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PREDICTION AND ASSESSMENT OF AIRPORT NOISE

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Before commencing any detailed design of an airport building, comprehensive estimates of the local noise environment must be made. It is not unusual for the ground noise sources to be totally ignored, and the noise estimates based solely on the noise anticipated from aircraft runway operations. Unless the totality of noises are included in these estimates, then an entirely erroneous set of design parameters may be specified. Once the external environment has been defined, the pattern of the building designs can be examined by considering the following factors:

External Environment: Siting of building: Two parameters must be considered (a) the protection of the interior inhabitants and (b) the protection of the workers within the local external environment of the building. Design factors: Shielding provided by other buildings, or obstructions, orientation and height of building, landscaping.

Internal Environment: Building design and layout. These parameters must be considered only after a full examination of the external environment has been made. Design factors: Interior layout arranged to provide maximum protection or quiet areas. Wall, window, roof and door construction, ventilation, design and interior space acoustical characteristics.

It is not unusual for the estimated external noise environment to exceed an Leq of 80 dB(A). Therefore, noise reductions of between 50-30 dB(A) must be chieved in order to arrive at a suitable range of interior environments. The lower figure can be readily achieved by following sensible design practices, but in order to arrive at attenuation values of around 50 dB(A), considerable care must be taken in all phases of the design. Using a breakdown of the design procedure described above, the following details in the layout and design of a specific building need to be considered.

External Environment:

With a new airport site, it is often possible to arrange the layout of the buildings to provide some shielding of the more noise sensitive buildings by structures having less stringent noise requirements. Depending upon the height and distance of the structure that acts as a barrier, attenuation of between 5-10 dB(A) can be achieved from ground noise sources. Unfortunately, from a noise control point of view, the ground noise problem has been exacerbated through the introduction of the wide bodied jets because their APU installations can be at considerable heights above the ground up to 10 metres. The effectiveness of shielding can be estimated using the "thick" barrier theories, but a much more reliable source of design data is that obtained by actual measurement under similar layout situations.

If a building is to be used to provide shielding, care must be taken to provide continuous line-of-sight protection, and all apertures such as doors, windows, loading bays, etc., must be suitably baffled to avoid gaps in the barrier. Of course, this technique offers little protection from the noise of airborne aircraft, but it is useful protection against ground operations of aircraft, as well as noise from road and rail traffic.

Purpose built noise barriers should also be considered in this connection. Screens, walls, and earth barriers may be designed to provide specific protection. In practice, this technique is only cost-effective if the height of the barrier does not exceed 10-13 metres. Up to this height, single unsupported elements can be designed but beyond these heights screen construction requires considerable wind loading support and the widths of earth berm "footings" become impracticable for most sites. A general design rule is that distance between the noise source and the protecting building, screen, or berm, should be kept to a minimum. For distances beyond 50 metres, unless the obstacle is very high and long, barrier performance quickly deteriorates.

The orientation of the building from the principal noise sources should also be examined. The building itself can provide protection for workers and visitors within its immediate vicinity. Noise sensitive surfaces containing open areas such as balconies, large areas of glass, doors, loading bays, and traffic ramps into the buildings, can often be located to minimise their noise exposure. If not awkward design problems can arise requiring the use of acoustically efficient door and window seals or baffling by external screens.

The shape and height of the building can also influence the impinging noise exposure. Tall airport structures should be avoided to maximise the effectiveness of any shielding strategies, and vibration control occur with Air and Ground Traffic Control Centres which often need to be elevated to provide visual inspection. On general complex geometrical shapes of buildings should be avoided to minimise reverberant effects derived from reflections off adjacent structural surfaces. For example, twin building structures connected by a lower level section may produce undesirable reverberation from aircraft noise during take-off and landing.

Except for specifically designed earth berms, landscaping is not an effective technique for noise control. In fact, vegetation should be avoided on the upper levels of a berm as trees or shrubs can lower its high frequency performance. Generally, unless great depths of shrubs or trees are available for screening, landscaping will produce little or no attenuation of the noise. The parameters which affect the noise attenuation are trunk density to provide attenuation in the low frequencies and leaf size and density for high frequency attenuation. As an example of the amount of attenuation that can be achieved, only 3-5 dB will be produced by 30-40 metres of densely foliated vegetation. But the great advantage of the use of landscaping is that it has a subjective value. Even though the noise levels are not significantly reduced, the impact of the noise is lessened if an attractive landscape feature is interposed between the source and the receiver.

Internal Environment:

Having established the characteristics of the external noise environment and the protection that can be derived from factors outside the building, consideration must now be given to the building design, layout and construction. The occupancy and usage of each building must be examined in terms of the interior noise requirements. The position of quiet areas such as dormitories, quiet offices and conference rooms should be arranged so that achievement of the necessary noise level is accomplished in the most cost-effective manner. For example, it would not be wise to place sleeping or conference room accommodation on the upper storeys of the building exposed to aircraft and helicopter noise, or facing a major source of ground noise. In this case, additional roof and wall insulation would be necessary and expensive. Therefore it is most efficient to locate sensitive accommodation in the quietest section of the building, and even basement locations should not be ruled out in this process of evaluation. Of course, the internally generated noise must not be neglected when making the location choice. This latter factor does not require any special arrangements for an airport building other than the usual good design procedures.

The range of attenuation requirements through wall elements of typical airport buildings will be 30-50 dB(A). Most suitably stiffened wall assemblies will provide for the former value, but 50 dB(A) can only be achieved through careful design. Brick or concrete materials, in conjunction with gypsum plaster or plywood interior panelling, offer suitable combinations of materials. Figure 1 shows the attenuations that can be produced, the data was derived from a United States - FAA report (Study of Soundproofing Public Buildings near Airports. DOT-FAA-AEQ-77-9) and offers typical values that can be taken as a general guide.

In areas of high attenuation design requirement problems often occur at the junction of walls, at doors, windows and roofing. In these cases, care must be taken not to allow discontinuities in attenuation values to occur for "acoustical gaps" could negate a careful design.

<u>References:</u>

The Status of Airport Noise Prediction. J.B. Large. Internoise 79 Proceedings. Warsaw. p671-680.

Higher Education in Acoustics within the European Community. J.B. Large. Internoise 80 Proceedings. Miami, Florida. p105-108

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EXTERIORS	INTERIORS	1/2"Gypsumboard 1	3/8"Gypsumboard 2	2 layers 1/2" GB 3	2 layers 5/8" GB 4	3/8Gyp.Lath/1/2"Plaster 5	3/8Gyp.Lath/1/8"Plaster 6	1/2"Soundboard/ 1/2"Gypsumboard 7	1/2"Soundboard 3/8"Gypsumboard 8	1/2" Plaster 9	3/4" Plaster 10	7/8" Plaster 11	1/2"Gypsumboard 1/4"Plywood Panel 12	1/2" Plywood Panel 13	1/2" Gypsumboard 1/4"Hardboard Panel 14	Exposed solid wall 15
Alum.Siding/1/2"Wood	A	37	35	39	40	41	37	37	38	39	41	42	37	33	39	--
7/8" Stucco Paper	B	44	44	45	44	40	45	45	45	40	38	37	45	41	46	--
7/8" Stucco/1/2"Wood	C	45	45	45	45	42	46	46	45	42	40	39	46	42	47	--
1/2" Wood Siding	D	33	34	38	40	41	36	36	37	39	41	41	37	31	39	--
3/4" Wood Siding	E	38	37	37	38	39	34	34	35	37	39	39	35	34	37	--
4-1/2" Brick Veneer	F	53	52	52	52	48	53	53	52	48	47	46	53	50	54	--
9" Brick	G	54	57	59	58	--	58	58	59	53	53	53	53	53	53	53
4" Concrete	H	54	54	--	--	--	55	55	55	49	--	--	48	48	48	48
6" Concrete	I	54	55	57	56	--	56	56	57	50	51	51	50	50	50	50
8" Concrete	J	56	58	50	59	--	59	59	60	54	54	55	54	54	54	54
6" Hollow Concrete Block	K	46	57	49	49	--	48	48	48	42	43	43	41	41	41	41
8" Hollow Concrete Block	L	47	49	51	51	--	50	50	51	44	45	45	43	43	43	43
6" Blockw/1/2" Stucco	M	47	48	50	49	--	49	49	50	43	44	44	42	42	42	41
8" Blockw/1/2" Stucco	N	48	50	50	51	--	51	51	52	45	46	46	44	44	44	44

Figure 1 - EXTERIOR WALL RATING (EWR) FOR EXTERIOR CONSTRUCTION.