

PREDICTION OF THE FLYING FRAGMENTS TRAJECTORIES AFTER VBIED DETONATION

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Abstract: The design process introduces not only solutions included in typical standards but must fulfill also extraordinary conditions for structural safety. One of them is unique threats such as incidental terrorist attacks or blast fragmentation events. From that point not only default stress-strain relations are important but also uncommon solutions for increasing structural strength or using sophisticated materials. The research presented is the final results of the regional grant dedicated to public safety under IED actions. The primary objective here was to measure the results of the detonation of dozens of IEDs primarily including the flying fragment and blast pressure. This data allowed the building of the numerical tool for analysis of the final effect based on the introduced numerical code. An exemplary view from one of the experiments are presented in Fig.1 and Fig.2. The data based on the previous already published research i.e. Sielicki et al. (2021) and Malendowski et al. (2023).

In the work presented the primary results from the actual experimental tests with VBIED threat was considered. The crucial data was taken as an input for the novelty numerical code for prediction of the hazard zones in the urban as well as critical infrastructure areas. This study is a continuation of the topic which is presented in the research i.e. Marks et al. (2021), Sielicki et al. (2021), Malendowski et al. (2023).



Figure 1: Flying fragments distribution after VBIED tests [Sielicki et al. (2021)].

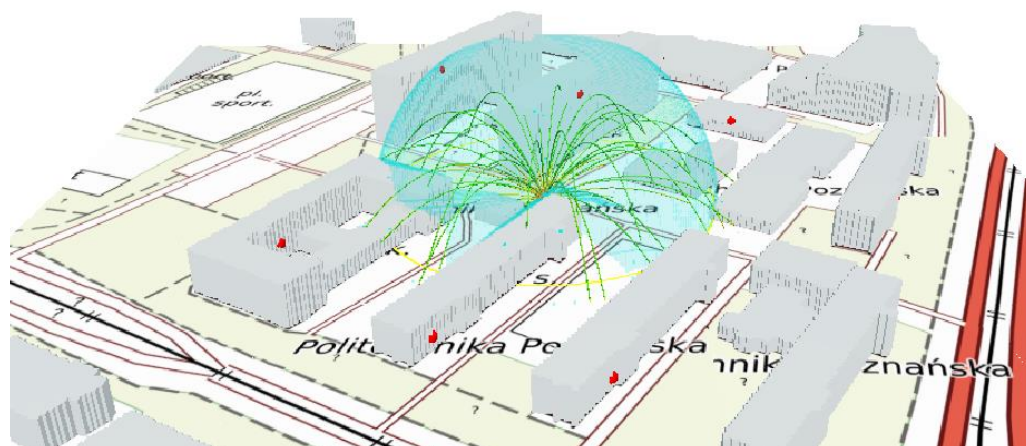


Figure 2: Prediction of the flying fragments and blast wave propagation in the city center area.

[1] Nicholas A. Marks, Mark G. Stewart, Michael D. Netherton, Chris G. Stirling, (2021) "Airblast variability and fatality risks from a VBIED in a complex urban environment", *Reliability Engineering & System Safety*, Volume 209, 2021, 107459, ISSN 0951-8320, <https://doi.org/10.1016/j.ress.2021.107459>.

[2] Piotr W. Sielicki, Mark G. Stewart, Tomasz Gajewski, Michał Malendowski, Piotr Peksa, Hasan Al-Rifaie, Robert Studziński, Wojciech Sumelka, (2021) „Field test and probabilistic analysis of irregular steel debris casualty risks from a person-borne improvised explosive device”, *Defence Technology*, Volume 17, Issue 6, 1852-1863, ISSN 2214-9147, <https://doi.org/10.1016/j.dt.2020.10.009>.

[3] Malendowski M., Sumelka W., Gajewski T., Studziński R., Peksa P., Sielicki P.W. (2023) "Prediction of high-speed debris motion in the framework of time-fractional model: theory and validation", *Archives of Civil and Mechanical Engineering*, <https://doi.org/10.1007/s43452-022-00568-5>