MEMORANDUM

Planning & Engineering Department

Date: March 14, 2013
Subject: Noise Attenuation Analysis of Main Street East Zoning and CMC
To: Larry Gross, CMC Capitol City Steel
Barney Cruz, CMC Capitol City Steel
David Putman, Aquila Commercial
From: Chance Sparks, AICP, CNUa, Director of Planning
Cc:

This memo, updated from a prior version sent February 15th, is in regards to possible noise attenuation methods related to Mr. Putman's request for MFR zoning adjacent to CMC. In particular, the memo discusses measured noise levels emanating from CMC, the effectiveness of a pre-cast cement wall and vegetative barrier in attenuating the noise, and structural attenuation measures for the residential buildings. A figure is attached depicting all measurements and attenuations.

Existing Noise Levels Emanating from CMC

The primary measure of noise is the decibel (dB), which is a logarithmic scale of measurement that displays the value of a physical quantity using intervals corresponding to orders of magnitude (similar to the Richter Scale for earthquakes), rather than a standard linear scale (such as weight/mass). On the decibel scale, the smallest audible sound (near total silence) is 0 dB. A sound 10 times more powerful is 10 dB. A sound 100 times more powerful than near total silence is 20 dB. A sound 1,000 times more powerful than near total silence is 30 dB.

For this study, two sample parallel paths were used along the south CMC property line: 20' south and 150' south. The reported results reflect the maximum decibel measurement along those lines, which extended from roughly 100' west of the rebar building to the east end of the craneway. All samples utilized a calibrated Center 325 Sound Level Meter with a ½ inch electret condenser microphone set to fast sampling, with C-weighted frequency (to detect low-frequency noise in addition to high-frequency). Period of sampling was February 12, 2013 for a one-hour period.

The sampled results are as follows:

Sample site 1 @ 20' south of the property line: 84.4dB max
Sample site 2 @ 150' south of the property line: 73.3dB max

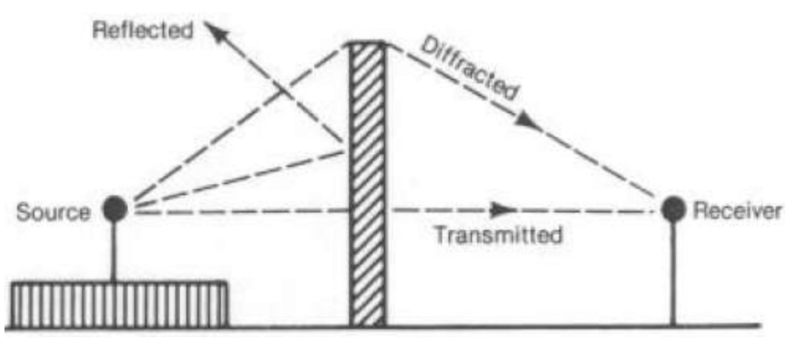
Based on these two data points, the following additional measurements were deducted:

Deduction site 1 @ noise source: 120dB
Deduction site 2 @ 300' south of the property line: 71.0dB

For comparison, a freeway like IH-35 measured from 50' is about 80dB average. A commercial jet taking off from about 200' away is about 135dB average. A car horn is about 110dB average, while a fire truck siren is about 120dB average. Inside a subway car is about 95dB average. Conversational speech at 5' is about 65dB average. A quiet single-family neighborhood residential street with little traffic is about 55dB average.

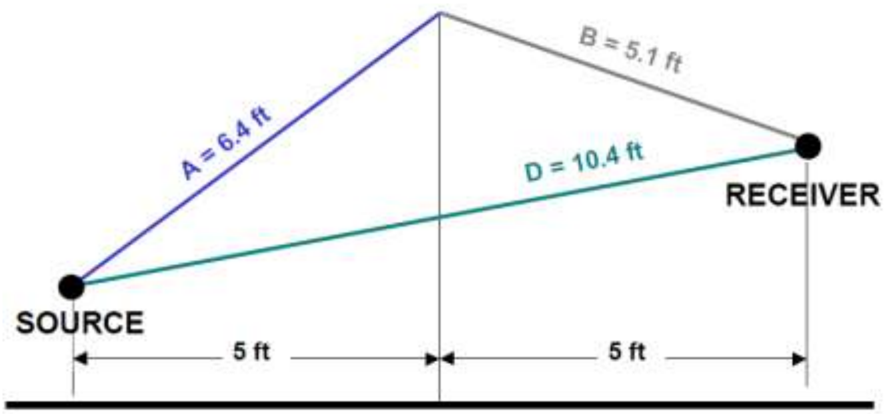
Effectiveness of Barriers in Reducing Exterior Noise Levels

When no obstacles are present between a noise source and adjoining areas sound travels by a direct path from the sources to the receivers. Introduction of a barrier between the source and receiver redistributes the sound energy into several indirect paths: a diffracted path, over the top of the barrier; a transmitted path, through the barrier; and a reflected path, directed away from the receiver.



Generally speaking, taller barriers and barriers located closer to the noise source are most effective. Effectiveness of barriers in an outdoor setting is determined using a calculation called Path Length Difference (PLD), a basic geometric calculation affected by barrier height & location and source & receiver heights. It is calculated based on the following formula:

$$PLD = A + B - D$$



The PLD calculation then corresponds to different "insertion loss" (decibel reduction) based on the octave band center frequency.

Path-Length Difference, ft	Insertion Loss, dB — Octave Band Center Frequency, Hz							
	31	63	125	250	500	1000	2000	4000
0.01	5	5	5	5	5	6	7	8
0.02	5	5	5	5	5	6	8	9
0.05	5	5	5	5	6	7	9	10
0.1	5	5	5	6	7	9	11	13
0.2	5	5	6	8	9	11	13	16
0.5	6	7	9	10	12	15	18	20
1.0	7	8	10	12	14	17	20	22
2.0	8	10	12	14	17	20	22	23
5.0	10	12	14	17	20	22	23	24
10.0	12	15	17	20	22	23	24	24
20.0	15	18	20	22	23	24	24	24
50.0	18	20	23	24	24	24	24	24

I did not have the ability to precisely measure octave bands as part of this study. As a result, my calculations err to the conservative and assume low frequency noise.

Conditions on the subject site were evaluated to determine best placement of a noise attenuation barrier. A drainage channel is present on the north property line along with a small berm that creates a net elevation increase of 3’ over the likely finished floor elevation of a multifamily project located on the subject site. The peak of the berm is located approximately 8’ south of the property line, making this the best location for any barriers. Placement of an 8’ masonry barrier on this berm creates an 11’ effective barrier.

In calculating the PLD to the midpoint of a 1st, 2nd and 3rd floor scenario on a building located 150’ south of the property line yields the following results:

1st Floor:	PLD = 4’	9dB reduction	64.3dB with masonry attenuation
2nd Floor:	PLD = 2’	8dB reduction	65.3dB with masonry attenuation
3rd Floor:	PLD = <1’	5dB reduction	68.3dB with masonry attenuation

Vegetative barriers present an additional means to reduce noise transmission. Based on research, it appears the most effective arrangement is to place the vegetative barrier between the masonry barrier and the noise source. Assuming a mature vegetative barrier of approximately 25’ (smaller species clumping bamboo), noise levels are reduced by an additional 4dB. Therefore, assuming both barriers are utilized, the results are as follows:

1st Floor:	60.3dB with masonry attenuation and vegetative barrier
2nd Floor:	61.3dB with masonry attenuation and vegetative barrier
3rd Floor:	64.3dB with masonry attenuation and vegetative barrier

These exterior noise levels are considered within acceptable ranges for a multifamily.

Structural Attenuation Measures to Residential Buildings

Structural attenuation utilizes construction methods to achieve interior noise reduction, with wall assemblies assigned a Sound Transmission Class (STC) rating. That rating indicates the noise reduction, measured in decibels, between the outside of the wall and inside. Simply stated, 1 STC = 1dB reduction. The City of Buda requires masonry construction, which typically takes two forms: stucco on frame or brick veneer wall. Both of these have relatively high STC ratings:

Stucco on Frame	STC = 46	Brick Veneer Wall	STC = 56
7/8” stucco		Face brick	
No. 15 building paper, 1” wire mesh		½” air space with metal ties	
2 x 4 studs 16” on center		¾” insulation board sheathing	
Fiberglass insulation		2 x 4 studs 16” on center	
½” gypsum nailed directly to studs		Fiberglass insulation	
		½” gypsum nailed directly to studs	

Update Regarding Noises Emanating From Multiple Sources at Distance

You presented two questions in follow-up to the original memo. The first question was about noise attenuation considering a second source (rebar shop) located 275' inside the property line (or 425' from a residential building based on the 150' setback). Given that this source is further away, it affects the angle of deflection. Unfortunately, I cannot easily calculate the noise level presuming that the closer source is blocked and the rebar source is potentially not impeded.

I can, however, say the 11' barrier (8' wall with 3' berm) would not block noise from that particular source to the 3^{rd} story based on geometry. I cannot easily calculate the net effect of the closer noise source being blocked while the other remains. Based on geometry, a barrier totaling 18' would be effective for 3^{rd} story attenuation based on a listening height of 28' for the noise source located a total of 425' from the nearest residential building. A barrier slightly more than 11' would be effective for 2^{nd} story attenuation based on a listening height of 17'. Unfortunately, I cannot determine whether the additional height is absolutely necessary given data available. Also, one could potentially consider a 2-story restriction for buildings between 150' and 200'. This does not consider the vegetative barrier, which is much taller and can reduce noise by 4 dB on its own.

HUD has established noise standards for projects it will assist with. Interior noise appears to be a non-issue given construction requirements in Buda, which place interior sound levels well below the HUD standard of 45dB. For exterior, HUD determines that 65dB is acceptable threshold, with 65dB-75dB requiring some type of mitigation to achieve at least a 5dB reduction.