Ideal Safe Building

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Situation

Natural disasters such as earthquakes, tsunamis, fires, and excessive winds are increasing worldwide. Areas on the north coast of the United Arab Emirates (UAE) such as Ras alKhaimah and Fujairah, in addition to some parts of Oman are highly prone to such disasters, because they are the closest areas to the sea. We chose this topic specifically to be able to protect civilians which are occupying such areas, and to decrease casualties to the minimal(not only in the region, but also worldwide).

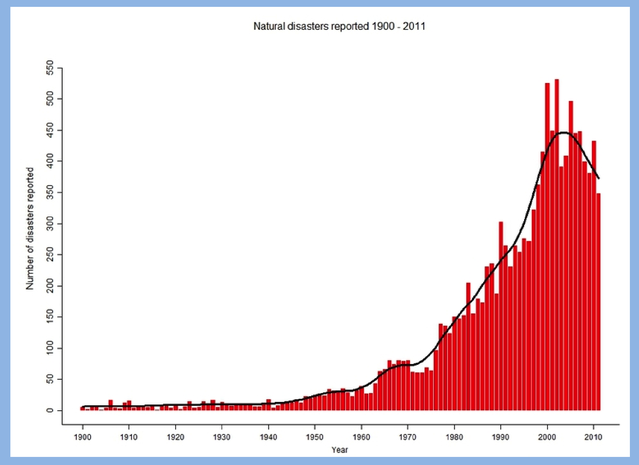

Fig. 1: Worldwide natural disaster report [1]

Problems

- Excessive deformations in buildings causes structural failure when hit with an earthquake, tsunami or high speed winds.
- Sever injuries happen because of broken glass shattered across the building.
- Accidental manmade fires and post earthquake fires destroy buildings and the environment around them.
- A lot of waste will be produced from the testing process.
- Difficult to simulate real life natural disasters in a lab or environment ,also space required for these tests is difficult to obtain.

Solutions

- Magneto Rheological (M.R) dampers and base isolation which can absorb and dissipate the vibrations caused by the earthquake [2].
- A major application of Polyvinyl butyral (PVB) is laminated glass. PVB film is placed between the glass to increase its strength and to prevent the glass from shattering.
- During the experimental phase, there will be a vast amount of waste material, and this could be recycled and reused for the production of other testable buildings.
- Piles will be installed on the bed rock to stabilize the building and increase its structural strength, in addition shear walls protects the building from massive wind loadings and therefore reduce the impact on the actual walls of the building [3].
- The building walls would be coated with a fire retardant paint, which prevents the fire from spreading through out the entire structure. Moreover, circuit breakers would be installed within the electrical wiring of the building to further reduce the risk of fire.
- Build a specific testing lab that takes into account, the requirements needed for testing the design.

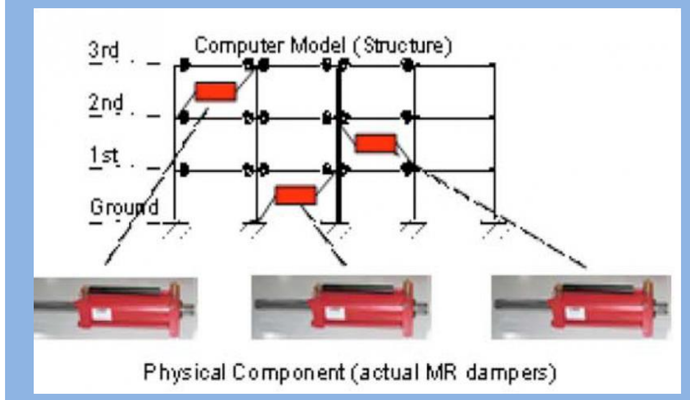

Fig. 2: Simulation of MR dampers in an anti earthquake structure [4]

Evaluation

Advantages

- The project can help decrease death rate and save lives throughout the world.
- More people can live in the same amount of space as required before.
- Higher buildings can be built on weak soil.
- It is economically beneficial to have these buildings in the long run.

Drawbacks

- Testing the design will be energy intensive and expensive.
- Technological advancement requires a lot of training.
- Insufficient time to test the theories, thus the project is mostly theoretical.

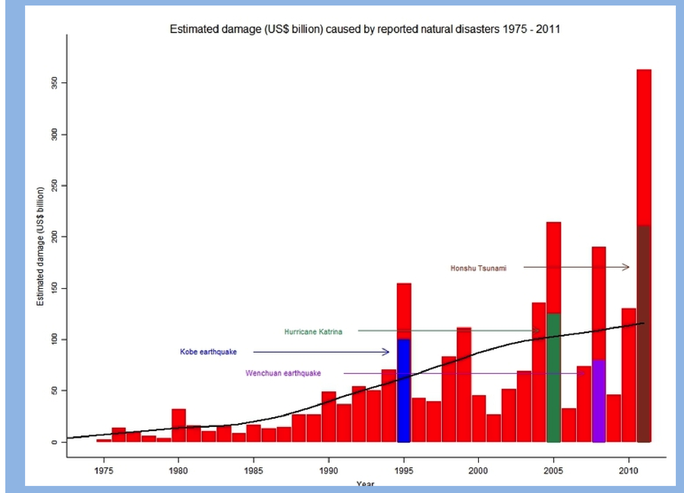

Fig. 3: Cost Analysis [1]

[1] The International Disaster Database.(2012).Natural Disaster Trends.[Online].Available:https://www.embat.be/natural-disasters-trends
[2] Ha, Q.P.; Nguyen, M.T.; Li, J.; Kwok, N.M., "Smart Structures With Current-Driven MR Dampers: Modeling and Second-Order Sliding Mode Control," *Mechatronics, IEEE/ASME Transactions on* , vol.18, no.6, pp.1702,1712, Dec. 2013
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[3] MCEER Information Service, "*Advanced Earthquake Resistant Design Techniques"* Retrieved January 12, 2007, from http://mceer.buffalo.edu/infoservice/reference_services/adveqdesign.asp
[4] G.E. Brown.(2007). Semiactive Control of Nonlinear Structures[online], http://nees.org/warehouse/experiment/ 154/project/21