C.R.E.A.M. Narrative

The new 88,740 ft^2 City Hall proposed for San Diego is envisioned as a center for local governance, but also as a hub which, during an emergency, can continue to administer civic operations while acting as an Emergency Operation Center (EOC) for the area. An Essential Facility; the building will not only weather a natural or manmade disaster, but also maintain functionality in the aftermath. Most critically the project must maintain operations for 14 days during a utility outage to coordinate emergency responses while maintaining critical functions like prisoner life safety and security. During an event the building will transition to a setback mode, minimizing energy consumption by relaxing thermal comfort targets. Building systems will then draw energy from a 10,000 kWh battery system & 427 KW PV array for power and 10 kgal potable & 20 kgal non-potable water storage tanks.

Site selection is critical for an EOC. The site was selected to be outside of the worst-case flood plain, but still within proximity to the city core. The architectural form of the building is shaped by the environmental and wellness performance objectives of the project. The office blocks are stacked in a staggered pattern around a central courtyard spanned by a trellis of PV panels above. The office floor plates are kept narrow so that the spaces can operate using daylight and natural ventilation alone, while the staggering and the trellis above provides shading to minimize solar loads and increase energy efficiency and thermal comfort. Parametric computational design modeling tied into performance simulation was used in all stages of the project to inform design decisions.

The staggering of the office blocks provides generous shaded outdoor terraces adjacent to every internal space. This fosters a biophilic connection with the outdoors, while providing occupants with the flexibility to work in a variety of settings per their personal preference. The overhead shading provides protection from direct sun to increase thermal and visual comfort.

Careful use of mass timber structural columns and CLT floors reduce the embodied carbon of the structure, while using key steel and concrete elements to maintain the structural standards of an emergency facility. These changes from conventional structural approach along with high fly ash concrete greatly reduces the embodied carbon of the build.

The impact of system design was analyzed for energy as well as environmental impact. The 6 heat pump chillers utilizing new R-1234ze refrigerant had similar energy performance to a high efficiency VRF utilizing R-410a, but the R-1234ze's reduction in refrigerant GWP meant that the net carbon impact of the system was 45% less. The 6 30 ton modular chiller bank allows for the cooling loop to be staged to function at very low part loads during emergency operation.

The design of the project utilized Grasshopper for most of the design and performance modeling. This allowed the integration of the design exploration process with multiple types of analysis within the same digital environment, increasing efficiency of the modeling process and more strongly embedding performance into the architectural design. The Grasshopper tools relied on plug-ins such as DIVA, Honeybee, and Ironbug incorporated into custom analysis scripts. The scripts were initially used on comparisons between different massing options and then utilized to parametrically study different façade, construction, and energy systems alternatives as the design process progressed.

The workflows were designed to be integrated with the architectural process yet allow for the decoupling some processes from a critical path method. For example, the HVAC team could work to define the mechanical system and operations options in Ironbug and test on a simplified building while parametric façade analysis of the massing was still being performed. The HVAC definitions could then be integrated into the energy analysis script once they had been completed.

Early climate analysis showed the potential of saving energy with natural ventilation strategies, the team followed the idea by studying different geometries and window to wall ratio to maximize the benefit of natural ventilation in the design. The final design results in a hybrid system rely on natural ventilation for more than 60% of the occupied hours and 42% saving in cooling consumption. In addition to saving energy a hybrid system will significantly reduce CO2 concentration to below 600 ppm for more than 90% of the time and below 500 ppm for 62% of the year. Operable windows will be occupied with automated controls to maximize the use of natural ventilation.

Achieving health and wellness criteria were a major priority for the team, the courtyard idea is the center of wellness strategies with promoting biophilic design and access to nature in addition to maximize the use of outdoor space. Access to daylight were analyzed in several stages to ensure both sufficient daylight and minimum glare in the building. High special daylight autonomy in the design will promote circadian rhythm for the occupants.