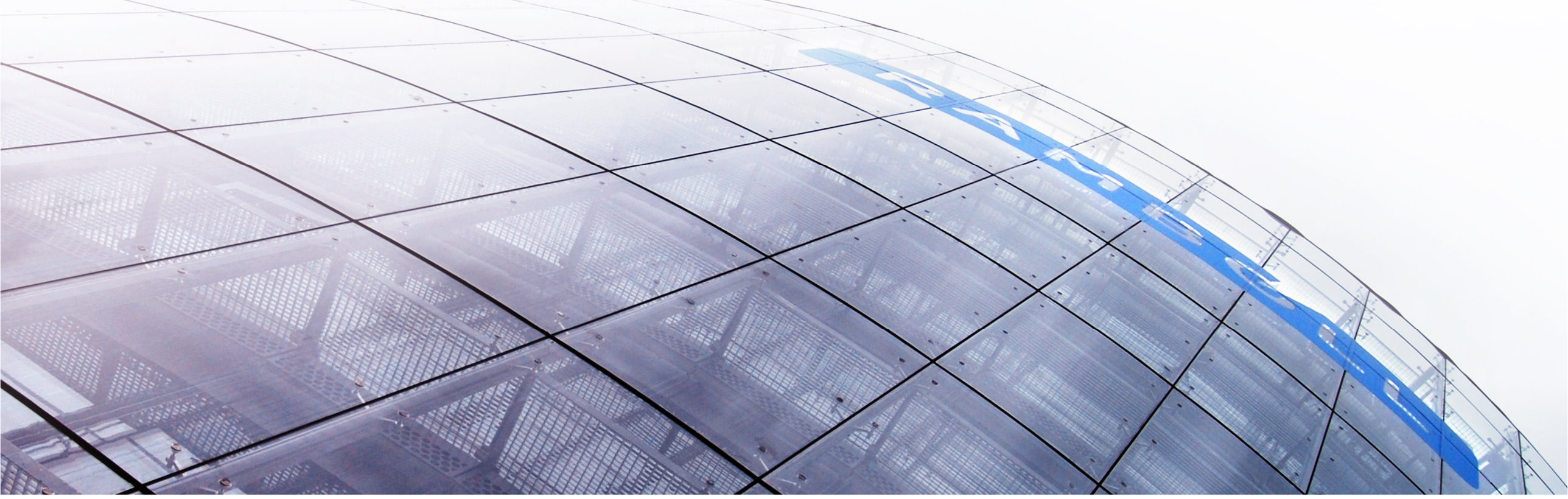

Blast loading on glass in facades

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PROJECT MOTIVATION

Commonly, we have a positive view on glass used in our facades, as it allows daylight to come into the buildings while providing protection against wind and weather. In the event of an explosion, however, glass shatters and will be accelerated to velocities that causes serious injuries (see Fig. 1).
Over the last few decades, an increase in the number of terror-related explosions has been reported, which emphasizes the importance of being able to predict what happens at such incidents and thereby minimizing consequential damage. Fortunately, the risk of an explosion near a given building is very small, but the consequences can be disastrous, especially if the load case was not thought into the design.
The use of glass in our buildings is rising steadily and today there is more glass than ever in our built environment. Despite this, we still lack precise and effective tools for calculating blast loads on glass in facades.

OBJECTIVES

The objective is to develop a generic tool for assisting engineers in developing, designing, and securing facades against extreme dynamic loads, such as pressure waves from explosions and impact scenarios. It is the hypothesis, that such tool can be developed by examining small glass specimens subjected to high-speed loading and then analysing and applying these experimental data to develop a material model for describing the fracture mechanism that can be further implemented in full-scale simulations. The planned project phases are illustrated in Fig. 2.

RESEARCH CONTRIBUTION

It is the academic goal to determine the dynamic properties of soda-lime-silica glass at varying loading rates primarily in a range equivalent to blast loads, as this is almost unreported in the literature. Based on these results, it is also the goal to develop and validate a numerical model capable of predicting the response of glass exposed to blast loading.

COMMERCIAL POTENTIAL

Unfortunately, there is no prospect in that the trend of the increasing number of terror related explosions is changing, which is why the focus is directed more and more towards the safety of our buildings and especially the facades.
Ramboll lives on having expert knowledge in a variety of areas, and with this project the possibility of expanding its knowledge and expertise in that field is clearly seen. Thus, there is a commercial potential in being able to offer services within simulation of explosions and blast secured facades, since both full-scale and scaled tests are highly advanced but also very costly.
Furthermore, a market is seen where the new expert knowledge can be used with advantage to consult building owners and municipalities in regard to risk assessment of new buildings as well as existing buildings.

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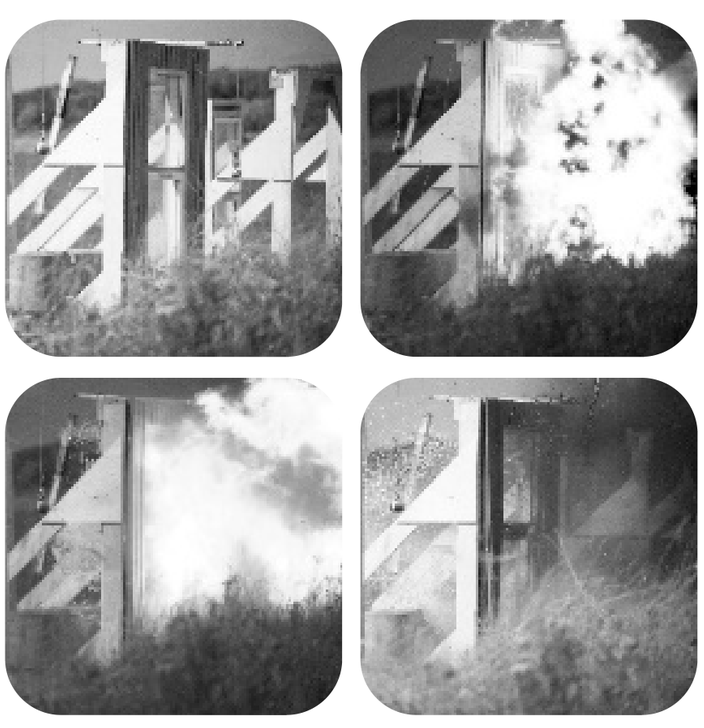

Figure 1 Blast test on a regular window with insulating glass units (IGU), detonating 250g explosives. As shown and expected, the glass shatters and poses a serious threat to persons behind. (High-speed recordings: Phantom v2512, 25.000 fps)

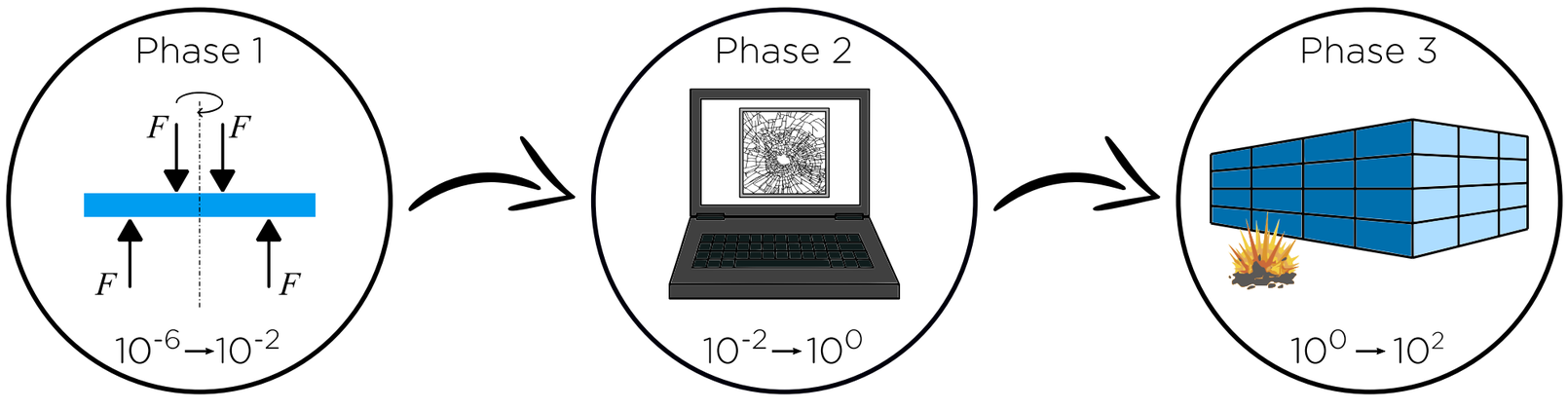

Figure 2 The project flow, illustrating the content of the planned three project phases together with the order of magnitude to be studied.

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RESEARCH, TECHNOLOGY & GROWTH
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