLASS RAIL W/ ALUMINUM FRAME W/ KYNAR FINISH FRAME COLOR: CHARCOAL GRAY GLASS COLOR: CLEAR W/ ETCHED PATTERN TYPE B
7. GLASS RAIL W/ ALUMINUM FRAME W/ KYNAR FINISH FRAME COLOR: CHARCOAL GRAY GLASS COLOR: BLUE TYPE A
8. HOLLOW METAL DOORS (SEE DOOR SCHEDULE) PAINTED TO MATCH BUILDING EXTERIOR
9. CONCRETE CANOPY PAINTED SMOOTH/LIGHT TEXTURE CEMENT PLASTER FINISH
10. CONTROL JOINTS SEE DETAIL
11. MECHANICAL LOUVER, FACTORY PRIMED & PAINTED. REFER TO LOUVER SCHEDULE. COLOR: FIELD PAINTED TO MATCH ADJACENT COLOR
12. 1" EXPANSION JOINT
13. ROLL UP METAL DOORS (SEE DOOR SCHEDULE)
14. ALUMINUM METAL LOUVER (SEE LOUVER SCHEDULE)
15. CMU WALL WITH STONE FINISH. SEE I3 FOR DETAILS PATTERN
16. ALUMINUM SWINGING GLASS DOOR W/KYNAR FINISH FRAME COLOR: CHARCOAL GRAY GLAZING COLOR: BLUE
17. EXISTING SIGN TO REMAIN
18. ALUMINUM FIXED SPANDREL GLASS W/ KYNAR FINISH FRAME COLOR: CHARCOAL GRAY
19. GLASS RAIL W/ ALUMINUM FRAME W/ KYNAR FINISH FRAME COLOR: CHARCOAL GRAY GLASS COLOR: BLUE TYPE C
20. PAINTED SMOOTH LIGHT TEXTURE CEMENT PLASTER FINISH COLOR: LIGHT GRAY TO MATCH WINDOW FRAME

6 05/23/05



1 EXISTING BUILDING NORTH ELEVATION
SCALE: 1/16" = 1'-0"

The Carillon
Residential Development
6801 Collins Avenue
Miami Beach, Florida 33141

OWNER:
The South Carillon, LLC
MANAGING MEMBER:
WSG Development Company
400 Arthur Godfrey Road, Suite 300
Miami Beach, Florida 33140
305.673.3707 tel
305.673.3711 fax
www.wsgdevelopment.net

ARCHITECT OF RECORD:
ARQUITECTONICA
801 Brickell Ave, Suite 1100
Miami, Florida 33131
305.372.1812 tel 305.372.1175 fax
www.arquitectonica.com

INTERIOR DESIGN ARCHITECTS:
Rockwell Group
6 Union Square West
New York, New York 10003
212.463.0334 tel 212.463.7336 fax

OPERATION:
Canyon Ranch
8600 E. Rockcliff Road
Tucson, Arizona 85750
520.749.9655 tel 520.749.9402 fax

STRUCTURAL ENGINEER:
Donnell Duquesne & Albalsa
4850 SW 74th Court
Miami, Florida 33155
305.666.7711 tel 305.666.2288 fax
www.ddaeng.com

MEP ENGINEER:
Steven Feller, P.E.
949 N.E. 3rd Avenue
Ft. Lauderdale, Florida 33304
954.467.1402 tel 954. 467.2782 fax
www.fellereng.com

LANDSCAPE ARCHITECT:
EDAW, Inc.
1666 Kennedy Avenue Suite 6363
Miami Beach, FL 33139
305.604.9978 tel 305.604.9794 fax

COASTAL ENGINEER:
Coastal Systems Int'l, Inc.
444 South Dixie Highway
Coral Gables, FL 33146
305.661.3663 tel 305.661.1914 fax

CIVIL ENGINEER:
Consul-Tech Development Svcs., Inc.
13870 NW 27th Street, Suite 1121
Miami, Florida 33172
305.468.5141 tel 305. 889.3143 fax
www.ctsi.us

LIGHTING DESIGNER:
Johnson Schwinghammer
330 West 38th Street
New York, New York 10018
212.643.1533 tel 212.643.1533 fax

KITCHEN CONSULTANT:
The General Group
1101 North 46th Street
Tampa, Florida 33617
813.980.8873 tel 813.985.6080 fax

POOL CONSULTANT:
Aquadynamics
4917 N.W. 176nd Avenue
Miami, Florida 33165
305.667.3873 tel 305.663.1060 fax

FOUNTAIN CONSULTANT:
Hall Fountains
5420 N.W. 22nd Avenue
Fort Lauderdale, Florida 33309
954.484.8353 tel 954. 484.2365 fax

SEAL / SIGNATURE / DATE

State of Florida Registration # 6805

CONSTRUCTION DOCUMENTS SET

Issue Date:
AUGUST 1, 2007

Office Registration #AA C000465

Issue / Rev.	Date / For
1	10/25/04 REVISION 01
0	01/31/05 C.D. SET
2	01/31/05 REVISION 02
6	05/23/05 REVISION 06
8	06/09/05 REVISION 08
10	07/15/05 REVISION 10
71	05/02/06 REVISION 71
90	06/01/06 REVISION 90

SHEET INDEX
EXISTING BUILDING NORTH ELEVATION

SCALE: 1/16" = 1' - 0"

SHEET NO
A3.1.03

PHASE 1: SOUTH PARCEL

DEFYING GRAVITY

BIRDAIR

SPECIALTY CONTRACTING FOR TENSILE ARCHITECTURE

EXPECT THE EXTRAORDINARY

Tensile architectural structures delight the eye and capture the imagination. They often cover very long spans, rising and arching without inhibition, appearing to defy gravity.

Only tensile structural engineering, materials and construction methods offer such freedom of form to the architect. With that freedom comes the opportunity to achieve great architecture – sometimes startling, but always intriguing.

Birdair is the world's foremost tensile architecture specialty contractor. More than 1,200 Birdair-built tensile structures can be found in over 30 countries – in every climate – from arctic cold, to arid desert, to steamy tropics.

But the versatility of tensile architecture is best demonstrated through the infinite variety of uses in which it's employed. These extraordinary and often famous structures include stadiums, arenas, convention centers, amphitheatres, airports, shopping malls, entertainment centers, museums, science centers, hospitals, schools, offices and more.

Birdair was founded in 1956 by engineering pioneer Walter Bird. In 1992, the company became part of Japan's Taiyo Kogyo Group.

BIRDAIR IS A PROUD SUPPORTER OF:

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14-15 BUDGET DEVELOPMENT, COST ANALYSIS AND VALUE ENGINEERING, FINAL ENGINEERING

16-17 FABRICATION AND SUPPLY CHAIN MANAGEMENT

18-21 CONSTRUCTION

22 POST-INSTALLATION AND SERVICE

23 CLIENTS

MASTERS OF MEMBRANE

Throughout its history, Birdair has continually advanced the art and science of architectural fabric membrane – innovating architectural applications for membrane; devising new, more effective and efficient methods of fabricating, installing, and maintaining membrane; and engineering entirely new membrane systems and materials such as insulated Tensotherm membrane and fully recyclable and remarkably sustainable Kenafine membrane.

Birdair is master of the widest selection of membrane to cover virtually any application, any size project, and any given budget.

Research & Development

ETFE

Lightweight and transparent ETFE, or ethylene tetrafluoroethylene, film allows the creation of cutting-edge large span spatial architecture. ETFE, with appropriate reinforcement, is suitable for both tension and air-supported applications.

ePTFE High Translucency

ePTFE-coated high translucency fabric membrane is a beautifully foldable tensile material unmatched for its aesthetic capability and durability. This woven, non-flammable material can be spot welded or sewn. It uses a 100-percent fluoropolymer coating and can offer up to 40-percent light transmission, eliminating glare to allow broad illumination throughout a given interior space.

Kenafine

Kenafine is a translucent, moisture-resistant, biomass roofing membrane that can be fully recycled into paper products at the end of its life cycle. The fabric is made with fibers of Kenaf, a type of annual hibiscus herb that absorbs more carbon dioxide and grows more rapidly than regular plants and trees.

Silicone-Coated Glass Fiber

Silicone-coated glass fiber fabric is a durable, weather resistant and fire-tested silicone-coated material offering a wide variety of translucency levels and unlimited color selection.

PVC

PVC, or polyvinyl chloride, is a molecule comprised of carbon, hydrogen and chlorine that is available as a woven or non-woven material, providing a cost-effective alternative to conventional roofing systems.

PVC Mesh

PVC-coated (polyvinyl chloride) mesh is an exceptionally durable fabric membrane produced with polyester, fiberglass and other types of reinforcements. PVC-coated mesh is woven during fabrication, increasing tensile strength and design versatility while diminishing concerns about fabric compatibility and size.

PTFE

PTFE, or polytetrafluoroethylene, is a durable, weather- and fire-resistant Teflon®-coated woven fiberglass membrane, with a project life cycle exceeding 30 years.

Tensotherm™ with Nanogel®

Tensotherm with Nanogel offers the architectural beauty of PTFE tensile fabric membrane with the added benefit of a feather-light insulation layer known as Nanogel aerogel that traps air to prevent heat loss and solar heat gain.

TiO_2-Coated PTFE

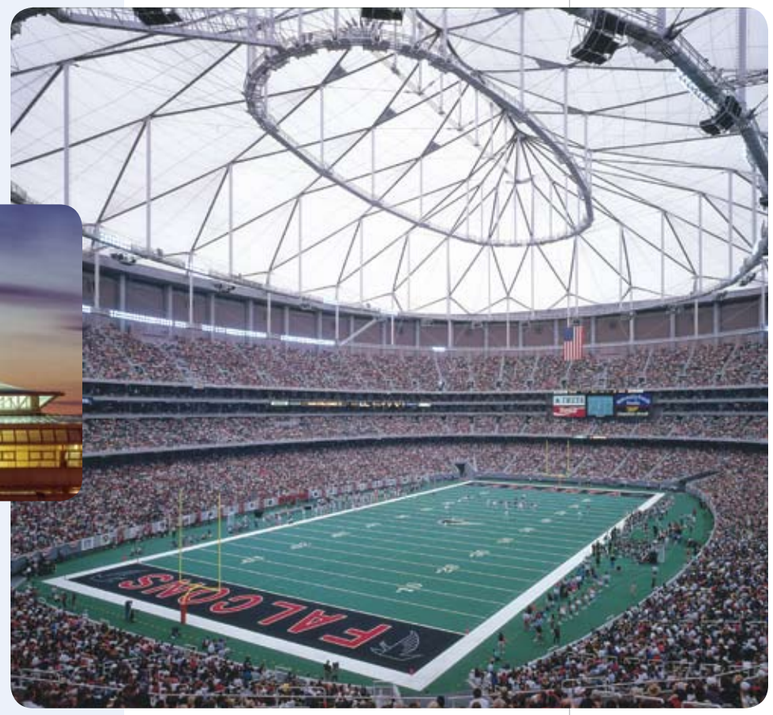
PTFE fiberglass coated with non-toxic and flame-resistant TiO_2 (titanium dioxide) produces a photocatalytic membrane that functions like the leaves of a tree, providing shade while actively neutralizing airborne pollutants.

PTFE Acoustical Liner

Translucent PTFE fiberglass acoustical liner membrane is used in conjunction with the exterior PTFE fiberglass membrane in order to achieve significant sound attenuation and reduce reverberation for a more perfect listening experience.

ATTENTION-GRABBING ECONOMICS

Birdair tensile architectural structures are the most economical way to achieve clearspan roofing enclosures of 150' (45m) or more, eliminating the need of interior columns, support foundations, and providing an overall light weight to support. Most tensile architecture projects are known for their signature rooflines made from millimeters thin membrane material. Flexible and smooth, Birdair membrane roofs are particularly well-suited for economically translating curvilinear designs into reality. Additionally, tensile architecture also offers other advantages:



- Provides the greatest degree of unobstructed interior space
- Optimizes sight lines and maximizes visibility – of utmost importance in stadiums and amphitheatres, for example
- Allows ample daylight to penetrate, reducing the need for artificial lighting and associated energy requirements for the space
- Permits usage in facade applications
- Produces an attractive soft glow through the roof membrane at night with interior lighting
- Membrane roofing system also double as interior ceiling
- Translucent insulated composite systems can provide daylighting while delivering insulation value consistent with built up roofing.
- Membrane can be TiO2-coated to help maintain a like-new appearance even in dirty or polluted environments, reducing maintenance costs
- Membrane liner and insulated systems can also provide sound-absorbing acoustical benefits
- Birdair offers ENERGY STAR, Cradle to Cradle and Cool Roof certified products

SUSTAINABLE AND FUNCTIONAL BY NATURE AND DESIGN

MATERIAL REDUCTION

Simply put, efficient building is green building. One of the most effective ways for an architect to achieve green design is to use less material. When a structure requires fewer materials, it wastes fewer materials.

The membrane, steel substructure, cables and clamping systems used in tensile architecture amount to a small fraction of the material consumed in creating the structure and building.

LONG LIFE-CYCLE AND RECYCLABILITY

The elements in a Birdair system also contribute to sustainable design by virtue of their reuse and recyclability. Steel, of course, is 100-percent recyclable and the steel used in fabrications produced for Birdair has a high percentage of recycled content. One new membrane material, made entirely of the Kenaf plant, is converted into paper at the end of its useful life as a roof or facade.

Membranes also last longer than conventional roof materials. Many of the oldest Birdair installations, dating back more than three decades, continue to look and perform beautifully today. Many professionals view PTFE fiberglass as the industry's next "forever" material.

Birdair roofs coated in TiO_2 (titanium dioxide) function like leaves on tree, not only providing shade but also actively neutralizing airborne pollutants and odors. Once neutralized, pollutants are washed off the membrane by rainfall, keeping the fabric clean and extending its vibrancy.

ENERGY EFFICIENCY

A membrane roof fabricated to Birdair specifications can save energy two ways. First, through its translucency, the roof allows daylight to flow into the space, reducing the requirement for artificial electrical lighting. Additionally, white membrane reflects heat back into the atmosphere. Birdair offers PTFE composites that can qualify for ENERGY STAR, Cradle to Cradle and Cool Roof Certification.

Birdair has also been instrumental in the innovation of Tensotherm™, a pre-engineered, highly efficient insulated translucent composite roofing system. Insulating Nanogel® aerogel* is the world's lightest solid material and the most efficient insulating material ever created. The result is a thin, translucent composite that delivers impressive insulation values.

* Nanogel® aerogel is a registered trademark of Cabot Corporation. Nanogel® aerogel is Cradle to Cradle certified. Cradle to Cradle (CM) is a certification mark of McDonough Braungart Design Chemistry (MBDC). Some PTFE membranes offered by Birdair have earned ENERGY STAR. Birdair roofs can achieve Cool Roof Rating Council certification.

TENSOTHERM™ INSULATED TRANSLUCENT MEMBRANE ROOFING SYSTEM

COMPREHENSIVE DESIGN-BUILD CONTRACTING SERVICES FROM CONCEPT TO COMPLETION

The complexity of tensile architecture flows from its nature as a precise blend of art, science, engineering, computer modeling and construction know-how. If you're considering tensile architecture, Birdair is the specialty contractor you want on your team from the start.

Birdair's full range of project delivery services – from design assistance to construction – ensures your project will be designed, engineered and built more quickly, more efficiently and more economically.

Most importantly, with Birdair on your design-build team, you have peace of mind. You know you've hired the first name in specialty contracting for custom tensile architecture with the longest history of experience and success in the business.

Experience proves that, when choosing Birdair, you will successfully achieve your next tensile architecture masterpiece.

BIRDAIR IS STRUCTURED BY DEPARTMENT TO PROVIDE OUTSTANDING FULL-SERVICE SPECIALTY CONTRACTING SERVICES

BUSINESS DEVELOPMENT
ENGINEERING
DESIGN & DETAILING
RESEARCH & DEVELOPMENT
ESTIMATING
FINANCE
PURCHASING
CONSTRUCTION
FABRICATION (PLANT)
PROJECT MANAGEMENT
QUALITY ASSURANCE & QUALITY CONTROL

DESIGN ASSIST

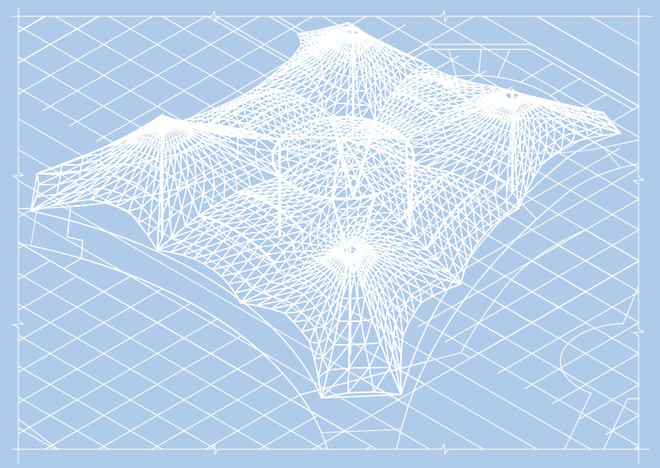
At the schematic design phase, Birdair Design Assist provides your design-build team with guidance and recommendations. Birdair helps you conceptualize form, geometry, scale, materials and structural support systems based on your design intent, budget and timeframe. Because tensile architecture is far more lightweight than traditional roof systems, a project's overall structural requirements are often significantly reduced. With Birdair Design Assist, your design-build team identifies and capitalizes on these reductions from the start.

DELIVERABLES

Feasibility Study
Preliminary Analysis
Pre-construction Budgeting
Scope Delineation
Schedule Feasibility

BIRDAIR RESOURCES

Business Development
Engineering



FEASIBILITY, ANALYSIS AND MODELING

Through Birdair Feasibility, Analysis and Modeling services, your project's form, geometry and materials begin to crystallize. Now, Birdair can begin to calculate reaction loads, determine methods for construction, perform any required testing and establish a preliminary schedule.

DELIVERABLES

Formal Analysis
Model Generation
Preliminary Reaction Loads
Construction Feasibility
Preliminary Construction Method Development
Materials Recommendations and
Applicability Testing
Preliminary Schedule Development

BIRDAIR RESOURCES

Business Development
Engineering
Research & Development
Estimating
Purchasing
Construction

BUDGET DEVELOPMENT, COST ANALYSIS AND VALUE ENGINEERING

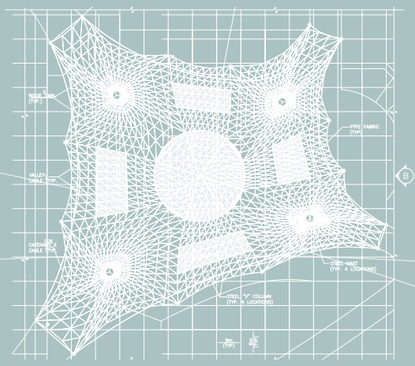
With 50-plus years of proven experience, Birdair is able to offer you Guaranteed Maximum Pricing contracts for complete construction of the largest tensile architectural projects worldwide.

DELIVERABLES

Proposal Development
GMP Proposals
Engineering Take-Off
Materials Confirmations
Supply Chain Engagement
Construction Methodology Confirmed
Proposal Schedule Confirmed

BIRDAIR RESOURCES

Pre-construction
Engineering
Estimating
Purchasing
Fabrication (Plant)
Project Management
Research & Development
Quality Assurance
Construction



FINAL ENGINEERING

Birdair details each component to be fabricated in-house or by a Birdair supplier. For a given project, these components may include steel support masts or compression rings, as well as an outside element barrier – be it fabric membrane, glass, or metal. Birdair also recommends all manufactured components such as cables, rods, fittings and clampings, and develops detailed methodologies for exactly how and when each component is to be installed on site.

DELIVERABLES

Formalize Submittal Drawings
and Patterning Details
Develop Final Reactions and Calculations
Construction Methodology
and Engineering Confirmed
Material Orders Confirmed
Finalize Fabrication and Associated Scheduling
Project Schedule Finalized

BIRDAIR RESOURCES

Engineering
Design & Detailing
Construction
Fabrication (Shop)
Project Management

FABRICATION AND SUPPLY CHAIN MANAGEMENT

Birdair Fabrication and Supply Chain Management assures that all materials required for your project are fabricated, manufactured, shipped and delivered to your job site according to precise specifications and timetables. Your project's membrane components are fabricated in the controlled environment of a Birdair 9001: 2008 ISO-certified facility. Here, fabric membrane is patterned, cut, welded, packaged, shipped, and many of the structural components, such as steel rods and cable, are pre-assembled. Birdair also maintains excellent relationships with qualified suppliers of tensile architecture building components, including fabric membrane, metal roofing, architectural mesh, and glass curtain wall, as well as structural steel masts and rings, cables, rods, fittings and clamps.

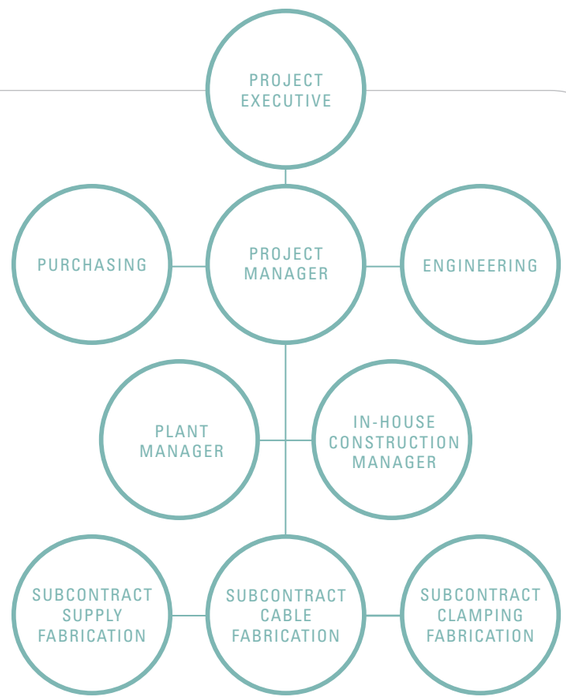
DELIVERABLES

Supply Chain Established and Coordinated
Material Schedules Confirmed
Final Detailing Completed and Released
Third-party Quality Assurance Testing
Fabrication Schedules Confirmed
Delivery Schedule Finalized

BIRDAIR RESOURCES

Engineering
Design & Detailing
Project Management
Purchasing
Fabrication (Shop)
Quality Assurance
Transportation & Logistics Coordination

SUPPLY CHAIN MANAGEMENT



CONSTRUCTION

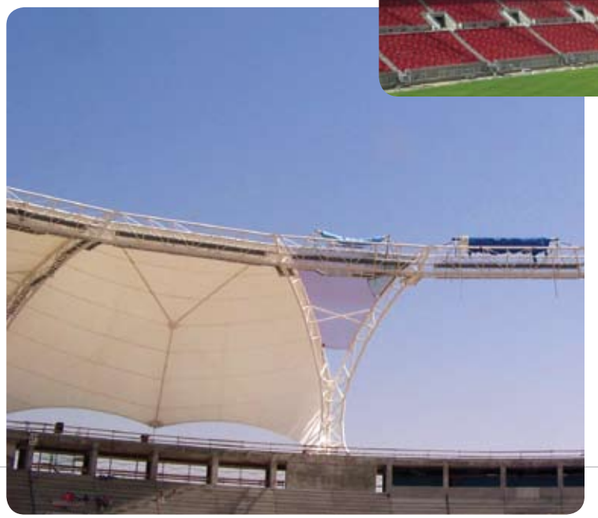
ESTABLISHED EXPERIENCE

Birdair – the original mega tension design-builders – founded many of the tensioning techniques used in modern tensile construction. For more than 50 years, Birdair has developed the art of tensile architecture, including hydraulics and tensioning equipment as well as specialty rigging.

More than 1,200 projects worldwide exemplify Birdair's custom engineering, craftsmanship and quality of work.

DELIVERABLES

Mobilization of Manpower and Equipment
Site Offices Established
Erection and Site Coordination Begins



CONSTRUCTION

INNOVATIVE EXPERTISE

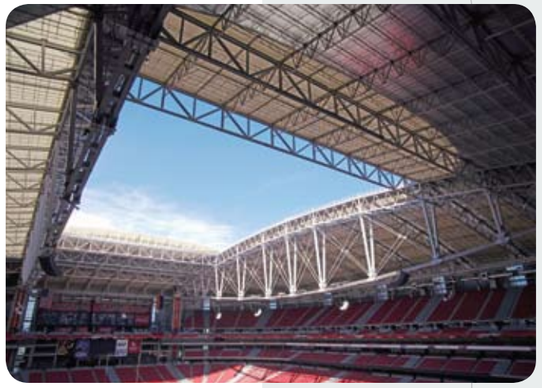
From the initial concept to project completion, Birdair is fluent in the science of construction. This versatility transcends blueprints, allowing execution of creative design using methods unique to each application. Birdair's scalable services can accommodate any project demands, no matter what size or scale.

BIRDAIR RESOURCES

Project Management
Construction
Engineering

POST-INSTALLATION AND SERVICE

Birdair boasts of an impressive roster of satisfied architects and owners who have achieved results surpassing the ordinary, both aesthetically and functionally. To keep their investments looking beautiful and functioning perfectly, Birdair offers service contracts for routine inspection, cleaning, and service if required.



"We wanted a material that would require simple periodic maintenance without time-intensive cleaning or repair. Birdair provided us with a structural fabric that meets those goals."

- John Drum, vice president of stadium operations for the Arizona Cardinals

"Our current Birdair roof has performed well beyond its expectations and has exceeded its lifespan. We made the decision to go with Birdair again a couple years ago when we foresaw that the roof would need to be replaced soon."

- Roy Saville, Radford University's director of facilities planning and construction

"I've been told by people that I broke the mold in U.S. sports architectural design. Working with Birdair's technical staff of design engineers helped me accomplish that."

- World-renowned architect Peter Eisenman regarding the University of Phoenix Stadium

BIRDAIR CLIENTS INCLUDE

Altoon + Porter Architects
Anschutz Entertainment Group
Arizona Sports & Tourism Authority
Arquitectonica
Arthur Erickson
Arup
Balfour Beatty Construction
Banca Mifel
Barton Malow Co.
Bay Area Rapid Transit District (BART)
BDP International
Bermello Ajamil & Partners
Bliss & Nyitray, Inc.
Bovis Lend Lease
Brasfield & Gorrie LLC
Buro Happold
Cambridge Seven Associates, Inc.
Cannon Design
Carter & Burgess, Inc.
City and County of Denver (CO)
City of Calgary (AB)
City of Palm Springs (CA)
Dar Al-Handasah
Del Castillo Márquez y Asociados
Dewhurst Macfarlane and Partners Inc.
E. Verner Johnson and Associates, Inc.
Eisenman Architects
Ellerbe Becket
EllisDon Corp.
Fentress Architects
Foster & Partners
FTL Design Engineering Studio
Geiger Engineers, P.C.
General Growth Properties, Inc.
Gensler
Georgia World Congress Center Authority
Gerkan, Marg and Partner
Gilbane Building Co.
Greater Orlando Aviation Authority
Grupo Arquitech
Grupo Aryba
Grupo Franco
Grupo GP
H-E-B
HDR, Inc.
Heery International
Hensel Phelps Construction Co.
Hillier
HKS, Inc.
HNTB Corp.
Hochtief AG
HOK
HOK Sport
Hornberger + Worstell, Inc.
Horst Berger
Hunt Construction Group
Interdiseños
Jacksonville Port Authority
Jerde Partnership International, Inc.
Kajima International
KMD Architects
KPFF Consulting Engineers
Liverpool
LMN Architects
Magnusson Klemencic Associates
Manhattan Construction Company
Martin & Martin
Metropolitan Transit Authority (Houston)
Metrorrey
Miami-Dade Aviation Department
Michael Hopkins + Partners
Murphy/Jahn Inc.
National Football League
National Park Service
NBBJ
New Jersey Sports & Exposition Authority
Nuevo Malecon Cancun
Palace Resorts
Palacio De Hierro
PCL Construction
Pei Cobb Freed & Partners Architects
Perini Corp.
Pittsburgh Sports & Exhibition Authority
Port Authority of New York & New Jersey
Radford University
Rafael Vinoly Architects PC
Raices En Promocion Sa De Cv
Raleigh-Durham Airport Authority
Richard Rogers Partnership
Rosser International, Inc.
Rossetti Associates
Rowan Williams Davies & Irwin
Royal Caribbean International
RTKL Associates, Inc.
San Diego Unified Port District
Schlaich Bergermann and Partner
Severud Associates
Simon Property Group
Skanska USA Building
Skidmore, Owings, & Merrill
SmithGroup, Inc.
Swinerton, Inc.
Syracuse University
The Clark Construction Group, Inc.
The Cordish Company
The Irvine Company
The Pyramid Companies
The Whiting - Turner Contracting Co.
Thompson, Ventulett, Stainback and Associates
Thornton Tomasetti
Tishman Speyer Properties
Turner Construction Company
U.S. Department of Defense
U.S. General Services Administration
Uni-Systems, LLC
VOA Associates Inc.
Walker Parking Consultants
Walt Disney Imagineering
Walter P. Moore and Associates, Inc.
Weidlinger Associates, Inc.
Werner Sobek
Zeidler Architects
Zimmer Gunsul Frasca Partnership

BIRDAIR LOOKS FORWARD TO WORKING WITH YOU.

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SPECIALTY CONTRACTING FOR TENSILE ARCHITECTURE

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Amherst, NY 14221 USA
Phone: 001.716.633.9500
Toll-Free: 1.800.622.2246
birdair.com

Design

Fabrication

Insulated Tensioned Membrane

Installation

Service

BIRDAIR

Tensile Architectural Structures

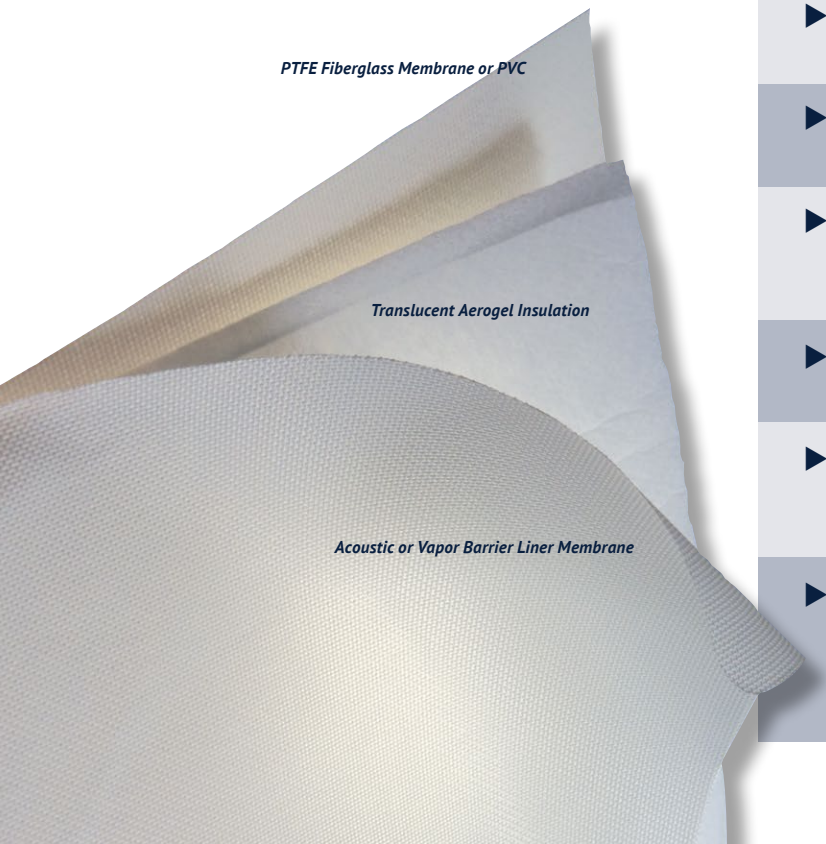
TENSOTHERM™

INSULATED TRANSLUCENT MEMBRANE ROOFING SYSTEM

Dedmon Center Basketball Arena
Radford, Virginia

System Description

Tensotherm™ is the world's first and only anticlastic and translucent insulated tensioned membrane system. To create Tensotherm, a thin translucent blanket, embedded with aerogel, is placed between a PTFE or PVC-coated fabric membrane exterior skin and a thinner and lighter acoustic or vapor barrier interior liner. The resulting composite material - Tensotherm - is a thin, flexible and highly translucent glazing system that provides extraordinary benefits.



Features and Benefits

- Enhances a tensioned membrane systems thermal, solar and acoustic capabilities while maintaining its translucent daylighting capability
- Provides diffused glare-free natural daylighting resulting in energy cost savings while creating a beautiful interior environment
- Reduces solar heat gain coefficient (SHGC) by at least 18.3% over non-insulated tensioned membrane systems
- Absorbs 70%[1] of broadband noise and reduces sound transmission up to 21 Db[2] and performs exceptionally in sound absorption at low frequencies
- Aerogel insulation maintains its performance characteristics for the entire 25-plus-year lifespan of the system
- Weighs normally 1lb/ft^2 ideal for small/mid-size to long-span applications
- Achieves up to a tenfold increase in thermal performance over a non-insulated tensioned membrane roof utilizing aerogel, the world's best and lightest insulating solid
- Retains design capabilities (i.e., non-rectilinear forms) of non-insulated tensioned membrane systems
- Hydrophobicity of aerogel insulation, combined with waterproof membranes, creates a continuous vapor barrier and mitigates problems associated with moisture
- Meets a return on investment (ROI) through energy and HVAC equipment savings within a five to 12 year timeframe, depending upon system specification, local climate and energy costs

[1] *per ASTM 423*
[2] *per ASTM E90*

Talisman Centre
Calgary, AB Canada

Tensotherm's Technical Performance

Performance Category	Blanket Thickness 8mm	16mm	24mm	Test Method
Thermal Performance				
U-Value (w/m2K)	1.16	0.76	0.56	ASTM C1363
R-Value ($ft^2°Fhr/Btu$)	4.90	7.50	10.10	ASHRAE 90.1
Solar Heat Gain Coefficient	5.30%	3.40%	2.30%	SHGC = T + (U/h) x A
Acoustic Performance				
Absorption ($Sabins/ft^2$)	0.55	0.69	0.73	ASTM C423
STC	18.0 dB	19.0 dB	21.0 dB	ASTM E90
Fire Performance	Class A	Class A	Class A	ASTM E84, ASTM E108, NFPA 701 DIN EN-13501-1 in accordance with EN 13823 EU Building Class B, S1
Visual Transmittance	4.3%	3.0%	2.2%	ASTM E424 Method B

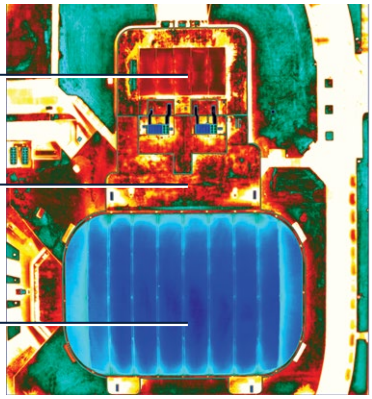
Note: *The values for 16mm Acoustical Absorption and Sound Transmission Class were measured in a laboratory. The 8mm and 24mm values were modeled based on the 16mm performance. The values also assume that the Tensotherm is used in a roof / ceiling configuration with the inner surface facing the interior of the structure and the outer surface facing outside the structure (no near field reflective surfaces behind the outside of the Tensotherm). For the basis of performance, the outer material is Sheerfill II-HT (PTFE) and the liner material is Fabrasorb 1A (PTFE).*

An aerial thermograph reveals Tensotherm's effective insulating capability.

Standard Tension Membrane: Outer & Liner
(1 foot gap, no insulation)

Traditional built-up roof

Tensotherm roof



Talisman Centre
Calgary, AB Canada

Who is Birdair?

Birdair is the leading specialty contractor for custom tensile membrane structures throughout the world.

With more than 50 years of experience, Birdair has worked with owners, architects, engineers and contractors to design and build custom tensile structures used to create innovative roofing systems, canopies and skylights. As a turn-key specialty contractor, Birdair provides preconstruction assistance; including design assistance, budgeting, construction methodologies and project schedule development. Our in-house capabilities consist of design, engineering, fabrication, installation and maintenance.

College Football Hall of Fame
Atlanta, GA

Working closely with architects and their clients, Birdair assists in delivering award-winning solutions by taking an idea and building an icon. Our work ranges from secure transportation terminals to sports venues and convention centers; from festive entertainment, performing arts facilities and museums to offices, hotels, resorts and visitor centers; from eye-catching retail complexes to walkways and porte-cocheres. To date, the company has completed more than 1,300 major installations in more than 30 countries, requiring over 30 million square feet of architectural fabric membrane.

Birdair is committed to the ongoing development of tensile architecture, working diligently to further promote the most modern technologies available and to continually innovate signature, high-quality designs.

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MakMax

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Tensile Architectural Structures