

Vertical Flight Society

2020 eVTOL Infrastructure Workshop Series

Workshop #4 / Urban & Municipality Planning & Land Use

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Question & Answer Session

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QUESTION

Does "6 passengers" include the pilot(s)?

ANSWER

Rik – No it is just paying passengers. Others are crew.

Brian – Current Uber CRM is anticipating (4) Passengers and (1) Pilot.

QUESTION

Would US Coast Guard regulations apply if you have multiple aircraft on the waterborne landing platform simultaneously that sum up to more than 6 paying passengers?

ANSWER

Rik – The simple answer is yes. As such, in principle, if you have one barge with two six passenger VTOLs landing at the same time, you are not USCG compliant, but if you cut the barge in half and make two smaller barges you would be compliant. Having said that if one were to try that trick, I would expect that the USCG and others will find a reason why you cannot get away with that too easily.

QUESTION

I'm interested in Developing Skyports / Vertiports for eVTOL / UAM Use Cases. However, I'm in Kansas City. I'm most interested in the Microgrid, IoT / Edge Solutions and the Wireless Connectivity. I am deep into each of these verticals and quite capable, but NOT an Electrician or an Engineer. I'm a Real Estate Development Project Manager...including Entitlement and Permitting. What are the most difficult challenges that Municipal Planners are faced with and what Solutions are needed to integrate UAM into the Transportation Electrification Master Plan (TEMP)? Is anyone checking the TEMP of Municipalities? If so who?

ANSWER

Brian - Planners and developers will likely face similar issues with respect to Skyport develop:

- Land Use / Zoning
- Site Selection
- Community Acceptance
- Infrastructure Capabilities (existing grid infrastructure)

Existing zoning and land use rules were not created with this new form of transportation

in mind. Ideal site locations (based on rider demand) that cannot be approved due to existing environmental or other reasons could negatively affect the commercial success of urban air mobility. Noise considerations will remain the biggest concern to address with community acceptance. Electrical grid infrastructure will certainly be a factor in Skyport location selection. Most major cities are already looking into EV transportation, zero emissions goods deliveries, and the acceleration of infrastructure integration to support. Skyport planners and developers will be connected with these efforts.

QUESTION

What impact will bottom-land ownership have on this? Need to be sensitive to who owns bottom-land when anchoring (local vs federal)?

ANSWER

Rik –Yes if we are talking about something floating or a pier above that land, the ownership comes first. Some river or lake or ocean bottom land is privately owned especially close to shore, but a lot of it is federally or state owned. Such lands can be used for commercial purposes, but there generally has to be some type of public good or absence of public nuisance.

QUESTION

My understanding is that San Francisco Bay is navigable, so it is under federal jurisdiction, but San Francisco Bay Conservation and Development Commission (BCDC) seems to have a lot of control over what happens there. Is there a clear threshold where an entity like BCDC can/can't get involved?

ANSWER

Rik – I am not sure about the specifics of the organization you mention, but in general such organizations have quite a voice. Use of public resources and land generally requires input by the public and organization such as the one you mention can have a significant voice. Often the applicant has to show a public benefit above the concerns of any reviewers. When it is a properly certified vessel that carried a VTOL and lands and takes off while the vessel is underway in the Bay nonfederal interest groups have little say, but if the take offs are frequent in the range of a public nuisance the interest group may pipe up and then the law suits start.

QUESTION

So, a barge on spuds (jack-up barge?) is a USCG flag vessel, what regulations apply to design and approval/certification?

ANSWER

Rik – A spudded barge is not a jack up barge. A spudded barge still floats and is moored by piles and the barge slides up and down along the spuds depending on waves and tides. As far as regulations go a barge without paying passengers in protected water gets very little USCG interest.

- The moment it is used for passengers (even boarding and transfer) it becomes a passenger vessel, and USCG rules for construction and inspection apply. The various CFR sections are shown in my presentation. For a barge without accommodations the rules are not terribly difficult to meet.
- Depending on the amount of fuel it carries it may also be a tank vessel, which also has to be USCG certified.
- A jack up barge may have similar USCG requirements plus additional requirements for its jack up gear.

QUESTION

What volts/amps are needed for recharging e-VTOLs? How will this be achieved for vertiports on existing buildings?

ANSWER

Brian – Elevate expects that vehicles will be charged by DC current provided from ground stations where the voltage will be below 800V and the current will be below 500A per pad. If vehicles have a well-defined need, Elevate may consider a current up to 750A at 800 V, but would not exceed that limit. Charging will occur at the minimum rate to meet mission needs so as to minimize costs and maximize charging efficiency.

- Elevate anticipates that most charging will occur well below the 400 kW nominal per vehicle maximum, 600 kW absolute maximum.
- To facilitate this level of power provision, Elevate intends to be selective with its skyport locations and select those which can support the modelled sustained loads, while using stationary storage systems to facilitate peak load balancing.

QUESTION

Is anyone considering projects to convert current shopping mall rooftops for VTOL operations ?

ANSWER

Chuck – Shopping malls initially appear encouraging, but there are several factors that limit their usefulness: They are usually only 1 or 2 stories, and the roofs are therefore close to the ground. This would place arriving & departing aircraft very near the surrounding areas which may reduce safety, generate objectionable noise, and produce rotor wash. Also, it may be difficult to achieve proper arrival & departure paths to & from the roof depending on neighboring buildings, utility lines, residential areas, etc. Mall buildings are typically constructed of light steel roof framing, frequently long-span open-web joists, which have little excess capacity for handling additional loads as would be the case with a new flight deck and terminal structure. Connecting the new vertiport structure to the existing building columns – and not bearing directly on the inadequate roof framing – may not be feasible either if the columns were designed to carry lighter loads. It may be possible to punch a new series of columns through the building and place new footings for the vertiport structure, but this is an expensive and intrusive process. Lastly, many malls have extensive rooftop mechanical units, ventilators, vents, and other items, that would preclude the construction of a new flight deck system. Not entirely insurmountable, certainly tantalizing, but problematic, yes.

Brian – In the early days of network development, a rider demand analysis will help identify the ideal locations for Skyports. If a shopping mall falls within the vicinity of this analysis it should be considered. However, I would initially suspect that a portion of the parking lot would be a better option for conversion as the structural loads available at the roof will not be sufficient and modifications to make it so would be prohibitive.

QUESTION

Can you give more info on the common reference model being used to begin the design process from an aircraft requirements perspective? What is that aircraft model, what is its size, power requirements, etc?

ANSWER

Brian

- [Uber Air Website](#)
- [Uber Air Vehicle Requirements](#)

QUESTION

How would such VTOL vehicles be secured and powered when parked?

ANSWER

Chuck – During normal flight ops – such as with on-demand flights – the pilot would land, shut down, and be moved to the parking pad by staff, tug (powered & attended or automatic pre-programmed), or by electrified concealed rail path the eVTOL would follow wirelessly. At the parking pad, the pilot would set the parking brake while passengers disembark and board, and battery charging would then take place. When out of the aircraft, the wheels would be chocked, and if away for an extended time, tied down to the deck with quick set & release cables (aviation standards). As for charging, techniques still must be developed. Manually, the pilot or attendant would plug the charger into the aircraft, perhaps mechanically-aided as the charge cables or devices are reportedly quite heavy. Alternatively, a rigid charge connector pivoting up from the deck might be connected directly into the aircraft (must be pin-point positioning) or into a flexible cable stored in the aircraft. Undoubtedly, the charger manufacturers and the aircraft designers need to develop close cooperation between them so to create standards for inter-industry adoption.

Brian – We continue to work with our partners who are developing these aircraft and are ensuring that they are planning and designing for the security of the aircraft when it is parked, unoccupied at a skyport or airport. Aircraft will draw power from their charged batteries while parked on a skyport or at an airport once the aircraft is energized.

QUESTION

How does Uber reconcile the quest to be "neighborly" and flexible with communities while also striving to copy/paste the same design concept for scalability and cost savings?

ANSWER

Brian – The goal is to design for ease of repeatability and scale while reducing the cost of custom engineering for each location. Creating a standard set of design and development guides should not interfere with community engagement and partnered approaches to resolving new impacts. It is not intended for this product to be 'steamrolled' into Urban or Suburban environments.

QUESTION

What is the presumed ratio of the landing areas to parking spots?

ANSWER

Brian – (1) FATO to (4) Parking Positions

QUESTION

Can you clarify the statement that ground movement will not require “the vehicles own power”? Doesn't Elevate white paper indicate wheeled/powered gear vehicles?

ANSWER

Brian – This was an early assumption and may still be an option, however, vehicle manufacturers may decide to eliminate the weight attributed to a powered wheel. To clarify I should say the vehicle will not move under its own ‘thrust power’, meaning the rotors will not be engaged.

QUESTION

Would the concept of operation of powering down the eVTOL and using ground crew or devices (i.e. tugs, rails, etc.) to move the eVTOL from the landing TLOF to the parking spot also exist for takeoff? If so, how would that effect efficiency/throughput assuming you are going to need some time to spool up the rotors and perform safety checks before takeoff?

ANSWER

Chuck – In essence, yes. Whether ground crew, tugs or rail are used, the aircraft returning to the TLOF from its parking pad would first be brought to a takeoff position facing the departure direction of flight. Operationally, powering up would not take place until any ground crew were away and clear. Arrivals and departures will most definitely have to be scheduled and coordinated, and also be broadcast among and between the aircraft operating to & from this facility, the flight deck attendant, and the base station operator as a minimum. UAM ATC – yet to be defined – will most probably be in the mix. Where there is only one TLOF & FATO, there's no choice but to have a high-level coordination for these flight ops. I am a proponent that at every vertiport where there will be a relatively high tempo of operations, to have dedicated and separate arrival and departure pads. Trying to do both from one pad is inviting delays. The separate departure pad could also serve as a parking spot for a disabled aircraft if none other were available. Since things in aviation don't always go as planned, we should be allocating space on our flight decks to accommodate high tempo of ops, good clearances and maneuvering space, a maintenance area, and a disabled aircraft space. Let's look to the historical record, which is the best teacher, and invite decisions that will lead to best practices for UAM.

Brian – Yes. Either manual, remote controlled, or automated taxi/tug operations are being assumed for both landing/parking and parking/takeoff maneuvers. These times are being calculated in our operational studies, and investigation continues into existing technology to complete these tasks efficiently.

QUESTION

50-60k square aft rooftops may be common, but are they commonly built for required loads and infrastructure interface?

ANSWER

Chuck – The short answer is that every rooftop consideration must have a structural analysis performed to check the weight-bearing capacity of any roof, whether constructed of wood, steel or concrete. The defining point will be calculating “accelerated loads” on the flight deck, which is the force generated by the gross weight of an eVTOL under a rapid descent – some sources suggest a descent rate of 30 feet/second, or as a rule of thumb, 1.5 times the gross weight of the aircraft. As an example, if an eVTOL’s gross weight was 7,000 lbs, and we applied the 1.5 factor to account for a high descent rate, we should then design the roof structure to carry a weight of 10,500 lbs. I would venture to say that, as a rule, most roofs as designed have little excess capacity for new added loads; so, we’d have to look at the “dead weight” of a new flight deck structure plus the newly imposed “live load” of the aircraft under acceleration (high descent rate). Just accounting for the aircraft’s “accelerated load”, it would equate to $7000 \text{ lbs} \times 1.5 = 10,500 \text{ lbs}$. Add that figure to the weight of the new flight deck structure, and we’d have the total weight to be accounted for. So, with a very limited existing capacity expected from existing conditions, some new form of structural design would be needed to support the new flight deck, terminal building, and aircraft.

Brian – With an anticipated eVTOL weight to be between 6000 lbs-8000 lbs, this is not much heavier than a single existing electric automobile. So with respect to parking structures the new load is not significant. Commercial high-rise structures would require additional in-depth analysis and potential reinforcements.

QUESTION

Has there been any consideration towards providing a mockup of the vehicle at the terminal so that passengers can see what they’ll experience when boarding aircraft? This could also provide an opportunity to weigh the passengers (in a discrete and respectful manner) to get final weight and balance data?

ANSWER

Brian – Passenger education and information will be vital to the positive experience; it is also very likely the passenger will be escorted to vehicles and provided assistance as necessary. There is investigation into technology that will allow for the collection of personal information in comfortable manner.

QUESTION

How does Uber plan to provide the level of power required to recharge vehicles without putting a heavy burden on the grid?

ANSWER

Brian – Electrical grid tie in will be critical to the initial site selection, and partnerships with local utility providers will be formed early. Efforts to offset peak demand power draw will also likely be desired in the form of behind the meter battery storage.

QUESTION

If renewable sources will be utilized, how will Uber harness the energy without needing to have a huge footprint? Is the solar array on the edge enough to provide several MW of power for recharging multiple vehicles?

ANSWER

Brian – Co-located renewable sources of energy to offset full power consumption is not likely a viable option due to spatial constraints, there may be potential to have power generating facilities within the same distribution network for this offset.

QUESTION

What is the plan when a vehicle needs to recharge, and the recharging stations are all occupied?

ANSWER

Brian – Our flight planning and dispatch management software should not allow this situation, also the number of parking pads is equal to the maximum number of vehicles expected at any time at a facility.

Darshan – Similar to manned operations, we will require Contingency Response Management and flight plans should include at least :

- Trip Charge
- Diversion Charge
- Reserve Charge
- Contingency Charge
- Taxi Charge

Also important to note that these are not long-distance operations. Each flight will need to take account all the factors including weight & balance to ensure there is enough charge

to complete operations. In case there is an emergency due to low charge then emergency procedures will be taken into effect and the vehicle will get priority for landing.

QUESTION

What are your thoughts on secure parking and powering being an autonomous process?

ANSWER

Chuck – Autonomous operations across the entire spectrum of UAM – as we’re conceiving of it now – are far off; quite far off, I would venture to say. There is so much yet to discover and prove in just getting Urban Air as a workable enterprise under design – and the areas to be studied and solved are enormous – that concentration on meeting the myriad challenges (call it in the thousands) , really needs to be foremost in everyone’s minds: industry, government, and public perception. There’s a saying that’s been repeated in current UAM topical discussions that suggests “crawl, walk, run”, and frankly, that’s sage advice. Eventually, there is probably much encouragement and desire to have the world of UAM reach an autonomous state. The reality, though, is that there is so much to prove first that we all must focus on reliability in every facet of UAM, coupled with its twin, safety. Only after these essential elements are developed, tested, proven, and shown to be repeatable, can we begin to think of how to transform a new and complex enterprise into a first-generation autonomous system. So much to learn first!

Brian – We think eventually this technology will be advanced enough to be adopted, and fully expect these advancements to improve overall efficiency.

QUESTION

Should infrastructure planning focus on fully autonomous vehicles (aerial and ground level) having no pilot or controls at all since this will be the future and needs to be the core goal for design – now?

ANSWER

Chuck – Autonomous operations in the field of UAM frankly needs to be held at bay for the time being – not as a damper on ultimately achieving autonomous flight – but because so much has first to be proven, tested, repeated, and accepted not only by government but also by the general public, who, after all, will be the users of the system (enterprise). Right now in aviation, there are numerous navigation and communications items that herald a regime of flight information heretofore unavailable and accessing this information into Urban Air should be a linear process. The “core goal” of autonomous flight is not yet agreed upon as it concerns urban air mobility for public consumption. Autonomous flight operations for the military and commercial limited package delivery is not in the same league as a passenger-carrying aerial enterprise. So much has yet to be developed, proven,

accepted, authorized, and standardized within the subject of vertical passenger flight that it is rather premature to focus on incorporating autonomous flight until the entire system has matured within its foundational element. Any autonomous equipment systems currently in use may in the end have little to do with the state of operations to be encountered sometime in the future. "Crawl, walk, run" most definitely applies here.

Brian – We are thinking of this now and are writing the assumptions to the requirements to the best of our ability. As this technology advances and improves, integration into already existing Skyport infrastructure should not be overly prohibitive. Though we think in reality this is still considerably further into the future (2030) and will not be necessary for 2023 launch planning.

Darshan – The level of full autonomy is only possible when we attain different levels of autonomy with good data to prove the safety case. The goal indeed is full autonomy but that is a long way out. The core goal of the design should be to accommodate both autonomous and semi-autonomous operations, but at the same time there are other functions which will need to be done which may or may not be autonomous. Hence taking all that into perspective should be the step forward for infrastructure planning.

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- **Address Additional Questions To:** staff@vtol.org
 - **Or Visit:** www.vtol.org/infrastructure