

Storm Resistant Affordable Housing in Agra, India

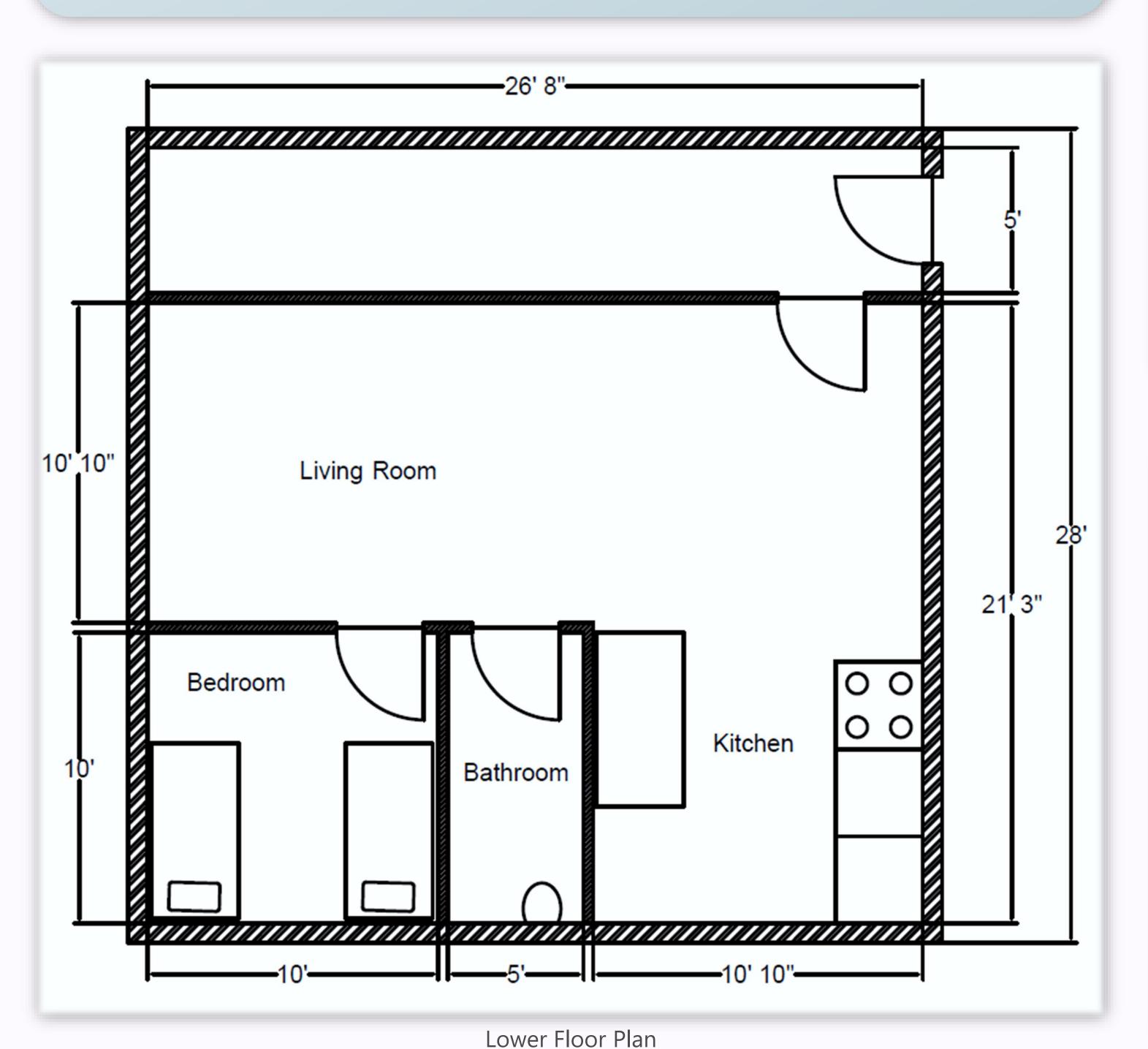
James Englander (Robotics), Troy Otter (Aerospace), Erin Thibeault (Robotics), Josh Thomas (Civil)
Advisor: Professor Soroush Farzin-M, Professor Courtney Kurlanska

Abstract

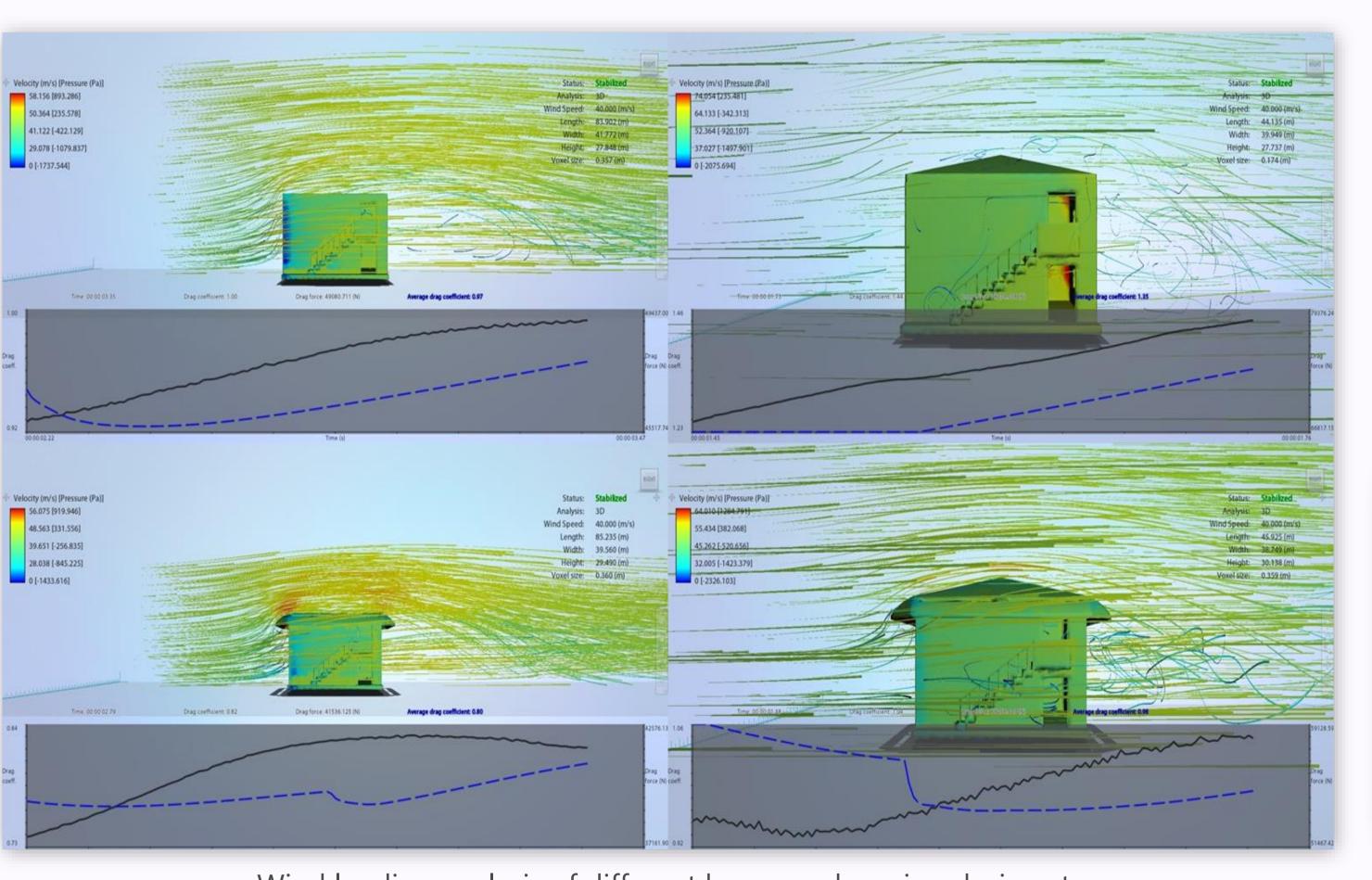
Currently, the slums are populated with inadequate shelters for the increasingly dangerous conditions present in Agra, India. In the most recent dry season, one dust storm leveled many slum residences resulting in nearly 125 deaths. The families and individuals left with no shelter then had to brave the severe rain and flooding during the monsoon season. In this project, we design a shelter, which has a slotted awning to help reduce the wind loading on the structure, and GFRG panels to improve strength and ease of construction. We modeled the building, performed a cost analysis, and created a plan for the construction process of an initial run of 5 houses, that meet all of the constraints put on houses in Agra slums.

Constraints

- Vasta Shastra, the doctrine of Hindu architecture, is reflected through orientation, site planning, and proportionality by placing kitchen on east side and living space on north end
- Average family size of 6.7 people per house
- > Typical house size ranges from 729 ft² to 900 ft²
- Average monthly income of 40.67-67.78 USD per household
- Area of undersized and structurally deficient urban slums
- Dust storms and monsoons impact the structurally integrity of the houses and the safety of the residents with their high winds and flooding



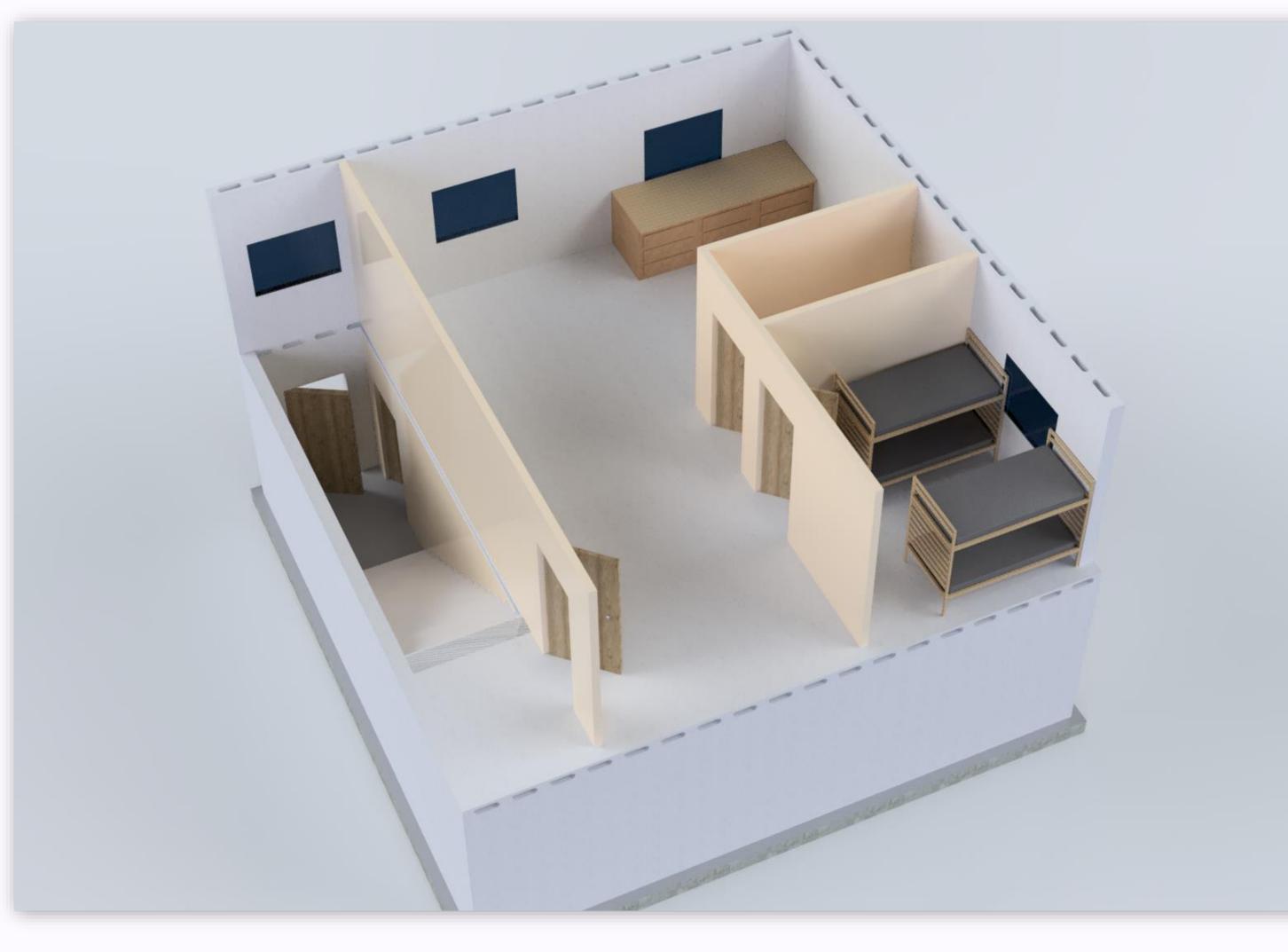




Wind loading analysis of different house and awning designs to determine the most effective design solution

Design

- Glass Fiber Reinforced Gypsum (GFRG) panels for walls
- Flat roof with slotted awnings
- > Liquid barrier on bottom of walls
- Shield for door
- > 10-week implementation process



Cost & Construction

- Compared the cost of brick and GFRG
- A brick building would be slightly cheaper, but GFRG panels reduce maintenance cost and greatly reduce construction time
- Estimated construction cost: 8500 USD
- Estimated furnishing cost: 1000 USD
- Total estimated cost: 9500 USD

determine the most enective design solution														
Affordable Housing in Agra Gantt Chart *= Calculated Value														
Task	Start	Duration *	* End	Months Prior	1	2	3	4	5	6	7	8	9	10
Fundraising		-				5								
Community Meetings	1	8	8											
Design Input	3	8	10											
Worker Recruitment & Training	9	10	18											
Site Preparation														
Site Clearing	16	4	19											
Site Grading	19	5	23											
Materials Transport	21	5	25											
Construction														
Foundation Laying	23	3	25											
1st Floor Wall Construction	25	6	30											
2nd Floor Laying	31	2	32											
2nd Floor Wall Construction	33	6	38											
Roof Construction	38	3	40											
Interior Furnishing & Finishing	36	7	42											
Wrap Up														
Site Cleanup	40	5	44											
Move In	44	2	45											
Community Debrief	46	5	50											