

AN ASSESSMENT OF ARCHITECTURALLY APPEALING, SEMI-OPEN SHOCK MITIGATION DEVICES

Rainald Löhner¹ and Joseph D. Baum²

¹Center for Computational Fluid Dynamics
Dept. of Computational and Data Sciences
M.S. 6A2, George Mason University
Fairfax, VA 22030-4444, USA

²Advanced Technology Group, SAIC, McLean, VA, USA

ABSTRACT

The blast mitigation potential of architecturally appealing alternatives to blastwalls is investigated numerically. Seven different designs are compared. It is found that for some of these, the maximum pressure is comparable to usual, closed wallwalls, and the maximum impulse approximately 50% higher. This would indicate that such designs could offer an alternative blast mitigation device that city planners may find acceptable.

1. INTRODUCTION

Explosions remain the most frequently used form of terror attack. They represent a low-tech, cheap, abundantly available resource that produces the desired destructive, psychological (mainly fear and rage), publicity (monopolization of news), economical (disruption of travel, commerce, investment and consumption) and political (destabilization) effects. Traditional ways to mitigate blast effects include the establishment of safe distance perimeters, reinforcement of windows and walls, as well as walls and other protective structures. Achieving acceptable standoff distances may not be possible in city environments. Walls, the logical blast mitigation device, typically affect negatively the urban landscape, and may therefore not be acceptable to city planners. This has led to the quest for architecturally appealing shock mitigation devices. The main criteria considered were the following:

- Unobtrusiveness to pedestrians: the device should not affect the movement of pedestrians in the vicinity of buildings;
- Visual appeal: the device should not affect the visual landscape of buildings; this implies that the devices considered must be either completely or semi-transparent.

The compromise solution considered here consists of thick, bending-resistant shapes made of acrylic material that may be Kevlar-reinforced.

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2. CALCULATIONS PERFORMED

In order to test the concept, the model problem shown in Figure 1 was studied. The different alternatives tested, as well as their 'footprint', are shown in Figure 2. The blast loads were computed with FEFLO, a code that has been used repeatedly for such applications [1-3]. A grid refinement study was carried out for the first case. Once a sufficiently converged result was achieved, the same mesh-size parameters were used for all subsequent geometries. This resulted in grids of approximately 3 Mtets. A typical run is shown in Figure 3. A comparison of the loads seen by window S1 and a comparison of the maximum pressure and maximum impulse seen by the front face of the building are given in Figures 4-7. Note the large spread in values.

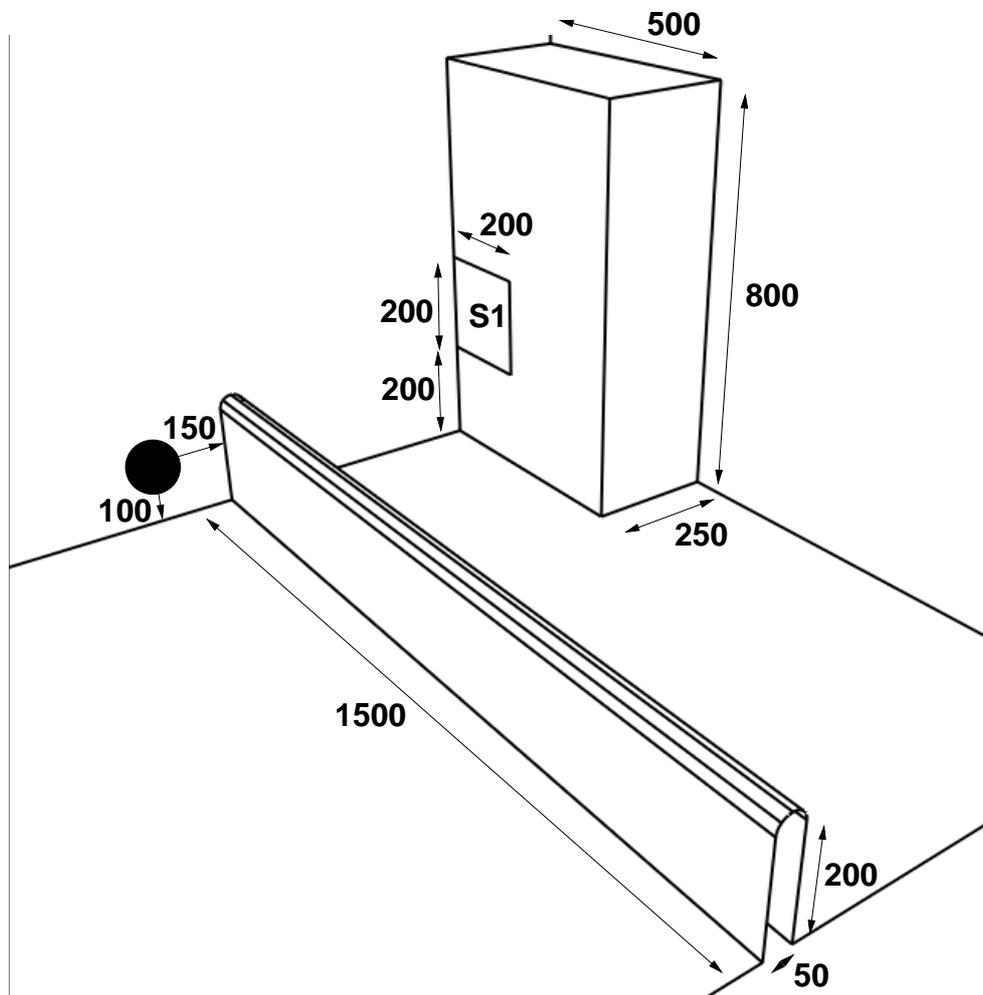


Figure 1 Base Configuration

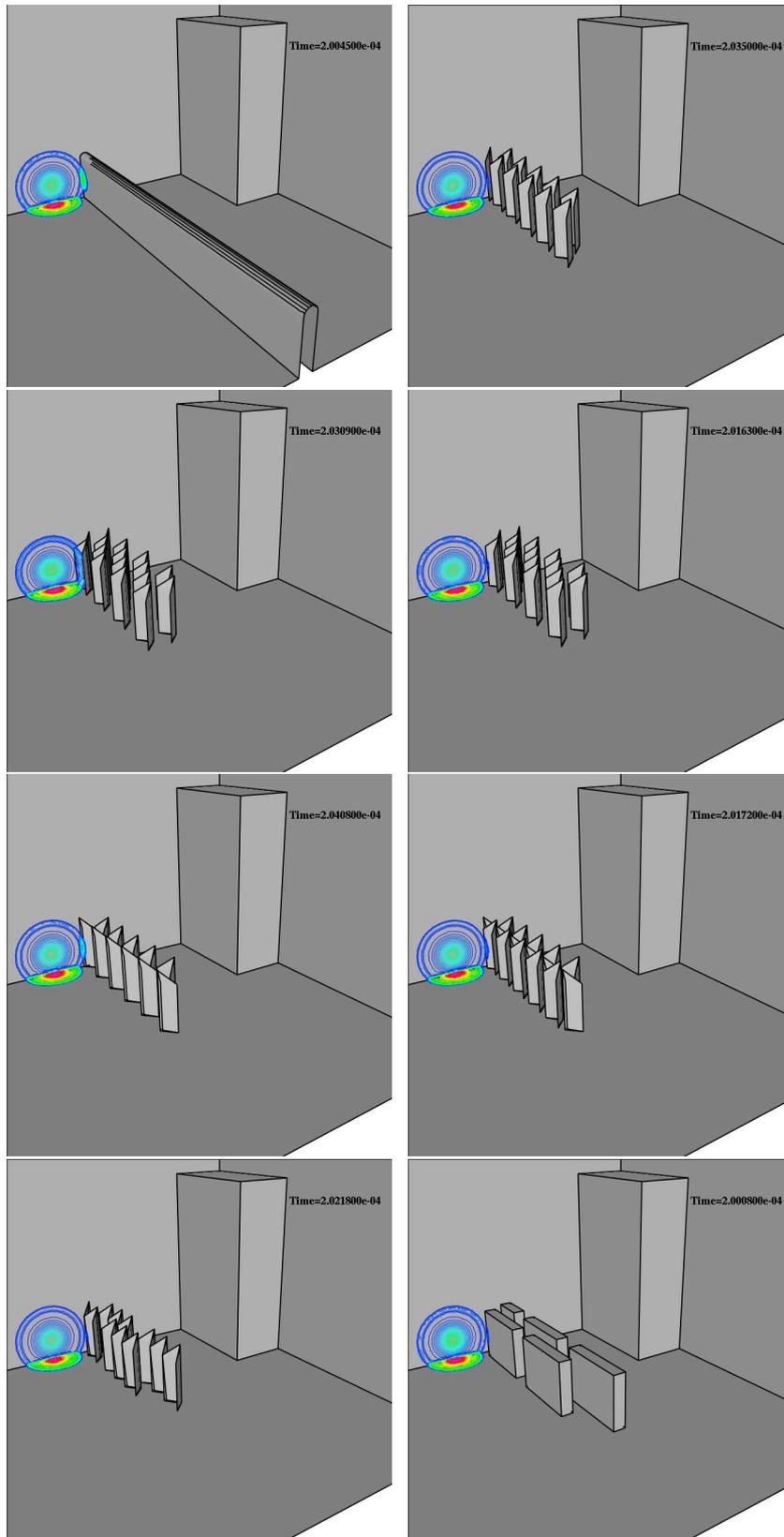


Figure 2 Alternatives Considered

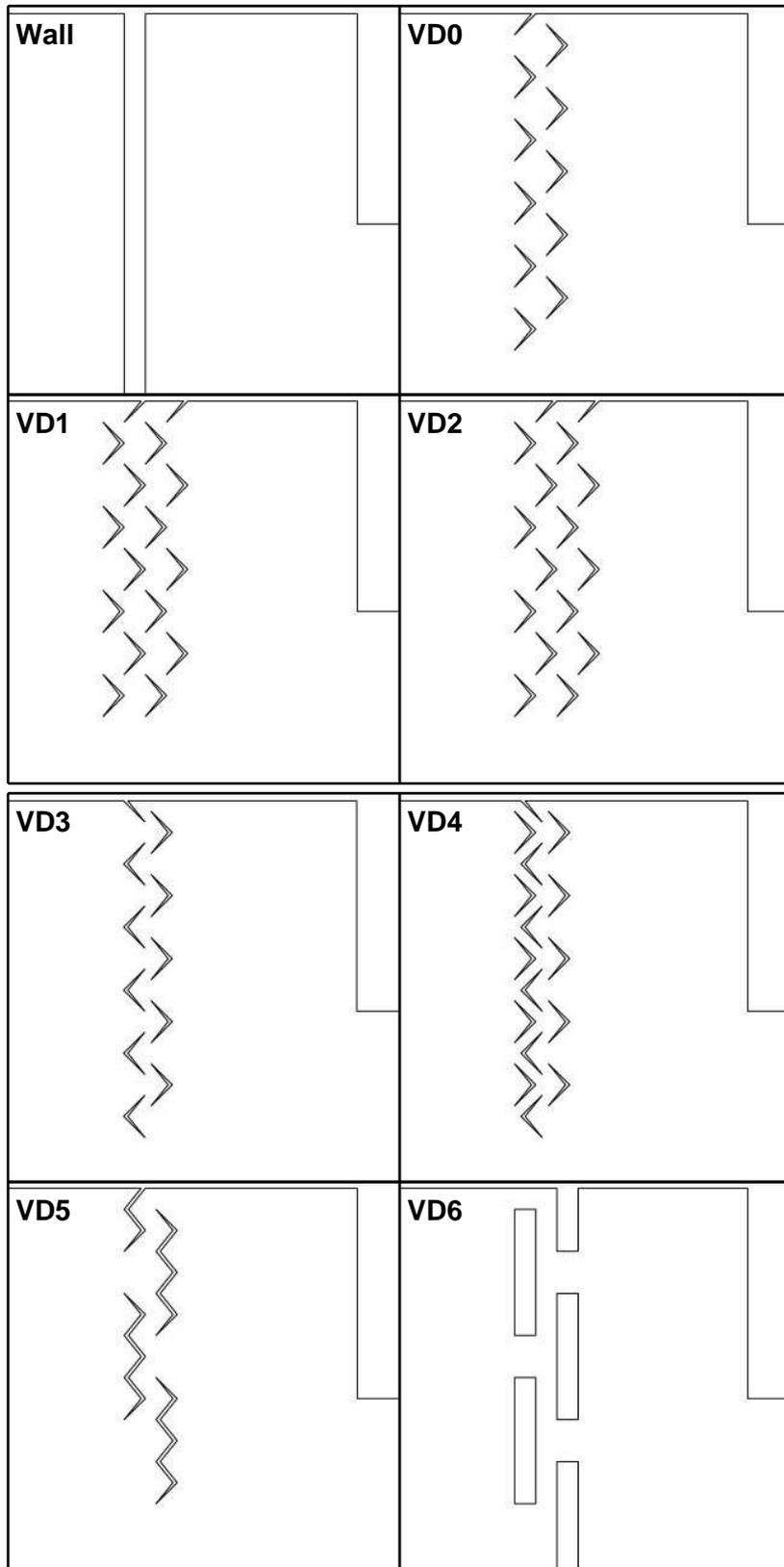


Figure 3 Footprint of Alternatives Considered

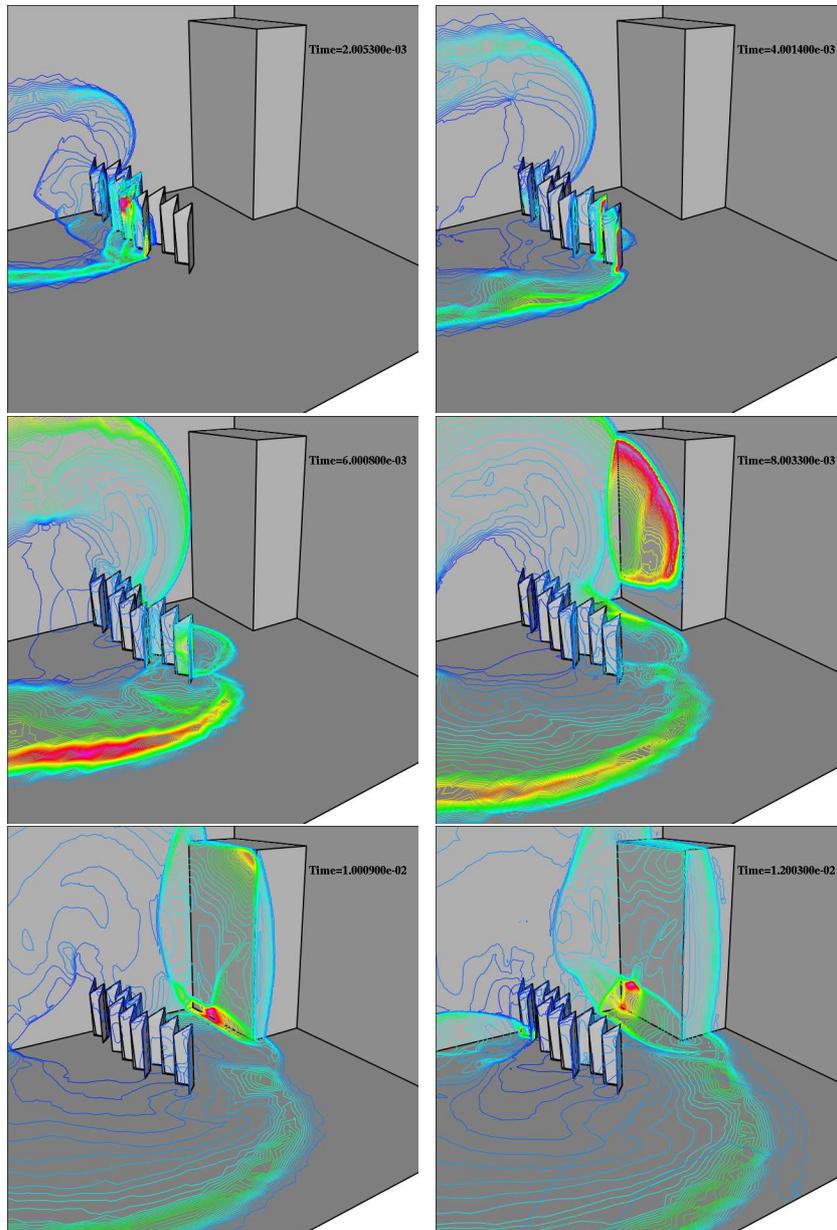


Figure 4 Typical Run

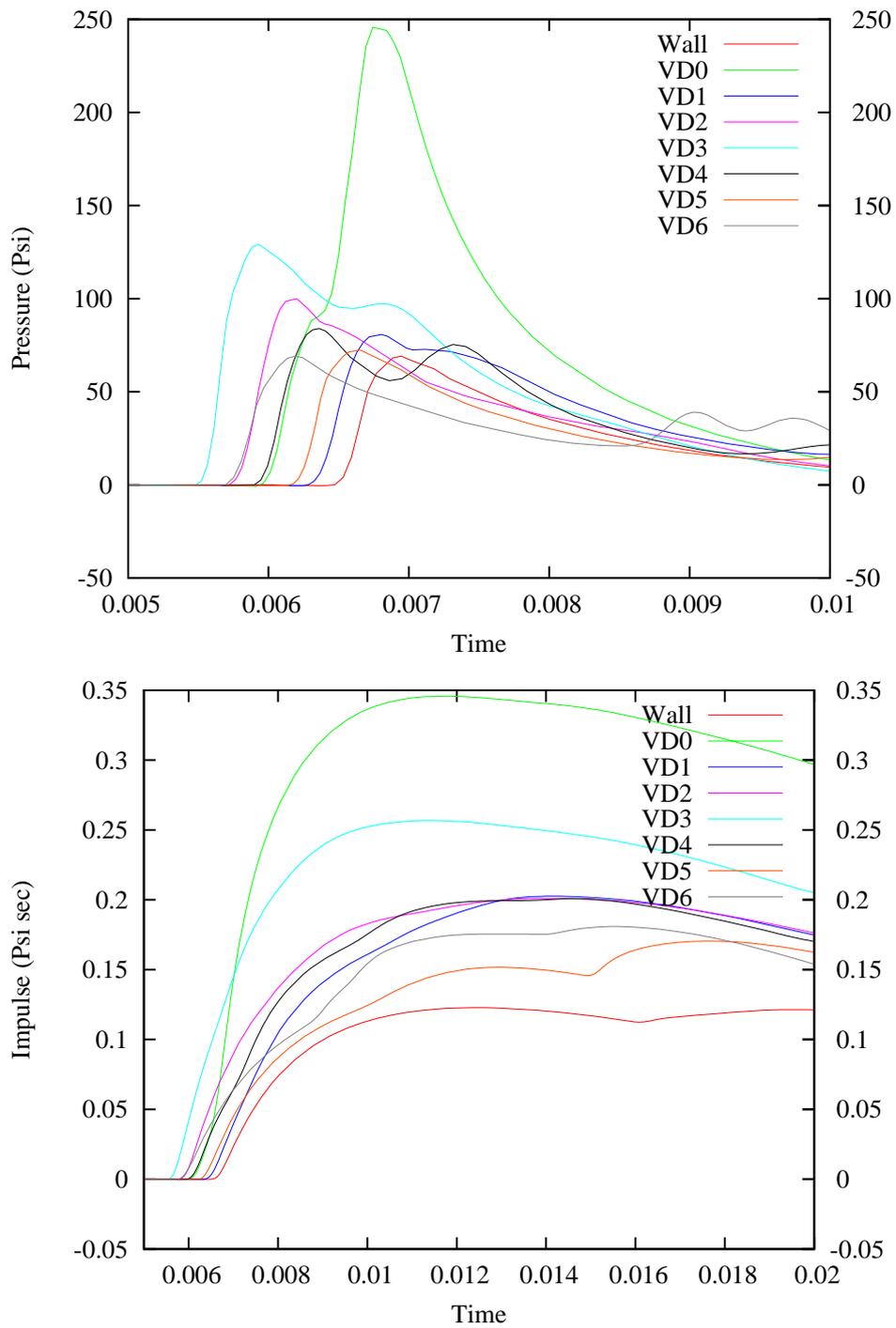


Figure 5 Comparison of Pressure and Impulse Time Histories

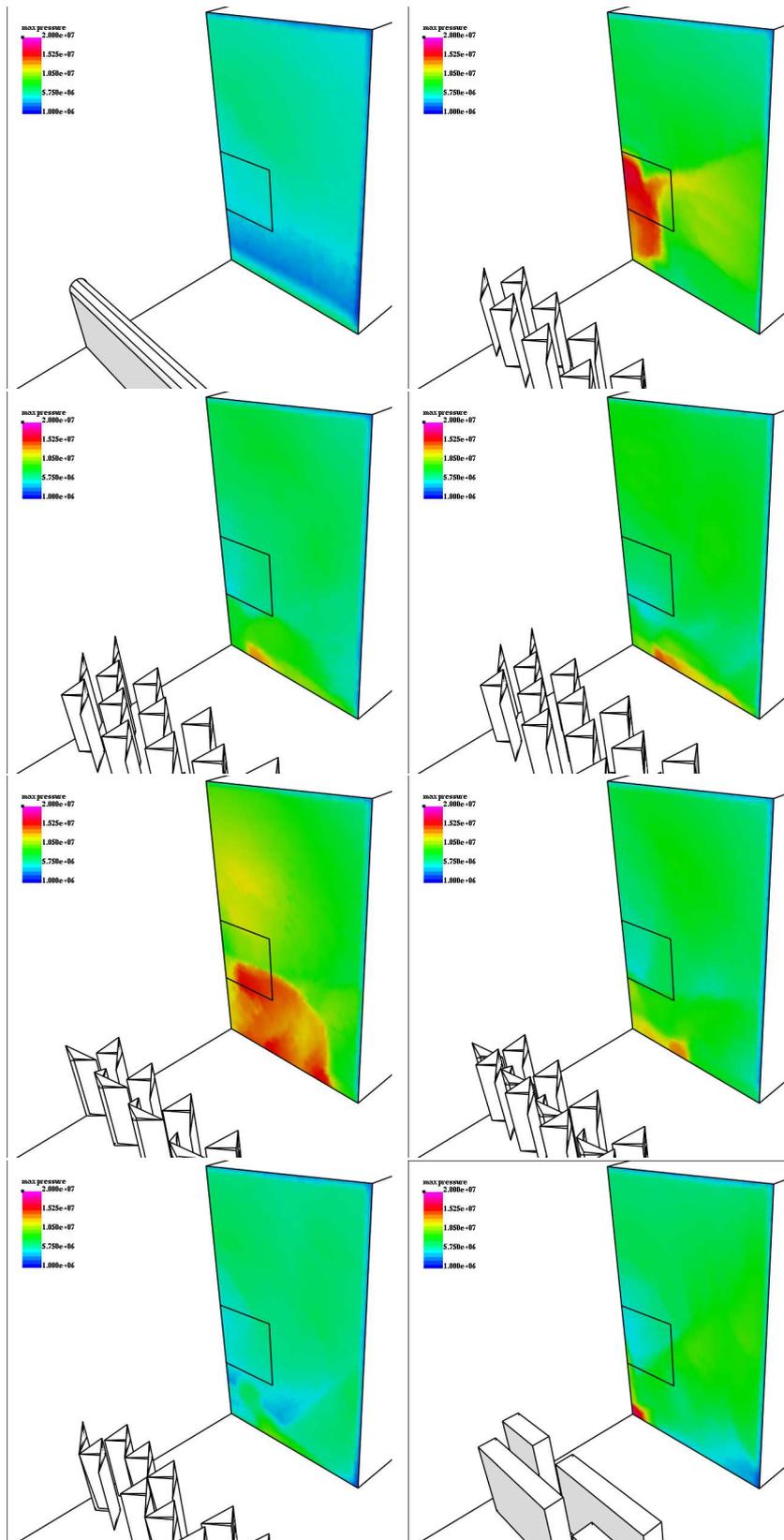


Figure 6 Maximum Pressure on Wall

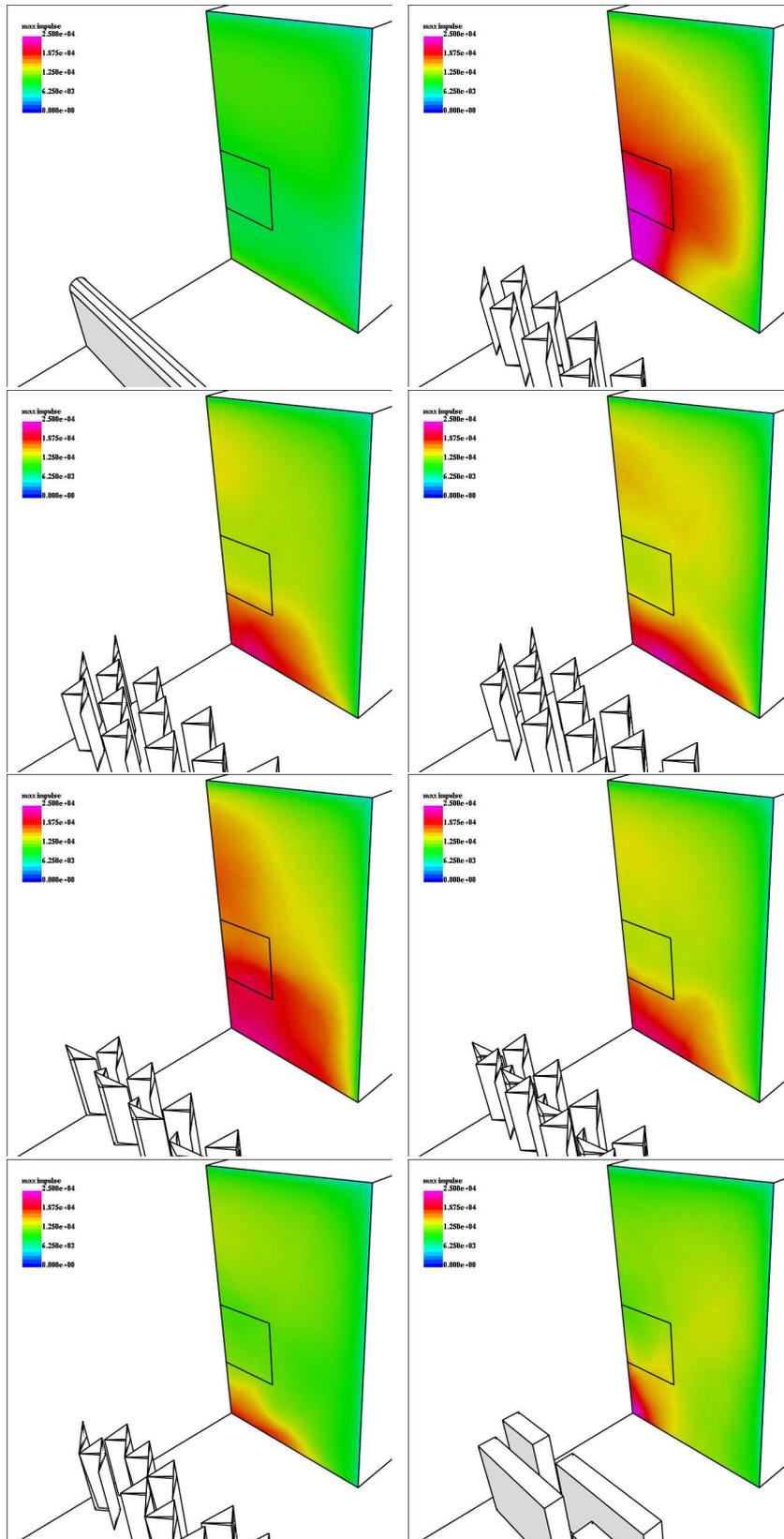


Figure 7 Maximum Impulse on Wall

3. DISCUSSION

The inspection of the results obtained immediately indicates that designs VD0 and VD3 are not competitive. Their maximum pressure and impulse as compared to the closed wall are up to 300% higher. The best designs are VD5 (3-1 L-elements) and VD6 (broken wall). For both of these the maximum pressure is comparable to the closed wall, and the maximum impulse approximately 50% higher.

4. CONCLUSIONS

The blast mitigation potential of architecturally appealing alternatives to blastwalls has been investigated numerically. Seven different designs were compared. It was found that for some of these, the maximum pressure is comparable to usual, closed wallwalls, and the maximum impulse approximately 50% higher. This would indicate that such designs could offer an alternative blast mitigation device that city planners may find acceptable.

Future work will consider fully coupled fluid-structure runs for the more appealing designs, in order to assess whether such devices can be manufactured from commonly available materials such as acrylics or other poly-carbonates.

5. REFERENCES

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