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February 26, 2014

Sam Dunn
MV Bowl LLC
455 State Rd, PMB 108
Vineyard Haven, MA 02568

Subject: Oak Bluffs Bowling Alley – Sound Control

Dear Sam,
At your request, I have reviewed the site plan and drawings for the proposed bowling alley in Oak Bluffs. The proposed new building would be just a few feet from the west property line, and the adjacent properties to the west are existing houses. This letter presents my analysis and recommendations to minimize bowling and other sounds transmitted through the walls of the building.

Sound Sources
The sound sources anticipated are those inherent with a public bowling facility. Bowling balls impacting pins, the clatter of pins falling, cheers from the bowling group. All of these are transient sounds of short duration. This will be a small facility, with just 10 lanes, so there will be fewer of these sounds, compared with large bowling alleys with 30 or more lanes.

The parking lot will be at the south end of the building. An existing fence plus landscaping will help screen activity sound in the parking lot from the nearby homes.

Design Goal
The design goal is to contain the activity noise from the bowling alley (and the rest of the facility) so that the associated sounds are all but inaudible at the adjacent houses. In this context, I mean that the loudest bowling sounds may be audible when the ambient sound is very quiet – i.e. no traffic noise, no wind noise, no residential air conditioning units running. This is consistent with the Oak Bluffs noise regulation which prohibits noise that creates a nuisance. Audibility of new sounds depends on the background sound, which I assume to be quiet in this area. It is impossible to guarantee zero audibility, but with good sound isolation design the audibility can be minimized.

Room Acoustics
Room dimensions and finish materials make a difference in the sound attenuation within the bowling alley. Sound is loudest at the pins, and attenuates with distance. Measurements at

other bowling alleys show a 20 decibel difference between the pinsetting area and the bowler's area.

In the current design, the bowling alley will have exposed structure with a shallow cathedral ceiling. The inside surface of the roof will be finished with glass fiber insulation with a vinyl facing. This surface is highly sound absorptive in spite of the vinyl facing. There are many sports and tennis buildings with this interior finish and they are not reverberant even though they have large volumes and no acoustic materials other than the vinyl faced insulation. I expect the vinyl faced insulation will provide good control of noise within the bowling alley. This means that sound will attenuate with distance inside the bowling alley. Sound at the foul line will be less than at the pins, sound from pins at the north alleys will be less then sound from the alleys close to the south wall, and sound at the ceiling will be less than sound at the wall.

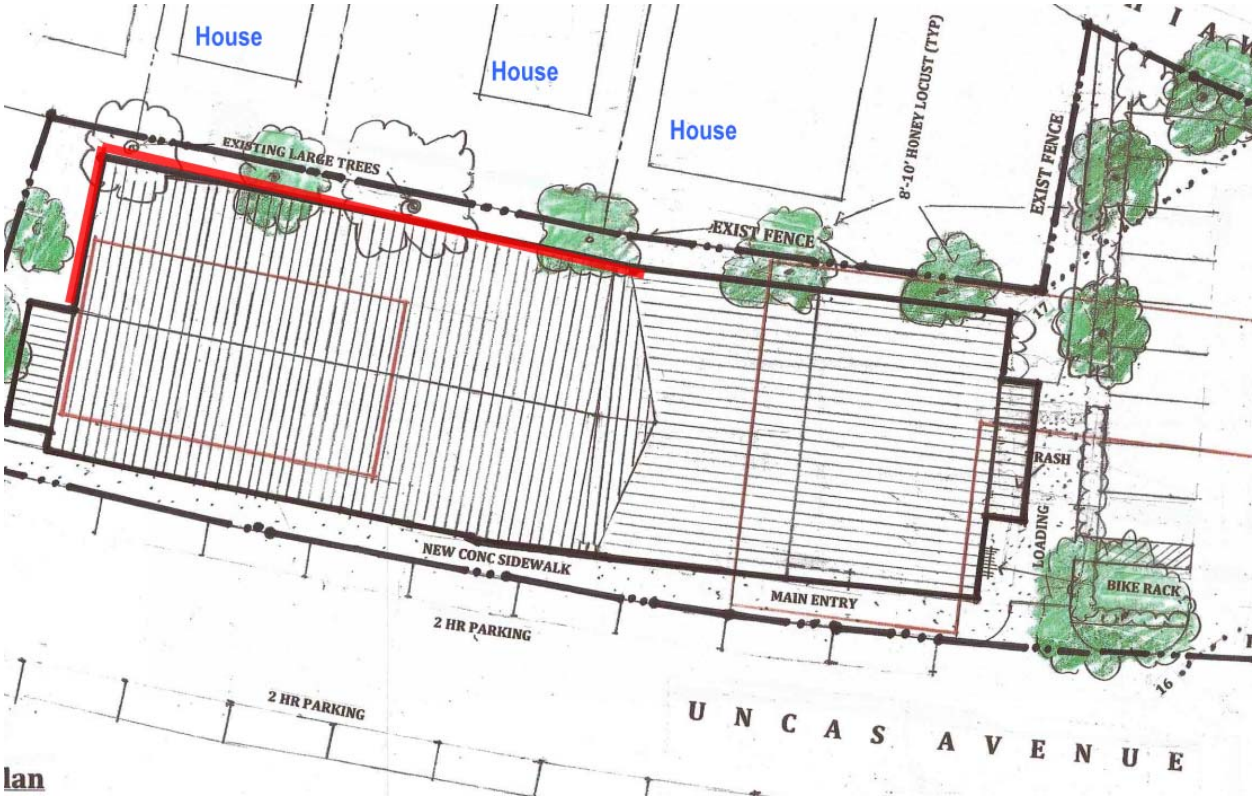
Curtainwall

Another feature that helps with sound isolation is the "curtainwall". The curtainwall is a full height partition at the end of the alleys, just in front of the pins. The purpose of the curtainwall is to screen the pinsetting machines from view. Even though this wall has openings for each set of pins, it will help contain the sound from the pins.

Recommendations

I recommend upgrading the standard construction to improve sound isolation. This includes upgrading the south and east walls, and part of the south side of the bowling alley roof. The figure below is a markup of your site plan. The red line denotes areas of the exterior walls that should be upgraded for sound isolation.

Site



Site Plan showing areas for special exterior wall detail

Exterior Wall Detail

From our discussions, your basic exterior wall is based on 2”x6” wood studs with 6 inch fiber insulation in the cavity. Normally there would be one layer of gypsum on the inside and plywood sheathing plus siding on the exterior. The sound isolation rating for this standard wall assembly would be in the range of STC 40.

I recommend adding a resilient clip system plus additional gypsum layers for sound isolation. The figure below shows an assembly that provides STC 62 which is excellent. Your assembly will be comparable to the assembly in the figure below, because on the exterior you will have plywood sheathing plus one layer of gypsum, and siding. The Hardie Plank (concrete panels) siding you plan to use is equivalent to a 5/8 inch layer of gypsum. Both have a surface mass of 2.25-2.5 lbs per square foot.

CONSTRUCTION
* 2 Layers 5/8" Gypsum
* 7/8" x 25 guage furring Channel @ 24" o.c.
* RSIC-1® clips at 48" o.c.
* 2x4 wood studs @ 16" o.c.
* 6" unfaced fiberglass insulation cavity fully filled
* 2 Layers 5/8" Gypsum
* Test Number TL01-211 RAL
* UL U301, U305, U309, U311, U331, U334

Diagram and description of recommended exterior wall construction

Roof

The roof as it is currently planned will consist of corrugated steel roof deck with 6 inch glass fiber insulation on the inside. Above the roof there will be several inches of foam insulation plus a roof membrane. There is limited data available for sound isolation of roofs. I estimate your standard assembly at STC 40 based on the layers and their respective weights. The roof does not need the same level of performance as the walls, because there is more distance from the pins.

The loudest sounds will occur at the pins, behind the curtainwall (the curtainwall is described above, in the section titled “curtainwall”. I would suggest adding a gypsum board ceiling above the pinset area behind the curtainwall. This ceiling should have a sound absorbing finish. I anticipate you would structure the ceiling with wood joists and build a plywood floor on top of the joists to create a storage mezzanine above the pinset area. The ceiling and wood deck will stop sound from reaching the roof in that area. The estimated STC rating for the ceiling and roof combination is 60.

The STC rating of the remainder of the southern half of the roof assembly needs to be improved. I recommend adding one layer of exterior gypsum sheathing product to the south pitch of the roof above the bowling alley. The estimated sound isolation rating with the gypsum layer is STC 43. The extra gypsum layer in the roof is not necessary above the pinset area if the ceiling is installed in that area.

I look forward to working with you to develop this design in more detail.

Sincerely,

Sincerely,

CAVANAUGH TOCCI ASSOCIATES, INC.

Timothy J. Foulkes