TAKING THE FLASH OUT OF FLOODS – Building a Flash Flood Proof House by Tom Robbins

When I Googled flash floods, there was a lot of information on the personal and economic impact of these natural disasters but not much offering solutions to the problem. I decided to see if I could design some simple solutions that could be permanently ready to minimise loss.

Flash floods occur when rain falls more intensely than the ground can absorb and creates a big wall of water that causes destruction. Humans have increased flash flood risk by changing the environment in a way that reduces the capacity for the water to drain away safely, for example - roads, deforestation and mining. Finding solutions to flash flooding is necessary as global development continues and more extreme weather is caused by Global Warming.

The UNSW Water Research Centre, published in the Nature Geoscience journal June 2015, suggest that peak rainfall during storms will intensify as the climate changes, leading to increased flash flood risks. Co-author and UNSW engineer, Professor Ashish Sharma said, "It means that most people in Australia can expect to see intensification in the magnitude of flash flooding in smaller catchments, particularly in urban or residential areas". Co-author Conrad Wasko, from the UNSW School of Civil and Environmental Engineering stated, "The climate zones we studied in Australia are representative of most global climates, so it's very likely these same trends will be observed around the world."

Flash floods in populated areas can cause property damage and loss of life. The water builds up power as it moves downhill creating a wall of water and debris that knocks over everything in its way. The rapidly rising water also creates a risk of drowning. Even after the water has gone, communities are impacted by the damage to homes, services, food and fresh water. We need to find ways to reduce the impact of flash floods.

Whilst flash flooding is a complex problem I have chosen to look at an effective design solution that protects people's homes as this has a direct benefit of saving lives and providing shelter after the flood has passed. Specifically, I have chosen a realistic high risk scenario being a house on the incline of a hill.

In creating my design, I considered the practicality and cost efficiency, materials and labour. I also needed to ensure that the house and surrounding property remain convenient and visually pleasing so that people still wanted to live in it. Paramount in the design was the need to operate independently and quickly at any time, including when people are asleep. One of the challenges in designing a prototype was considering other potential risks created by the structural changes.

My first design idea was to put the house high on piers secured into the hillside so that the water wall would wash under the house but I realised that may not be practical to live in and would not reduce the risk to other homes down the hill. I decided it would be better to have the piers at a normal home height but have the water channelled into a pit and move under the house through a large pipe. To reduce the risk of people and animals falling into the large pit, I included a trap door that opened the pit when the flood hit. I decided to fill under the house with small rocks for both safety and convenience. The rocks would allow easy access to the house from all sides and still drain any flood water down to the pit and the underground pipe.

I still needed to solve the danger caused by the speed and power of the initial water wall. My first design solution was to strategically place trees or bollards uphill from the house to divert and slows the waters descent. I preferred this to a full wall barrier as it would still allow animals to easily move through the area just like a forest. My final design solution was to place a final front barrier to take the impact instead of the house but still look like a normal fence. I then realised that the pit trap door and the fence barrier could work together. When the flood water hits the fence barrier, the trap door lid opens and forces the water into the pit and provides a taller protection barrier for the house. The water finally exits the pit through the pipe at a slower rate so that other homes below are protected.

I did some diagrams of my design before building the model so that I would know what materials I would need and to consider any design problems. I built the model using a wooden box we had plus balsawood which is easier to cut and glue but did create some waterproofing problems.

My final design worked well at diverting the water safely away from the house. In fact, the hill bollards initially worked so well in absorbing the water wall that insufficient water hit the fence barrier to open the pit. In testing I had to increase the angle of the hill and the speed I poured the water in order to have enough water force to open the pit.

After testing, I believe the design would benefit from backup sensors and motors to ensure that the trap door always opened. I would get an engineer to calculate the best size for the pit and pipes for moving the water and construction cost.

A key practical design feature is the house can be constructed from typical materials such as brick or timber without compromising its effectiveness. This is because all the design is focused on keep the water away from the house.

Throughout my project my dad helped me by asking questions about my design drawings and assisting with any tools that were too dangerous for me to use on my own. My teacher, Mr Fairhurst, helped me organise the order of my report.

https://www.engineering.unsw.edu.au/civil-engineering/news/flash-flooding-risks-increase-as-storm-peak-downpours-intensify-research-shows#sthash.yake8dcy.dpuf