

# Use of Steel Fiber Reinforced Concrete for the Protection of Buildings Against High Dynamic Actions

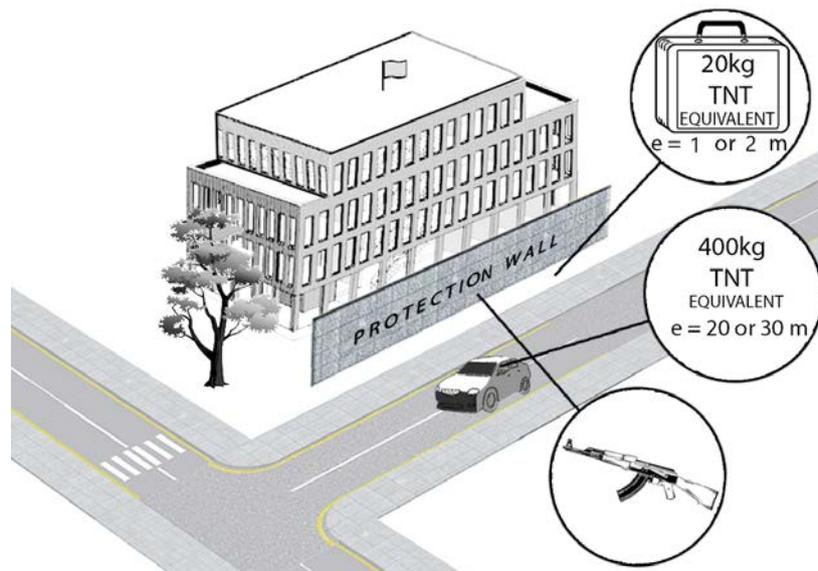
Vahan Zohrabyan, Thomas Braml, Tobias Zircher and Manfred Keuser

University of German Armed Forces, Chair for Concrete Construction,  
Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany, vahan.zohrabyan@unibw.de

**Keywords:** *High Dynamic Load, Protective Components, Contact Detonation, Steel Fiber Reinforced Concrete, Damage Crater.*

## 1 Introduction

In this research project, reinforced concrete plates as well as steel fiber reinforced concrete plates made of different geometries and steel fiber content are produced and tested under different high dynamic loads (Figure1). (Zohrabyan *et al.*, 2019)



**Figure 1.** Scenarios of terroristic attacks on a building (Picture: V. Zohrabyan).

The hand gunshots represent a high risk for soldiers in action. If it were possible to eliminate this danger by using a protection system made of fiber concrete components with exclusion of secondary debris, part of the task would be solved. In order to slow down or completely intercept the secondary debris that flakes off as a result of the bombardment, the fiber reinforced concrete slabs will in future be equipped with a kind of steel grid curtain. In the following, the first test results of the fiber reinforced concrete slabs with high compressive strength concrete C80/95 under hand gunshot are presented.

The 300 x 300 x 60 mm thick fiber concrete plates (C80/95) were shot with both soft- and hard-cores hot caliber 7.62 mm x 51 308 Winchester (Figure 2). In order to measure the damage caused by the projectile, the 6 cm thick plates fired on were analyzed with regard to the crater volume.



**Figure 2.** Setup and execution of hand gunshot test.

The steel fibers KH DE35/0.55 N have the best effect in concrete in terms of increasing compressive strength and improving energy absorption when shot at with soft-core ammunition. The plates of this mixture showed a good protective capacity and withstood the shots well. (Michal *et al.*, 2014)

The aim of the study is to make the panels as thin and light as possible in order to allow them to be attached to existing facades as a protective element (Zircher *et al.*, 2019). Since in many buildings the panels cannot be fixed to the front of the building depending on the architectural solution, the protective wall would be used as a second alternative. The crash barrier panels should also be as light and thin as possible and must withstand both shock waves and impact loads. Here it is important that the panels can be produced in an economically favourable way and installed easily.

## ORCID

Vahan Zohrabyan: <http://orcid.org/0000-0003-3050-9687>

## References

- Michal, M., Keuser, M. and Frey, M. (2014). *Effects of a new Steel Fiber in Concrete under Small-Caliber Impact*. Universität der Bundeswehr München, Neubiberg: Doktorarbeit.
- Zircher, T., Keuser, M., Braml, Th., Berg, A. and Burbach, A. (Oct. 21-25, 2019). 18th International Symposium for the Interaction of Munitions with Structures. *Investigations on the use of fiber concrete for infrastructure protection*. in Panama City Beach, FL, USA.
- Zohrabyan, V., Braml, Th., Zircher, T. and Keuser, M. (Oct. 21-25, 2019). 18th International Symposium for the Interaction of Munitions with Structures. *The residual load bearing capacity of reinforced concrete as well as steel fiber reinforced concrete components after contact detonation*. in Panama City Beach, FL, USA.