Environmental Planning for Munich's Transrapid Airport Link, in particular noise and vibration protection

(*) Wolfgang Herrmann, (**) Michael Kordon
(*) OBERMEYER Planen+Beraten GmbH, Hansastr. 40, Munich, Germany,
49 89 5799 650 / 49 89 5799 666, wolfgang.herrmann@opb.de, www.opb.de
(**) Bayerische Magnetbahnvorbereitungsgesellschaft, Arnulfstr. 19, Munich, Germany
49 89 543283 530 / 49 543283 999, michael.kordon@bayerische-magnetbahn.de

Keywords

environmental impact assessment, environmental protection, immissions, mass-and-spring system, noise protection, Transrapid, vibrations

Abstract

During planning the high-speed Maglev Munich-Airport link emphasis is placed on environmentally compatible design. This is seen in the environmental impact assessment which is necessary for the permission procedure. In public and for future neighbors of the track the question of immissions of noise or vibrations plays a significant role. For this extensive studies were conducted regarding the expected immissions. As a result noise barriers were planned along the open sections of the route and mass-and-spring systems were designed in the tunnel areas.

1 The Transrapid and its Environment

Due to low area consumption, little specific consumtpion of energy and low levels of noise and vibrations the Maglev can be seen as an environmentally favorable transportation system. Never the less negative environmental influences can't be totally avoided during the planning of a Maglev route. The assignment of an environmental impact assessment is to determine these, quantify them and to evaluate alternative routes.

1.1 Environmental Impact Assessment

According to European Law [1], an environmental impact assessment is prescribed for all large environmentally relevant projects. This includes public transportation routes and therefore the Maglev, too. Subjects of the environmental impact assessment are the different environmental factors: people, plants and animals, cultural heritage sites and buildings, soil, water and air. In order to conduct such a study, certain standards have been developed over the past 10 to 15 years. The environmental impact assessment plays an important role during permission procedures. So it is also necessary to discuss all the possible environmental effects in a so called "scoping hearing" in which each environmental authority and association is invited to quantify the necessary environmental analysis. The public, which is included in the legal proceedings, has a right to be informed about special influences of the project and, if personal rights are affected, to let the matter be examined in court.

In the project Transrapid Munich Main Station-Airport environmental concerns have played an important part in finding the routings. After investigating several alternatives one route has been chosen which leans closely on an existing highway and therefore avoids a new disruption of the landscape surrounding Munich. Still, even this from an environmental point of view optimized route contains a few sections with potential environmental conflicts. Here, emphasis is on the crossing of the Isar-river meadows near the airport. This region is considered especially precious from an ecological point of view and enjoys a particularly high protection status in EU-law. Only because of the close bundling

with the highway in this region the influences on this natural landscape could be limited to an acceptable level.

2 Protection from noise and vibrations

In the environmental impact assessment the evaluation of the environmental factor "people" is of especially great interest. Here possible impairment of neighbors through the operation of the Maglev is evaluated. In addition to the law concerning the environmental impact assessment, a special law concerning protection against immisssion exists. It states that the effects of public transportation systems like the Transrapid aren't allowed to exceed certain limits to an unacceptable degree.

2.1 Noise immissions

The Transrapid is a quiet means of transportation compared to conventional railroads. Thus the Transrapid is much more quiet during passing than a high-speed train compared at the same velocity. Running at substantially higher speeds the Transrapid reaches the same noise level as a commuter train running 80 to 120 km/h. Yet the Transrapid isn't noiseless and can cause disturbances of the neighbors in adjacent buildings. The German Federal law of pollution control provides that the noise levels which result from the passing of the Transrapid are calculated using a special procedure [2]. Therein the sound levels are calculated separately for the day- and nighttime. These are compared to limit values. In the Transrapid Munich project, where the train runs in large parts within the city limits in a tunnel, the calculations, showed exceeded limit values only in a few relatively short zones. For these areas noise barriers are planned like they are common next to highways or high-speed railway tracks. The calculations were repeated considering these measures and it could be shown that there was no exceeding the limit values at one of the houses along the route. In the presently running permission procedure the presentation of the future noise situation will play a significant role. Therefore noise maps were calculated on which future noise situations are shown in color along the whole maglev line to the Munich Airport.

2.2 Vibrations

The Maglev, which is guided without contact on its guideway, transfers forces into the guideway and therefore into the subsoil due to its magnetic carrier and guidance system. Therefore ground vibrations can arise near the route which are also transferred to neighboring buildings. The levels of these vibrations in the buildings can be measured and evaluated according to DIN 4150/2 standard [3]. Actually there is no experience concerning vibrations which are transferred by a Maglev to adjoining buildings. However, measurements of vibrations at the test track of the Transrapid in Emsland in Germany and also at the new system in Shanghai including experience with rail traffic allow a forecast of expected vibrations. Derived from that one has to expect that vibrations which exceed the recommended values can result in a certain percentage of the buildings which are distanced less than about 20 to 30 meters from the track.. If not only single houses are affected by vibrations, protection systems are included in the planning.

3 Protection Measures

3.1 Noise Protection

Measurements with an "acoustic camera" have shown that the main noise source of the Transrapid vehicle is located next to the surface of the girder. Hence good protection can be expected from conventional noise barriers like they are well-known from streets or high-speed railway routes. Accordingly such measures are also scheduled for the Transrapid Munich with noise-absorbing surfaces on the side facing the vehicle. During construction of these elements special attention must be

paid that the surface can't be damaged due to suction by the passing vehicle. Figure 1 shows an example for a cross-section with noise barrier.

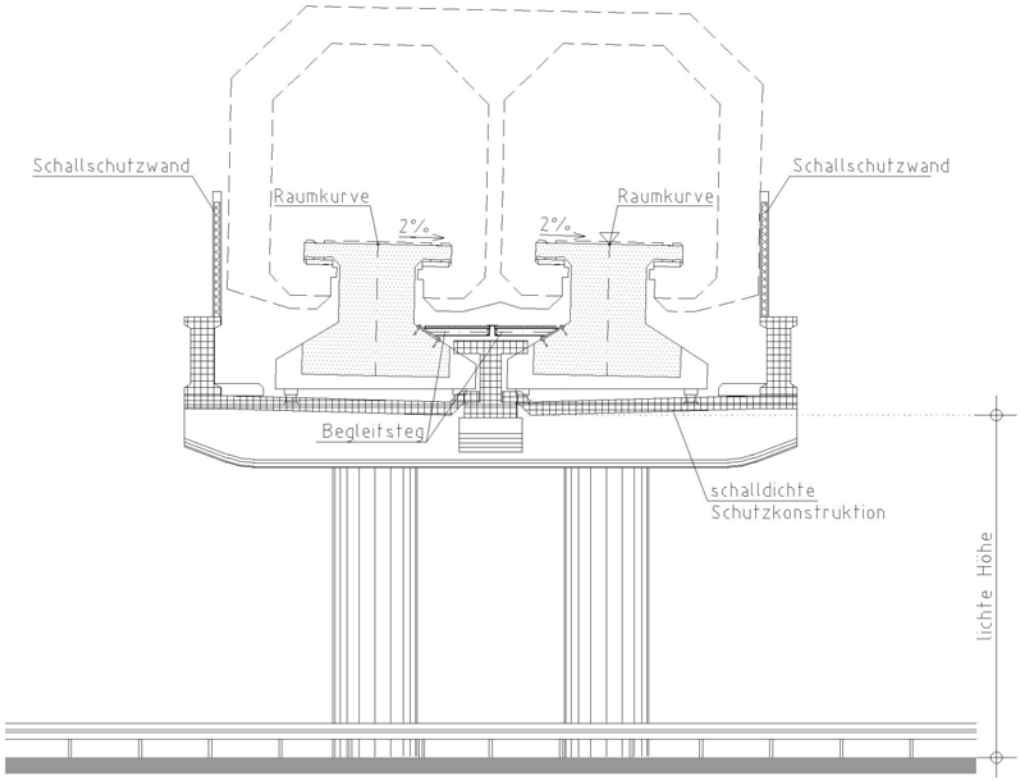

Fig. 1: Noise Barriers

3.2 Protection measures against vibrations

In the project Transrapid Munich Airport Link vibration protection measures are almost exclusively planned where the track runs in the tunnel immediately underneath or directly in the neighborhood of inner-city apartment houses. These mainly have 4 to 6 stories. Referring to vibrations this fact turns out to be unfavorable because according to experience a significant reinforcement occurs from the foundations of the houses to the upper stories. Surely not all the houses within the mentioned distance range will be affected by annoying vibrations. This depends on individual characteristics of each single building, that is how strongly and in which frequency range between about 8 and 80 Hertz the houses let themselves be stimulated to vibrate. Due to the large number of houses in the area of the Transrapid tunnel one has to be prepared for the occurrence of noticeable and therefore annoying vibrations in numerous apartments. Therefore a so-called mass-and-spring system to reduce the vibrations is planned for a length of several kilometers along the track. Such systems have been well-known for years from rail traffic and therefore it is to be expected that they will also unfold their effect with the Transrapid, so far as they are tuned to the examined individual case.

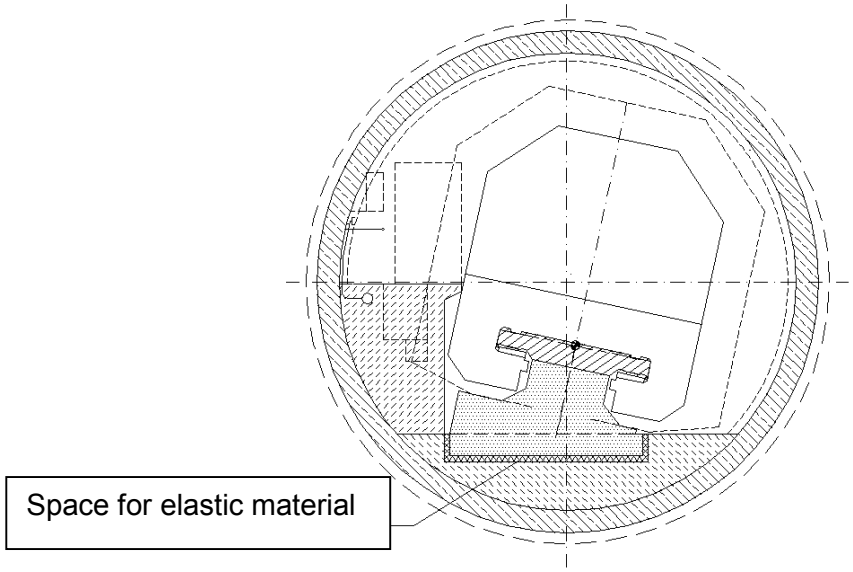

Fig.2: Mass-and-spring system in the tunnel

Figure 2 schematically shows the planned mass-and-spring system in the tunnel cross-section. The design of the elastic layer and the concrete slab above depends on the vibration frequency that has to be dampened: the lower it is, the greater the employed mass must be. It is intended to carry out further measurements before the track in the tunnel is built in order to be able to determine the transfer of vibrations from the tunnel to neighboring apartment houses.

References

1. The Council of the European Communities. *85/337/EEC: Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment,* Official journal NO. L 216 , 03/08/1991 P. 0040

2. Federal Republic of Germany. *Magnetschwebebahn-Lärmschutzverordnung,* 1997, Bundesgesetzblatt Teil I Nr. 64, 1997

3. Deusches Institut für Normung e.V.. DIN 4150-2, *Erschütterungen im Bauwesen, Teil2: Einwirkungen auf Menschen in Gebäuden (Vibrations in Buildings – Part 2: Effects on Persons in buildings)*, Beuth Verlag GmbH, D-10772 Berlin, Germany, 1999