Pumping Station Noise Emissions - Equations Used

Internal Noise Calculation

(i)   Surface Area (SA) $=$ $2 (l \times w + l \times h + w \times h)$

(ii)   Room Constant (Rc) $= \dfrac{SA \times \bar{\alpha}}{(1 - \bar{\alpha})}$

where $\bar{\alpha}$ = average absorption coefficient

(iii) $SPL_{(inside)}$ $=$ $SWL + 10 \log\left[\dfrac{Q}{4\pi r^2} + \dfrac{4}{Rc}\right] dB(A)$

External Noise Calculations

(i) $SPL_{(outside\ louvre)}$ $=$ $SPL_{(inside)} - R_{(louvre)} - 6\ dB(A)$

where $R_{(louvre)}$ is the sound reduction index of the louvre

(ii) $SPL_{(NSR)}$ $=$ $SPL_{(inside)} - R_{av} + 10 \log(S) - 20 \log r - 14 + 3\ dB(A)$

where R_{av} is the average sound reduction index of the radiating surface
   S is the surface area of the radiating surface
   r is the distance between the source and NSR

(iii) R_{av} $=$ $10 \log\left(\dfrac{1}{\tau_{av}}\right)$

where τ_{av} $=$ $\dfrac{\tau_1 S_1 + \tau_2 S_2 + \ldots\ldots}{S}$

where τ_1 $=$ $10^{(-R_1/10)}$ R_1 is the sound reduction index for material 1

S_1 $=$ surface area of material 1

(iv)   Total $SPL_{(NSR)}$ $=$ $\sum SPL_{(wall\ 1)} + SPL_{(wall\ 2)} + \ldots\ldots SPL_{(roof)}\ dB(A)$

Pumping Station Noise Emissions - Unmitigated

Assumptions

SWL (4 * 104 dB(A))	110
Q (Directivity)	Assume hemispherical Radiation (ie $2(Pi)r^2$)
length, m	42
height, m	3
width, m	24
S (surface area), m²	2412
Rc (Room Constant)	1034
alpha (absorption coefficient)	0.3

Calculations

SPL(inside louvre), dB(A)	107.0
SPL(outside louvre), dB(A)	96.0

Source	Surface Area, m²			Sound Reduction Index, R (dB(A))		Interim Calculations			(dB(A))	(dB(A))	(dB(A))
	Total	Concrete	Louvre	Concrete	Louvre	Tau*Area (concrete)	Tau*Area (louvre)	Tau*Area (total)	Rav	Directivity correction	SPL (NSR)
Wall 1	126	122	4	25	5	0.386	1.265	1.651	18.8	0	47.6
Wall 2	126	126	0	25	5	0.398	0.000	0.398	25.0	-10	31.4
Wall 3	72	72	0	25	5	0.228	0.000	0.228	25.0	-5	34.0
Wall 4	72	72	0	25	5	0.228	0.000	0.228	25.0	-5	34.0
Roof	1008	1008	0	25	5	3.188	0.000	3.188	25.0	-5	45.4
Total	1404	1400	4							Total	49.9

Results

SPL(at 1 m)	96 dB(A)
SPL(NSR)	50 dB(A)

Pumping Station Noise Emissions - Mitigated

Assumptions

SWL (4 * 98 dB(A))	104
Q (Directivity)	Assume hemispherical Radiation (ie $2(Pi)r^2$)
length, m	42
height, m	3
width, m	24
S (surface area), m^2	2412
Rc (Room Constant)	1034
alpha (absorption coefficient)	0.3

Calculations

SPL(inside louvre), dB(A)	101.0
SPL(outside louvre), dB(A)	90.0

	Surface Area, m^2			Sound Reduction Index, R (dB(A))		Interim Calculations						
										(dB(A))	(dB(A))	(dB(A))
Source	Total	Concrete	Louvre	Concrete	Louvre	Tau*Area (concrete)	Tau*Area (louvre)	Tau*Area (total)		Rav	Directivity correction	SPL (NSR)
Wall 1	126	122	4	25	5	0.386	1.265	1.651		18.8	0	41.6
Wall 2	126	126	0	25	5	0.398	0.000	0.398		25.0	-10	25.4
Wall 3	72	72	0	25	5	0.228	0.000	0.228		25.0	-5	28.0
Wall 4	72	72	0	25	5	0.228	0.000	0.228		25.0	-5	28.0
Roof	1008	1008	0	25	5	3.188	0.000	3.188		25.0	-5	39.4
Total	1404	1400	4								Total	43.9

Results

SPL(at 1 m)	90 dB(A)
SPL(NSR)	44 dB(A)

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