

APPENDIX 2-D.3: NOISE MODELING



Daytime Construction Activities-Heavy Duty Equipment

				Reference Emission	
	Distance to Nearest	Combined Predicted		Noise Levels (L _{max}) at 50	Usage
Location	Receptor in feet	Noise Level (L _{eq} dBA)	Equipment	feet ¹	Factor ¹
threshold	141	80.0	Pickup Truck	55	0.4
Center	5000	49.0	Pickup Truck	55	0.4
Staging Area	3000	53.4	Flat Bed Truck	84	0.4
			Concrete Mixer Truck	85	0.4
			Concrete Mixer Truck	85	0.4
			Auger Drill Rig	85	0.2
			Crane	85	0.16
			Drill Rig Truck	84	0.2
			Backhoe	80	0.4
			Backhoe	80	0.4
			Dozer	85	0.4
			Dump Truck	84	0.16
			Ground Type	hard	
			Source Height	8	
			Receiver Height	5	
			Ground Factor ²	0.00	

Predicted Noise Level ³	L _{eq} dBA at 50 feet ³
Pickup Truck	51.0
Pickup Truck	51.0
Flat Bed Truck	80.0
Concrete Mixer Truck	81.0
Concrete Mixer Truck	81.0
Auger Drill Rig	78.0
Crane	77.0
Drill Rig Truck	77.0
Backhoe	76.0
Backhoe	76.0
Dozer	81.0
Dump Truck	76.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)

89.0

Sources:

 $L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)$

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

 ${\sf D}$ = Distance from source to receiver.

¹ Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

 $^{^{\}rm 2}$ Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

³ Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).



Site Preparation

				Reference Emission	
	Distance to Nearest	Combined Predicted		Noise Levels (L _{max}) at 50	Usage
Location	Receptor in feet	Noise Level (L _{eq} dBA)	Equipment	feet ¹	Factor ¹
Threshold	1,707	50.0	Dump Truck	84	0.4
Residence 1	25	96.3	Flat Bed Truck	84	0.4
Residence 2	50	88.3	Flat Bed Truck	84	0.4
			Scraper	85	0.4
			Scraper	85	0.4
			Front End Loader	80	0.4
			Pickup Truck	55	0.4
			Pickup Truck	55	0.4
			Backhoe	80	0.4
			Dozer	85	0.4
			Ground Type	Soft	
			Source Height	8	
			Receiver Height	5	
			Ground Factor ²	0.63	

Dump Truck Flat Bed Truck	80.0				
lat Rod Truck	00.0				
iat bed fluck	80.0				
lat Bed Truck	80.0				
Scraper	81.0				
Scraper	81.0				
Front End Loader	76.0				
Pickup Truck	51.0				
Pickup Truck	51.0				
Backhoe	76.0				
Dozer	81.0				
Combined Predicted Noise Level (L _{eq} dBA at 50 feet)					

Sources:

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

88.3

 $^{^{\}rm 1}$ Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

 $^{^{2}}$ Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

 $^{^3}$ Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3). $L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)$



Night Line Stringing Equipment

				Reference Emission	
	Distance to Nearest	Combined Predicted		Noise Levels (L _{max}) at 50	Usage
 Location	Receptor in feet	Noise Level (L _{eq} dBA)	Equipment	feet ¹	Factor ¹
Threshold	793	45.0	Man Lift	85	0.1
Residence 1	690	45.0	Pickup Truck	55	0.1
Residence 2	250	56.6	Pickup Truck	55	0.1

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor ²	0.63

Predicted Noise Level ³	L _{eq} dBA at 50 feet ³
Man Lift	75.0
Pickup Truck	45.0
Pickup Truck	45.0

Combined Predicted Noise Level ($L_{\rm eq}$ dBA at 50 feet)

Sources:

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

75

 $^{^{\}rm 1}$ Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

² Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

 $^{^3}$ Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3). $L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)$



Day Line Stringing Equipment (no helicopter)

				Reference Emission	
	Distance to Nearest	Combined Predicted		Noise Levels (L _{max}) at 50	Usage
Location	Receptor in feet	Noise Level (L _{eq} dBA)	Equipment	feet ¹	Factor ¹
Threshold	835	50.0	Crane	85	0.16
Residence 1	600	52.1	Man Lift	85	0.2
Residence 2	100	72.6	Pickup Truck	55	0.4
			Pickup Truck	55	0.4

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor ²	0.63

Predicted Noise Level ³	L _{eq} dBA at 50 feet ³
Crane	77.0
Man Lift	78.0
Pickup Truck	51.0
Pickup Truck	51.0

Combined Predicted Noise Level (Leg dBA at 50 feet)

80.6

Sources:

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

¹Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

² Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

 $^{^3}$ Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3). $L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)$

Combined Noise Levels @ 50 feet

Reference Noise Levels	SEL dBA	Leq dBA
Helicopter (10 minute hovering)	100	72
Reconductoring Construction Noise		89

Reconductoring + Helicopter

Combined Hourly Leq Noise Level @ 50 feet 89

Source: Kaman Aerospace Corporation 1993



Attenuation Calculations for Stationary Noise Sources

KEY: Orange cells are for input.

Grey cells are intermediate calculations performed by the model.

Green cells are data to present in a written analysis (output).

STEP 1: Identify the noise source and enter the reference noise level (dBA and distance).

STEP 2: Select the ground type (hard or soft), and enter the source and receiver heights.

STEP 3: Select the distance to the receiver.

Noise Source/ID	Referenc	e No	ise Level	Α	ttenuation C	haracteristics		Atte	nuated Noise	Lev	el at Recep	tor
	noise level		distance	Ground Type	Source	Receiver	Ground		noise level		distance	
	(dBA)	@	(ft)	(soft/hard)	Height (ft)	Height (ft)	Factor		(dBA)	@	(ft)	
Helicopter	83.0	@	492	hard	6	5	0.00		99.8	@	71	
							0.66					
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							0.66					

Notes:

Estimates of attenuated noise levels do not account for reductions from intervening barriers, including walls, trees, vegetation, or structures of any type.

Computation of the attenuated noise level is based on the equation presented on pg. 12-3 and 12-4 of FTA 2006.

Computation of the ground factor is based on the equation presentd in Figure 6-23 on pg. 6-23 of FTA 2006, where the distance of the reference noise leve can be adjusted and the usage factor is not applied (i.e., the usage factor is equal to 1).

Helicopter attenuated distance is calculated based on the distance at 45 degrees from the helicopter at 50 feet above ground with respect to the ground distance at 50 feet from construction noise source

Sources:

Federal Transit Association (FTA). 2006 (May). Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06. Washington, D.C. Available: http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf. Accessed: September 24, 2010.

Equipment Description	Acoustical Usage Factor (%)	Spec 721.560 Lmax @ 50ft (dBA slow)	Actual Measured Lmax @ 50ft (dBA slow)	No. of Actual Data Samples (count)	Spec 721.560 LmaxCalc	Spec 721.560 Leq	Distance	Actual Measured LmaxCalc	Actual Measured Leq
Auger Drill Rig	20	85	84	36	79.0	72.0	100	78.0	71.0
Backhoe	40	80	78	372	74.0	70.0	100	72.0	68.0
Bar Bender	20	80	na	0	74.0	67.0	100		
Blasting Boring Jack Power Unit	na 50	94 80	na 83	0 1	88.0 74.0	71.0	100 100	77.0	74.0
Chain Saw	20	85	84	46	74.0	71.0	100	77.0	74.0
Clam Shovel (dropping)	20	93	87	4	87.0	80.0	100	81.0	74.0
Compactor (ground)	20	80	83	57	74.0	67.0	100	77.0	70.0
Compressor (air)	40	80	78	18	74.0	70.0	100	72.0	68.0
Concrete Batch Plant	15	83	na	0	77.0	68.7	100		
Concrete Mixer Truck	40	85	79	40	79.0	75.0	100	73.0	69.0
Concrete Pump Truck	20	82	81	30	76.0	69.0	100	75.0	68.0
Concrete Saw	20	90	90	55	84.0	77.0	100	84.0	77.0
Crane	16	85	81	405	79.0	71.0	100	75.0	67.0
Dozer Drill Rig Truck	40 20	85 84	82 79	55 22	79.0 78.0	75.0 71.0	100 100	76.0 73.0	72.0 66.0
Drum Mixer	50 50	80	79 80	1	78.0 74.0	71.0	100	73.0	71.0
Dump Truck	40	84	76	31	78.0	74.0	100	70.0	66.0
Excavator	40	85	81	170	79.0	75.0	100	75.0	71.0
Flat Bed Truck	40	84	74	4	78.0	74.0	100	68.0	64.0
Front End Loader	40	80	79	96	74.0	70.0	100	73.0	69.0
Generator	50	82	81	19	76.0	73.0	100	75.0	72.0
Generator (<25KVA, VMS si		70	73	74	64.0	61.0	100	67.0	64.0
Gradall	40	85	83	70	79.0	75.0	100	77.0	73.0
Grader	40	85 85	na	0	79.0	75.0	100	01.0	77.0
Grapple (on Backhoe) Horizontal Boring Hydr. Jack	40 I 25	85 80	87 82	1 6	79.0 74.0	75.0 68.0	100 100	81.0 76.0	77.0 70.0
Hydra Break Ram	10	90	na	0	84.0	74.0	100	70.0	70.0
Impact Pile Driver	20	95	101	11	89.0	82.0	100	95.0	88.0
Jackhammer	20	85	89	133	79.0	72.0	100	83.0	76.0
Man Lift	20	85	75	23	79.0	72.0	100	69.0	62.0
Mounted Impact Hammer (90	90	212	84.0	77.0	100	84.0	77.0
Pavement Scarafier	20	85	90	2	79.0	72.0	100	84.0	77.0
Paver	50	85	77 	9	79.0	76.0	100	71.0	68.0
Pickup Truck	40	55	75 25	1	49.0	45.0	100	69.0	65.0
Pneumatic Tools	50 50	85 77	85 81	90 17	79.0 71.0	76.0 68.0	100 100	79.0 75.0	76.0 72.0
Pumps Refrigerator Unit	100	82	73	3	71.0 76.0	76.0	100	67.0	67.0
Rivit Buster/chipping gun	20	85	79	19	79.0	72.0	100	73.0	66.0
Rock Drill	20	85	81	3	79.0	72.0	100	75.0	68.0
Roller	20	85	80	16	79.0	72.0	100	74.0	67.0
Sand Blasting (Single Nozzle	20	85	96	9	79.0	72.0	100	90.0	83.0
Scraper	40	85	84	12	79.0	75.0	100	78.0	74.0
Shears (on backhoe)	40	85	96	5	79.0	75.0	100	90.0	86.0
Slurry Plant	100	78	78	1	72.0	72.0	100	72.0	72.0
Slurry Trenching Machine	50 50	82 80	80	75 0	76.0	73.0	100	74.0	71.0
Soil Mix Drill Rig Tractor	50 40	80 84	na na	0 0	74.0 78.0	71.0 74.0	100 100		
Vacuum Excavator (Vac-tru		85	85	149	79.0	75.0	100	79.0	75.0
Vacuum Street Sweeper	10	80	82	19	74.0	64.0	100	76.0	66.0
Ventilation Fan	100	85	79	13	79.0	79.0	100	73.0	73.0
Vibrating Hopper	50	85	87	1	79.0	76.0	100	81.0	78.0
Vibratory Concrete Mixer	20	80	80	1	74.0	67.0	100	74.0	67.0
Vibratory Pile Driver	20	95	101	44	89.0	82.0	100	95.0	88.0
Warning Horn	5	85	83	12	79.0	66.0	100	77.0	64.0
Welder / Torch	40	73	74	5	67.0	63.0	100	68.0	64.0

Source:

FHWA Roadway Construction Noise Model, January 2006. Table 9.1 U.S. Department of Transportation

CA/T Construction Spec. 721.560