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INCE: 50

REVIEW ON NOISE ABATEMENT MEASURES AT MILITARY TRAINING FACILITIES IN GERMANY

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1. ASSESSMENT OF MILITARY FIRING NOISE

As of the 1980s, permissions are required for firing ranges of the Federal Armed Forces in accordance with the Federal Immission Control Act. Under this Control Act it was not possible, however, to deal with the firing noise, since it was drawn up only for the assessment of traffic and industrial noise as permanent noise for the determination of neighboring conditions for populated areas. Sole evaluating quantity is the assessment by the curve dB(A). Low-frequency noise, however, can only be judged by the weighting (assessment) of the dB(C) curve. Firing noise is a high or low frequency pulse-type noise.
To this day, we have conducted extensive studies focusing on the standard methods for measuring and evaluating firing noise to clarify the connection between the evaluation of high-frequency long term noise assessment by dB(A) and low-frequency pulse-type noise (eg. heavy weapons) assessment by dB(C). Several test series were conducted at the MUNSTER Training Area and in connection surveys about annoyance were taken on that. The data are to be evaluated now. In the future, these results are intended to serve as a basis for decisions to be made under the Federal Immission Control Act in the case of acoustic annoyance of citizens caused by firing noise of the Federal Armed Forces.

2. NOISE PROGNOSIS AND NOISE MAPS

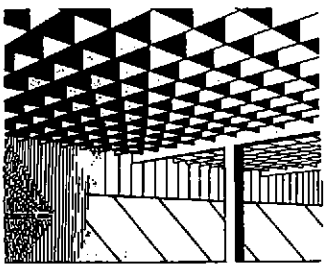
Firing noise is always a collection of noise events. In order to provide the means for an assessment of such complex noise

sources, a **Noise Prognosis Model** was developed for the production of Noise Maps. It is now in use and is called **LARMLAST** (Institut für Laermschutz Dr. Buchta, Düsseldorf). This program requires a database for indication of firing locations, type and frequency of firing and also noise propagation data that are characteristical for weapons. The program allows the calculation of contours of equal noise intensity. Since the noise on a training area is essentially a low frequency firing noise of large-calibre weapons, the maps are calculated in dB(C). Now also programs are developed for high frequency shooting noise in ranges for small arms in dB(A). The maps serve as a **planning basis** for the **layout of firing lanes/ranges**, the **construction of noise abatement structures** directly at the source (active noise protection) and technical noise protection measures to be taken at residential areas (passive noise protection).

3. PHYSICAL NOISE PROTECTION AT SMALL ARMS RANGES

Since about 1980, we began to experiment with structurally constructive measures for reducing the noise at firing ranges. Firstly, we developed constructions at small arms firing ranges which enclosed the muzzle blast of the weapons and the supersonic boom of the flying shell. For this purpose, we have covered typical firing facilities with open sound absorbers at the top in that way that the entire firing range is enclosed. We have tested and developed sound absorbers of this type in a series of tests. With this structure, we have achieved a reduction of noise of up to 20 dB(A). So, it was possible to reach the noise reduction required by law. In the meantime, these constructions are so well advanced in their developement that they can be regarded as state of the art. The sound reflections at the walls of the construction achieve a higher intensity (double) than the muzzle blast. Therefore, mixed constructions are built, which reduce the firing noise particularily in direction to the location of the residential area. In this case, only partial substructures are required.

Now a **new Noise Prognosis Model** is developed in order to provide the means of an assessment for **typical constructions for small arms ranges** including all reflections of their typical baffles, walls and buildings.



small arms range

4. NOISE PROTECTION IN THE PERIPHERY OF TRAINING AREAS

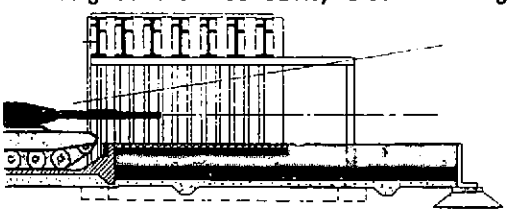
In the periphery of training areas where heavy weapons practice large scale firing, we firstly tested sound-reducing measures at the residential buildings. The results of these tests led to technical standards for noise protection measures on residential buildings such as the installation of noise protection windows which proved to be sufficiently effective for low-frequency impulse noise.

5. NOISE PROTECTION AT TRAINING AREAS

We have tested active anti-noise measures for firing ranges at training areas. Such measures are useful on the basis of firing ranges at training areas, because firing is always practised from the border into the depth of the training area. The residential areas of the citizens are outside the facility, always behind the line of fire. Therefore, the muzzle blast of the weapon must be reduced here, because the sonic boom of the flying projectile is not audible in the residential areas. Such structures are useful on the basis of firing ranges, since firing is usually conducted here from fixed positions. Also such structures are useful on fixed firing positions outside the training area where the artillery is shooting over long distances into the central impact area.

6. NOISE ABATEMENT STRUCTURES AT TRAINING AREAS

Simple noise abatement structures, e.g. those buildings along roads as walls or embankments, are ineffective in the case of low-frequency sounds with large wave lengths. In order to construct suitable sound absorbing structures, we have firstly developed suitable sound absorbers for low-frequency pulse-type noise. For this purpose, we tested a series of constructions indoor and outdoor. Such sound absorbers consist of boxes with openings and internal sound absorption material. We installed them in supporting systems for the roof or designed them as cavity block building stones for walls. Such walls can be arranged like absorber baffles vertically to the firing direction. A practical test of such structure with different absorber

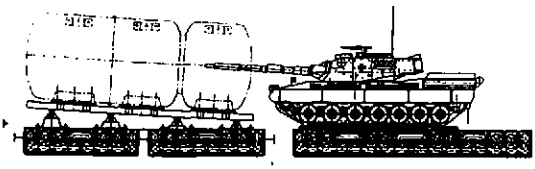


sound absorber construction

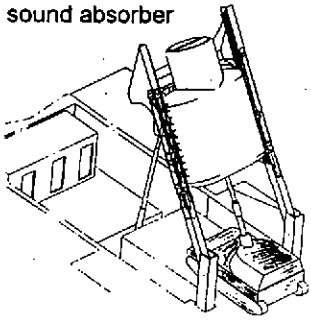
elements was conducted in a detonation pit at a training area. We also designed an absorber building installable at the basis of a range. The measurements yield a noise reduction by about 10 dB. However, since canon noise has a very high intensity (130 dB at 30 m), it is hardly possible to achieve a fully sufficient noise reduction with these structures to be in accordance with the Immission Control Act for residential areas near a training area. These structures can be of great help, however.

7. MOBILE LARGE-SCALE SOUND ABSORBERS

Lately, we started testing mobile large-scale sound absorbers which are located movable in front of the muzzle only whilst shooting. For this purpose we installed a test-station in order to get basic physical knowledge. It began with tests with the cannon 35 mm and we continued with 120 mm tank and with artillery 155 mm calibre. They showed a noise reduction up to 40 dB. In a further step we developed applicable constructures for special cases e.g. in outside-fire-points.



movable sound absorber



applicable construction

8. ORGANISATIONAL MEASURES FOR REDUCTION OF NOISE

To relieve the citizens in the periphery of training areas as much as possible, we must exhaust all technical possibilities for reducing noise in connection with organisational measures. One of these measures is the relocation of the firing training or of the firing ranges at the training area into less irritating areas. For this purpose, the noise prognosis model with noise maps is used as a basis for decisions. Other measures are restriction of firing times during the day, primarily at night and on holidays or the use of simulation possibilities for firing training.