July 17, 2019

6611 Shepherdsville Road Proposed Warehouse Development

Heavy Truck Reverse Warning Noise Evaluation for Adjacent Residents

Prepared by:
HMB Professional Engineers, Inc.

Prepared for:
Land Design & Development, on behalf of Core 5 Industrial Partners

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1 – PROJECT INTRODUCTION

1.1 PROJECT DESCRIPTION

CORE 5 Industrial Partners (CORE5) is proposing to redevelop the Southern Sports Recreation Center site comprised mainly of a driving range and parking lot. The redevelopment would involve site preparation and the construction of an approximate 270,000 square foot warehouse facility with office space and loading bays. A project site map of the proposed facility is shown in Figure 1.

At the request of Land Design & Development (LD&D) and CORE5, HMB Professional Engineers, Inc. evaluated the potential impacts to the nearby residents located along the southern edge of the property, along Ye Old Post Road. This analysis was conducted to evaluate the potential noise levels from the truck reverse warning beepers on those residents. This report summarizes the evaluation methodology and results and utilizes known specifications and comparative data to calculate the anticipated potential sound levels for the residents adjacent to the proposed development.

1.2 EXISTING NOISE ENVIRONMENT

The noise environment in the vicinity of the proposed facility and the residences is generally comprised of highway traffic noise (from Shepherdsville Road carrying 26,000 AADT with 15% Trucks), commercial and industrial activities, a rail line, a driving range and localized noise sources, including local traffic and residential noise generators (e.g. A/C compressors, conversations and lawn mowers).

The purpose of this evaluation was to determine whether the sound generated from high decibel (dB) truck reverse warning beepers would adversely impact the sound levels of residences located in the adjacent Whispering Hills Apartments.

The closest residential units and residences along Ye Old Post Road are 95 feet from the proposed facility, measuring from the closest point of the residences to the closest point of the proposed facility where trucks would begin backing maneuvers to the loading bays.

These locations and distances are shown in Figure 1.

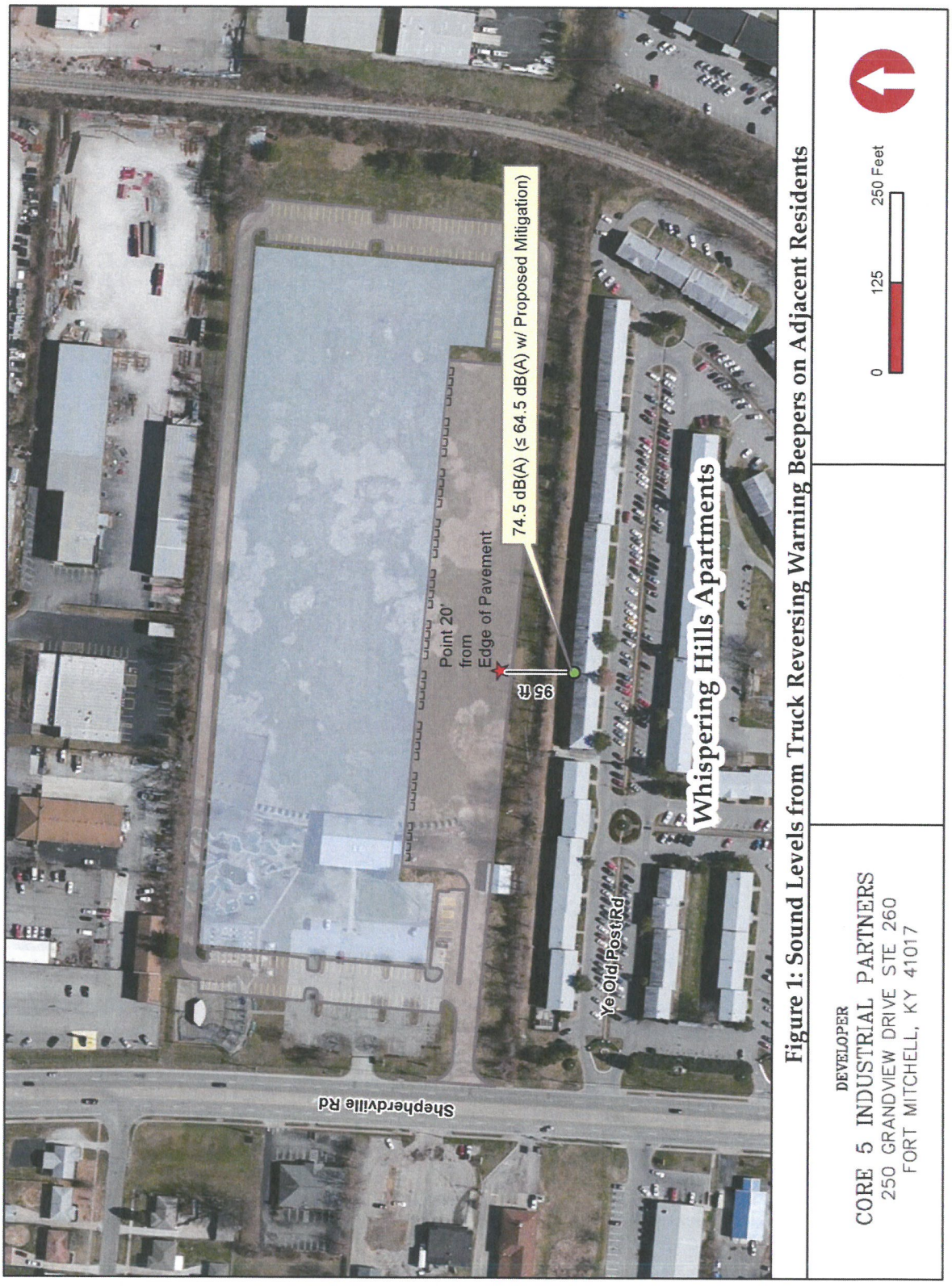

Figure 1: Sound Levels from Truck Reversing Warning Beepers on Adjacent Residents

DEVELOPER
CORE 5 INDUSTRIAL PARTNERS
250 GRANDVIEW DRIVE STE 260
FORT MITCHELL, KY 41017

CHAPTER 2 – METHODOLOGY AND RESULTS

2.1 QUANTITATIVE ASSESSMENT OF THE SOUND LEVELS AT NEARBY RESIDENTS FROM TRUCK REVERSING OPERATIONS

To assess the sound levels generated at the apartments by the truck reversing beepers, the specifications for reversing beepers was found and the measurement standards were identified to qualify the generated levels from the beepers.

Specifications indicate that on-road beepers range from 97dBA to 102dBA depending on the manufacturer. For the purposes of this evaluation, and to express a worst-case condition for the adjacent residents, 102dBA was used in all calculations. The manufacturer specifications indicate that this level (102dBA) is generated at 1.2 meters, or approximately 4 feet.

Based on this data from the source sound, the sound level at the residents was calculated.

The sound pressure Level (L) falls inversely proportional to the distance (1/r) from the noise source. Sound pressure levels decrease by (-)6dBA for each doubling of the distance from the source. Formula 1 expresses the sound level (L2) at a projected, evaluative distance based on a known sound level (L1) at a reference distance. Based on the above specifications the beepers emit 102dBA at a reference distance of 4 feet.

$$L_2 = L_1 + [20 \times \log (r_1/r_2)]$$

r_1 = reference distance, r_2 = at measured distance

Formula 1

This expression was used to determine a calculated sound pressure level that would be attributable to the reversing beepers at the closest residence, again representing the worst-case level. The distance to the closest residents was measured in GIS software and begins 20 feet of the edge of pavement in the truck loading/unloading area to account for the space necessary for large truck backing operations.

The data for beepers and the calculated sound pressure level attributable to these devices at the nearest residences are given in Table 1.

Table 1. Source and Calculated Sound Levels for Truck Reversing Beepers

LOCATION	DISTANCE (FT)	NOISE LEVEL (DBA)
Reference Point	4	102
Closest Residence	95	74.5

To provide a reference for the measured and calculated sound levels, a range of common sounds and their associated levels is included here.

- 40dB equates to an average home living room, library;
- 44dB equates to bird calls;
- 42-56dB equates to a suburban residential area;
- 50dB equates to an average office, soft music, or quiet suburban area;
- 60db equates to normal conversational speech;
- 70-80dB equates to a highway at 50 feet;
- 85dB equates to heavy traffic (including large trucks), a noisy restaurant;
- 90dB equates to a passing motorcycle at close range; and
- 110-120dB equates to a rock concert.

2.2 QUANTITATIVE NOISE ASSESSMENT SUMMARY

The noise evaluation of the truck reversing beepers on nearby residents indicates that the 102dBA generated by the warning devices would still be at a level of 74.5dBA at the closest residents.

While sound pressure level measurements are a quantifiable number utilizing sound pressure level meters and acoustic equations, noise loudness is a perceived or "feeling" measure. Scientific research indicates that a doubling of the loudness feeling is obtained with an increase of about 6-10dBA.[1] Research has also shown that a sound level increase of 3dBA is "barely perceptible" to the human ear.[2]

The Federal Highway Administration (FHWA) considers a roadway to have an impact on adjacent residents if the sound level at the residents exceeds 65dBA. As outlined previously, general human conversation is in the range of 60dBA and noise generators of greater than 65dBA can impede on outdoor human use.

Based on the calculations, the noise generated from the warning beepers would create impactful noise levels for the worst-case conditions.

Importantly, these are exterior evaluations at the single closest resident to the proposed facility and calculated from the closest point of truck backing operations. All other residences at distances from backing would experience lower levels than those presented here. It should also be noted that interior noise levels would be approximately 15-20dBA lower than these exterior levels based on the construction of the residential structures. Meaning, the perception of sound significantly decreases inside the residences.

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[1] Richard M. Warren, "Elimination of Biases in Loudness Judgments for Tones", 1970, Journal of the Acoust. Soc. Am. Volume 48, Issue 6B, pp. 1397 - 1403 and Richard M. Warren, "Quantification of Loudness", 1973, American Journal of Psychology, Vol 86 (4), pp. 807 - 825

John G. Neuhoff, "An adaptive bias in the perception of looming auditory motion", 2001, Ecological Psychology 13 (2) pp. 87 - 110 and John G. Neuhoff, "Perceptual Bias for Rising Tones", 1998, Nature, Volume 395, 10 September

[2] https://www.fhwa.dot.gov/environMent/noise/regulations_and_guidance/polguide/polguide02.cfm

Quantitative analysis of the warning beepers in operation at the facility has demonstrated that, from an acoustic perspective, the implementation of the project would not have an impact on the sound levels for residents adjacent to the facility.

2.3 PROPOSED MITIGATION FOR SOUND LEVELS

Section 2.2 identified that the sound levels from the reversing beepers would be impactful to the adjacent residents. To account for this impact the project team has implemented design features as mitigation measures for this sound impact.

The developers of the proposed facility have incorporated a combination berm/fence along the southern boundary of the property between the facility and the adjacent residences in Whispering Hills Apartments. This combination will be at least 10 feet in height and create a visual barrier to the truck operations, breaking line-of-sight between the residents and the backing trucks.

Based on measurements taken along high-volume roadways, and the modeling of sound barriers, breaking the line-of-sight between a noise source and receptor will decrease the sound level by 5dBA. Based on this criterion, the implementation of the combination berm/fence should reduce the sound level generated by the reversing beeper from 74.5dBA to 69.5dBA.

This level, 69.5dBA, would still be considered intrusive on the outdoor uses for the adjacent residents. Based on this evaluation, the project team proposed the implementation of a sound blocking material to be installed on the fence to further reduce the sound levels. The chosen product is AcoustiFence, a material produced by Acoustiblok. Acoustifence is a heavy-mineral filled viscoelastic acoustical material that is utilized on constructed fences to reduce exterior noise and has been implemented for projects like the proposed facility to reduce the noise levels transmitted to adjacent land uses.

The specifications sheet from the manufacturer indicate that it is effective at both low frequencies and high frequencies. The manufacturer specifications indicate that the material will provide a minimum sound attenuation of 24dBA at 100Hz and 16dBA at 40Hz. This indicates that the material, while effective at low frequencies, is more effective at higher frequencies. The manufacturer specification sheet is included in Appendix A of this evaluation.

While the manufacturer claims between 16dBA and 24dBA of noise reduction, if we assume that the material contributes 5dBA of additional reduction to the berm/fence barrier, then the total berm/fence/acoustifence sound barrier would attenuate the sound from the reversing beepers by 10dBA. This would result in a level of 64.5 at the adjacent residents and therefore should not create a meaningful impact to the outdoor sound levels for these residents.

Appendix A

Specification Data

Acoustiblok® quieting the world

Product Data Sheet

Product Name

AcoustiFence® Noise Reducing Fences

For Manufacturer Info:

Contact:
Acoustiblok, Inc.
6900 Interbay Boulevard
Tampa, FL 33616
Call - (813) 980-1400
Fax - (813) 549-2653
Email - sales@acoustiblok.com
www.acoustiblok.com

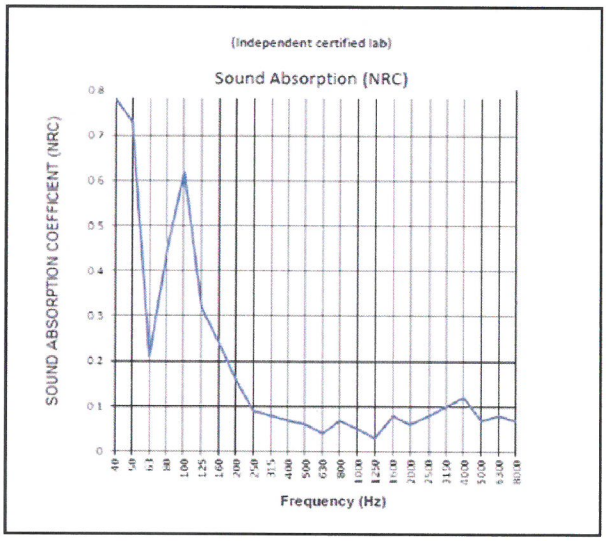
Product Description

Basic Use

AcoustiFence was originally developed by Acoustiblok, Inc. for noise isolation on offshore oil rigs, but has since proven successful in many other demanding outdoor settings, such as construction sites, commercial/industrial facilities, and residential communities.

AcoustiFence Noise Reducing Fences

AcoustiFence is a unique, heavy-mineral filled, barium free, viscoelastic acoustical material that is made in the U.S.A. Unlike fences or shrubs, this material does extraordinarily well in blocking direct sound, and a unique characteristic of the material sets it apart from other sound barriers when dealing with very low frequencies.



Sound Absorption Test Results

Benefits:

- Effectively reduces exterior noise
- Easy to install
- Resistant to UV, dirt and water
- Resistant to corrosion, mold and mildew

Acoustiblok® quieting the world

Product Data Sheet

Product Name

AcoustiFence® Noise Reducing Fences

AcoustiFence Noise Reducing Fences continued...

In frequencies of 50Hz and below, the heavy limp AcoustiFence material actually begins to vibrate from low frequency sound waves. In essence it is transforming these low frequency sound waves into mechanical movement and internal friction energy. Laboratory tests indicate that this transformation process inhibits these lower frequencies from penetrating AcoustiFence, reducing their level by over 60 percent relative to the human ear. In addition, AcoustiFence becomes an absorbent material in these frequencies with test results show an NRC (noise reduction coefficient) as high as 0.78 (with 1.00 being the max). As such it is clear that AcoustiFence not only reduces sound as a barrier, but also acts as an acoustical absorbent material in very low frequencies, as opposed to reflecting those frequencies back like most other barriers. It is worth noting that lead sheets (which are toxic) work in the same manner.

Green AcoustiFence

One of Acoustiblok's most popular products, designed as an advanced sound barrier that easily attaches to most types of fencing, is now available in a new green shade that easily blends into the environment. This makes it ideal for landscaping projects, residential home use and any outdoor applications where blending into the natural foliage is a concern.

Green AcoustiFence has the same sound deadening properties and features as our original black AcoustiFence. In addition, this new version features advanced reinforced edging and stainless steel cable ties. Made and sourced in the USA, It comes in 6x30 foot sections and is one of the most effective first steps in reducing noise for industrial, commercial and residential projects.

Acoustiblok® quieting the world

Product Data Sheet

Product Name

AcoustiFence® Noise Reducing Fences

Sound Transmission Class (STC)

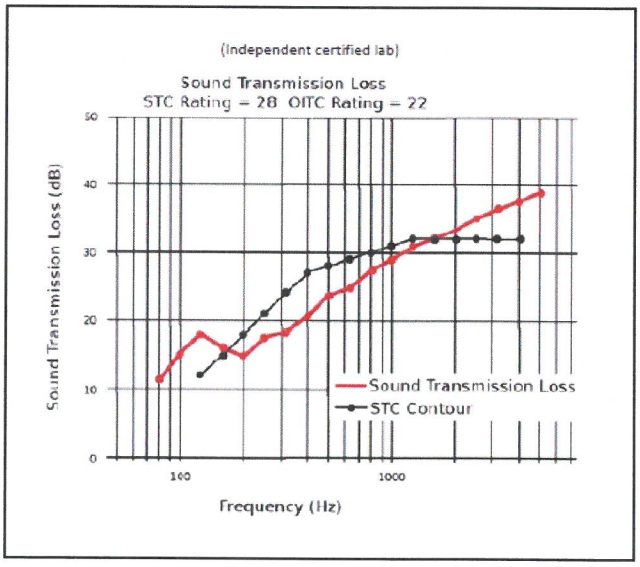
Sound Transmission Class (STC) is a single number that represents the sound blocking capacity of a partition such as a wall or ceiling.

STC numbers are often called out in architectural specifications, to assure that partitions will reduce noise levels adequately. For performance similar to laboratory test numbers, it is necessary to adhere closely to the construction materials and techniques used in the tested partition.

STC is calculated by comparing the actual sound loss measured when 18 test frequencies pass through a partition, with fixed values for each STC level. The highest STC curve that the measured sound loss numbers fit under, determines the STC rating of the partition.

STC calculations emphasize sound frequencies that match the human voice. A high STC partition will block the sound of human speech and block noise that interferes with human speech. To estimate high and low frequency performance, consult the Sound Transmission Loss graph included in STC test reports. Impact Insulation Class (IIC) measure transmitted impact noise and are specified for floor-ceiling assemblies only.

Acoustical test reports for numerous wall and floor/ceiling designs are available from Acoustiblok on request. All our test data is taken directly from independent 3rd party laboratories under NVLAP certification.



Sound Transmission Loss Test Results

Acoustiblok® quieting the world

Product Data Sheet

Product Name

AcoustiFence® Noise Reducing Fences

Physical Properties

- Barium free
- Minimum STC 28 per ASTM E90-02 & ASTM E413-87
- Minimum sound attenuation 24 dBA @ 100Hz & 16dBA @ 40Hz
- Size - 6 ft.(1.83m) x 30 ft.(9.14m) x 0.125 in. (.3mm) – 180 ft² (16.83m²)
- Color - black or green
- High UV resistance
- Heat tolerance: 200°F (93°C) for 7 days, less than 1% shrinkage with no deformation.
- Freezes at -40°F (-40°C). Do not unroll or flex frozen material. Properties not affected by freeze/thaw cycles.
- No fungal or algal growth and no visible disfigurement, per ASTM D3273 and ASTM D3274 (rating=10)
- Tensile Strength - min. 510 PSI
- Weight per section: 185 lbs. (84Kg)

Material Specifications – Part # "Acoustifence 6x30 Industrial"

Acoustical Rating	STC 28 / OITC 22
Size	6 ft. (1.83m) x 30 ft. (9. 14m) x 0.125 in .(3mm) 180 ft² (16.72m²)
Weight	185 lbs. (84Kg)
Fastening	Black brass grommets every 6 in. (152mm) along top edge with four grommets spaced along the bottom edge. Commonly installed horizontally.
Color	Black
(This is an industrial product and minor surface blemishes are a possibility.)	

Acoustiblok® quieting the world

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Tampa, Florida USA 33616
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www.Acoustiblok.com
sales@acoustiblok.com

Uniclass	EPIC
L68161:P7113	F852:X724
Ln6	(P2)

Acoustiblok® sound insulation

Acoustiblok UK Limited

AcoustiFence® Acoustic Perimeter Barrier Membrane

***AcoustiFence* is an economical way to reduce outdoor noise. It is hung via grommets onto the top line of existing chain link, panel, security or support pole fencing systems. *AcoustiFence* uses a toughened revolutionary sound deadening material which is only 3mm thick.**

GENERAL

Introduction ***AcoustiFence*** was originally developed by Acoustiblok for use on offshore oil rigs and has had proven success in demanding environments. It is now used where an economical straight line attenuation sound barrier is required.

Applications ***AcoustiFence*** can be hung in multiple sections and overlapped to reach the desired overall height and length.

Unlike open space fences or shrubs, this material does extraordinarily well in not only blocking sound, but also in reducing sound reflection, thus preventing increased reverberation time, vibration and urban resonance in the near and far fields.

Authority ***AcoustiFence*** is UL approved and has attained an STC (Sound Transmission Class) of 28 dBA in independent laboratory tests; this represents to the human ear a reduction of over 80%.

DESCRIPTION

AcoustiFence is a reinforced, noise isolating, mineral filled material that is flexible. Easily cut and shaped with a craft knife, it may be installed by nailing, stapling or glueing.

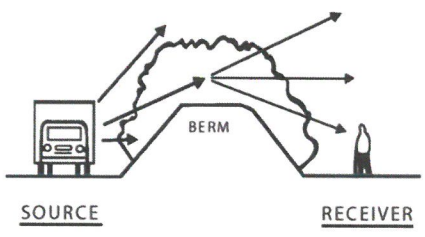
Composition, manufacture ***AcoustiFence*** is formed from pressed polyvinyl and is available with grommets along all edges for ease of installation.

Accessories include high strength securing ties and fire-rated acoustic sealant and caulk for joints.

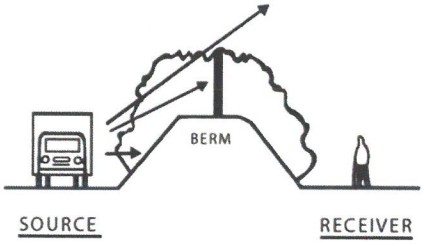
Dimensions, weight are shown in the table overleaf.

Appearance is black but is paintable with specific PVC / latex vinyl based treatments.

- STC 28dB Independent lab certified
- Easy to install or remove and reuse
- Paintable
- Totally non-mould (rated 10 from 10)
- Impermeable to water and easily washed
- UV Tolerant
- Made from over 90% recycled or organic material
- 100% recyclable
- Vermin Proof



Acoustical Scattering



Acoustifence Controls

Acoustiblok UK Ltd
AcoustiFence Acoustic Perimeter Barrier Membrane

Dimensions, weight *AcoustiFence*

Thickness (mm)	Weight (kg/m2)	Roll: width (m)	length (m)
3 + 0.75	4.78	1.82	9.14

PERFORMANCE

Fire Material has been tested to BS 476: Part 7 and UL classified.

Liquids The material is impervious to water or any form of moisture.

Biological ***AcoustiFence*** is proof against mildew growth.

Heat It may be used in temperatures up to 93°C.

Light ***AcoustiFence*** is resistant to UV light.

Sound *AcoustiFence* reduces sound transmission over a range of frequencies including those under 100 Hz. Typically, it exhibits a transmission loss of 19 dB at 100 Hz.

Sound reduction index (SRI): 3 mm AcoustiFence provides an SRI of 29 dB

Electrical *AcoustiFence* has high electrical resistance.

Compatibility *AcoustiFence* can be used with all common building materials.

SITEWORK

Health and safety ***AcoustiFence*** is non-hazardous as defined in 29 CFR 1910, 1200. Skin that comes into contact with molten material should be immediately immersed in cold, running water until cooled before removal of the material is attempted.

Handling and storage Note should be made when handling the material of its comparatively high weight. It should be stored in a sprinklered warehouse at a temperature below 60°C.

Cutting **AcoustiFence** can be cut with normal hand tools.

Installation The following methods of installation are available: attaching to existing fencing systems - including post and rail, panel, chain link and security.
Securing ties or screws and collars can be fixed through the grommets.

SUPPLY

All products are supplied direct from the company.

***AcoustiFence* installation details**

AcoustiFence *can be attached directly to standard security chain link fencing with cable ties through the grommets.*

AcoustiFence *installed as a perimeter screen to attenuate road and rail noise propagation.*

AcoustiFence *can be attached to various existing fencing solutions from standard panel or post and rail systems. This can be incorporated either as an internal or external skin.*

AcoustiFence *attached onto a perimeter fence on top of an earth bund or siding.*

SERVICES

The company provides the following services to specifiers:
- supply only
- technical advice
- site visit, acoustic survey feasibility study and specification report
- consultancy, working alongside sub-contractors, builders and maintenance teams

REFERENCES

Information on acoustic underlays, tapes and caulk is available from the company.
Information on UL certification is available:
- directly from the company's website, or
- from www.ul.com using classification file number R21490.

Acoustiblok UK Limited

Tel: 01622 840289
Fax: 0844 779 2422
Email: info@acoustiblok.co.uk
Website: www.acoustiblok.co.uk

Appendix B

Study Author Resume

Resume

Mitch Green

Noise Specialist

Introduction

Mitch has developed technical, field survey and NEPA expertise across a range of disciplines. Mitch has been the principal author for NEPA decision documents, ranging from Categorical Exclusions to Environmental Impact Statements. He has performed both air quality and highway traffic noise baseline reports, including the noise modeling for several constructed barriers in Louisville. His noise experience includes highway traffic noise analyses, including barrier evaluations, for major projects in Kentucky and Indiana. These include the Louisville-Southern Indiana Ohio River Bridges Project and most recently completed an evaluation of noise barrier feasibility for the I-69 Ohio River Crossing (ORX) Project. He has performed noise analyses for development projects to assess the effects of development on residential properties including a recent study for TopGolf at Oxmoor center.#

Related Experience

Type II Noise Walls, Jefferson County, KY
Mitch has performed noise analyses and evaluated structural noise barriers for a number of locations along Interstate Routes in Jefferson County. These studies identified existing sound levels through field measurements and predicted attenuation form the construction of structural noise barriers. Several of these noise barriers have been constructed along I-64, I-264 and I-265.

TopGolf Oxmoor: Jefferson County, KY
On this project, HMB provided an assessment of the potential noise impacts on nearby residents from the proposed TopGolf facility at Oxmoor Center. This study incorporated site specific field measurements of ambient noise and projected noise levels at residential receptors that included TopGolf in operation based on real-world measurements from an operational TopGolf.

Louisville-Southern Indiana Ohio River Bridge Project: Jefferson County, KY & Clark County, IN
Environmental Analyst, 2001-Present
Mitch has performed noise and air quality analyses covering all preliminary alternatives, including barrier cost-effectiveness analyses. As part of the GEC project management team he provides environmental review for all noise related assessments and mitigation. He updated the air quality documentation, including analyses for carbon monoxide, particulate matter and mobile source air toxics.

KYTC Statewide Environmental Services: Statewide, KY
Mitch has served as a Project Manager for projects awarded under the KYTC Statewide Environmental Services contract the last two times it has been awarded and has performed services under these contracts for 13 years. Work performed on these contracts keeps Mitch "plugged in" to what KYTC and DEA need to deliver projects and what the regulatory agencies need to approve KYTC actions.

Personal Background

Years of Experience
20 Years

Education
MS, Chemistry,
Washington State University
BS, Chemistry,
University of Kentucky

Professional Development

- KYTC Project Manager Bootcamp Express
- Advanced Seminar on Transportation Project Development: Navigating NEPA Maze/NHI
- Fundamentals of Title VI/Environmental Justice NHI
- Plan Development Process/GDOT
- Rosgen Natural Channel Design Levels I9IV
- OH DOT/Managing the Environmental & Project Development: Process/ Two-week NEPA
- KYTC & KEC: NEPA Thinking Beyond the Pavement - Workshop on Context Sensitive Design
- ODOT Section 106/ National Register Eligibility Training
- ODOT Section 4(f) Training
- Traffic Noise Modeling
- Mobile Source Air Quality Modeling
- US Army Corps & Wetland Delineation Mgmt.
- MOVES Training
- NEPA & INDOT Decision Making Process