Vertical Rising Self-operated Flood Barriers as Adaptation Measures to Climate Change

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1 INTRODUCTION

As storm events become more intense and more frequent and as sea level rises due to climate change the risks of river flooding, flash flooding and coastal flooding increase. Lives, properties and infrastructure are at risk of damage due to flooding. Measures may be taken to reduce the risk of flooding such as making the ground more absorbent, deepening and widening rivers, creating retention ponds etc. However, there are cases, such as properties in historic areas where no such measures are effective or feasible.

An effective and feasible solution is to adapt the built environment to "*live with the floods*". Self-operated vertical-rising flood barriers prevent the entry of flood water from the flooded area to the protected area (Figure 1). The barriers, normally hidden below ground level, have the following key characteristics:

1. The barriers blend with the existing environment
2. During normal use, the barriers allow unobstructed passage of traffic
3. On flood risk, the barriers are automatically activated, blocking the passage through which flood water might enter into the protected area, without the use of electricity or human intervention
4. During flood conditions, the barriers withstand the loads from hydrostatic pressure, waves on the water surface, currents and wind as well as accidental loading from debris impact such as vehicles, trunks etc carried by the flood
5. The rate of water (if any) passing past the barriers by leakage and overtopping is within acceptable levels,
6. After the flood, the barriers return to normal position quickly without the need of pumping

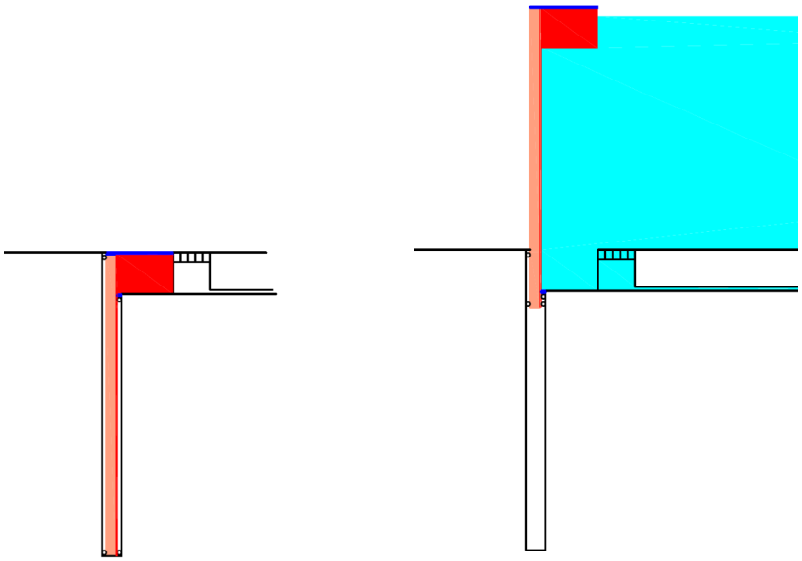

Figure 1 *Vertical rising flood barrier*

2 HOW THE BARRIER WORKS

Gravity and buoyancy are the two main actions that govern the operation of the flood barrier. During normal use gravity keeps the barrier hidden below ground. On flood approach, water enters the underground space

in which the barrier is resting. The barrier has a buoyant body protruding at the crest of the vertical flood gate. Hydrostatic uplift pressure acting on this protruding body lifts the gate as flood level rises, the crest of the flood gate rising ahead of the rising flood. (Figure 2)

The innovation of this system lies in:

- the design of the buoyant body which is robust to traffic loading passing over it in normal use and
- the struts of the flood gate which provide robustness in their performance as cantilevers as well as guides for sliding up and down without out of plane rotations.

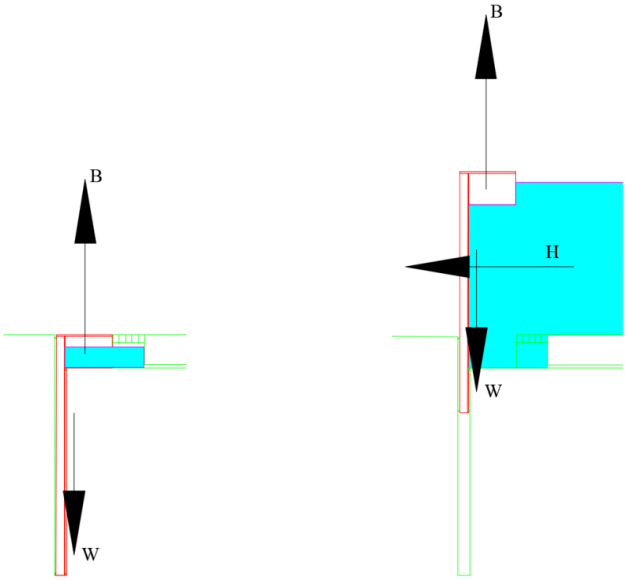

Figure 2 *Forces applied on vertical rising barrier*

3 HOW THE BARRIER IS BUILT

The barrier is fabricated using non-ferrous materials. All structural members are aluminium profiles, the buoyant material is extruded polystyrene, encased in bodies built using composite aluminium plates, the seals are neoprene.

The barriers are built in modular form so that they are easy to transport and install on site. The housing in which the barrier slides up and down is also the packing housing.

4 ADAPTATION MEASURE

Vertical-rising self-operated flood barriers are ideal adaptation measures in cases where the risk of flooding increases, lives, properties, infrastructure are in danger and living with the floods is unavoidable, such as:

- entrance to underground spaces, for example train stations, car parks, subways
- entrance of museums, historic buildings,
- along river banks, canals

The footprint of the flood barrier is relatively small, having a length of about 1/3 the flood level. This exposed footprint surface may be built with materials which are in harmony with the built environment.

REFERENCES

Toumazis A. (2018). Liquid Barrier. UK Patent Office, Patent application no. GB 1606562.5.