

13 - Flying Carpet for Fire Departments

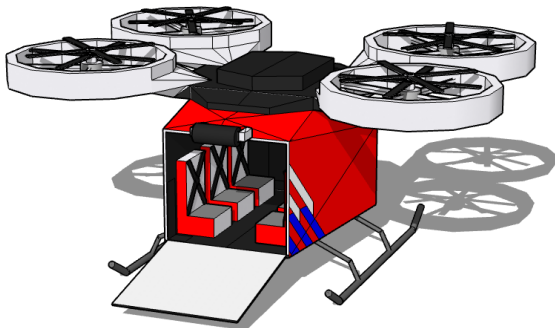
Between 2009 and 2013 US Fire Departments reported an estimated 14,500 high-rise building fires per year. High-rise buildings are any buildings over 70 feet (~ 21 meters) tall. This is currently also the maximum height any firefighter can reach externally by means of a vehicle, at least at the moment. Nowadays buildings can reach up to several hundreds of meters tall which poses issues for rapid evacuation in case of an emergency. Additionally rapid evacuation through external means is rarely possible above a certain height. The *FireFly* aims to solve this issue by providing an external evacuation route from high rise buildings in case of disasters such as fire, toxic fumes and many other scenarios.

Mission Objective

The purpose of the system is to provide safe and rapid evacuation for emergency situation in high-rise buildings up to 1000 meter tall where no external evacuation infrastructure is in place.

The evacuation procedure is done in three main steps. The first step in the procedure is transportation, unloading, and initialisation of the system. The second stage consists of ascending to the required altitude with 1 firefighter on board. The longest part of the mission then comprises of the craft maintaining altitude while it approaches the side of the building and folds its engine arms in such a way as to maintain rotational stability while at the same time providing minimal clearance space. During this stage a bridge unfolds from the cabin to allow evacuees to be rescued while also providing a safe entry method for the firefighter. Finally the last stage involves disengaging and safely landing with at most 6 evacuees on board.

System Design



The craft employs a state of the art propulsion system using recent developments in battery design, namely Lithium Metal batteries. Their superior power density enabled a payload capacity of 6 evacuees or 600 kg while being more reliable and less complex than an internal combustion engine or a turboprop. The craft is completely remote controlled by a firefighter on the ground with the help of a full 360° view of the surroundings which is live-streamed by four cameras mounted on the craft. The extreme gust loading around high rise buildings are mitigated by a PID controller that ensures positional stability of at most 4 cm deviation.

Boarding of the craft will be done via a draw-bridge designed to carry 3 passengers simultaneously to the craft. All structures are made of aerospace grade metal alloys or fibre reinforced composites to ensure light constructions, easy manufacturing and low maintenance.

Since the majority of the craft's mission will consist of hovering next to the building, the propeller was custom built to perform best during hovering. Eight coaxial rotors distributed over four arms are employed to keep the craft in the air for as long as 15 minutes before needing a new set of batteries.

Since high rise disaster usually involves the evacuation of more than 6 people, the craft has a detachable cabin which can quickly be swapped during operations, in the process providing a new battery array to immediately go back up after bringing the previous group of people to safety. This way the ground time of the craft is minimised and as many lives as possible can be saved.