structural analysis - red square

Much of Red Square is built on top of the Central Plaza Parking garage. This garage is built out of concrete post and beam construction. Portions of the plaza in front of the Suzzallo Library and Garibaldi are built on top of unexcavated subgrade and the remainder of the plaza is constructed above the basements Kane Hall and the Odegaard Library. Because of this unique situation, there are a number of structural constraints associated with potential future development on the plaza including:

- limited live load capacity of the parking garage roof
- constraints on alteration of grade due to the shallow depth from plaza grade to the top of the roof slab
- potential difficulty in structural anchoring on top of the parking structure
- sensitivity of penetrating the waterproof membrane on top of the parking garage roof

existing conditions and construction strategies

The columns in the parking garage supporting Red Square form 20'x50' bays and the beams which span these 60' bays are spaced approximately 6 1/2" O.C., providing ample structural integrity to support the weight of vehicles on the plaza above.

The brick paving is set upon a 1/4" bed of sand which sits above a 1-1/2" asphaltic concrete membrane. Below this is a coal tar membrane; penetration of this membrane is undesirable. Any punctures in this membrane must be meticulously patched in order to ensure a waterproof seal is maintained.

Concrete tree pits were built between the beams and similarly constructed additional planters can be added if desired.
lightweight building technologies and strategies

Because of the constraints associated with building on top of the parking garage, it may be necessary to explore different lightweight building technologies in order to design the most load capacity structures. Here is a brief introduction to some strategies that may help in developing feasible design possibilities for Red Square.

geofoam

Geofoam is the generic term for any type of foam made from polystyrene or expanded polystyrene (EPS) foam. Geofoam can be made into large slabs or panels with this quality, durability, and environmental friendly stress sufficient to support or ground level structures. Geofoam's lightweight nature makes it a good choice for applications where low dead loads are a consideration. It would be especially useful for projects involving the design of low-rise structures, such as residential buildings or light industrial facilities. It is commonly used as lightweight fill in a subgrade application or used to elevate a building above ground level.

roof top anchoring strategies

The roof slab beneath the plaza piers is topped with a cost or waterproof membrane to anchor and protect the slab to the roof structure. Parapet anchoring strategies are typically illustrated here.

Spread footings: spread footings are one way to stabilize structures on the plaza because they can be placed directly under the slabs. They are not well-located for many applications.

Concrete Anchors: setting structures into the roof slab beneath the plaza is another anchoring strategy. However, in order to build in this concrete slab below the waterproofing membranes must be penetrated. This penetration may cause subsequent problems.

alternative concrete technologies

lightweight concrete - These exist many lightweight concrete types ranging in weight from 30 to 115 pounds per cubic foot. The compressive strength is typically not more than 5,000 psi. These are not recommended for continuous construction on roofs because they require less need for structural reinforcement, and have lower fatigue lives.

Geofoam used as lightweight fill in a subgrade application.

lightweight soil blends

Due to the live load restrictions of the parking garage beneath Red Square, the following methods used in design, construction, and field work is crucial for achieving an optimum balance of both storage and structural properties.

Lightweight soil blends used often in green roof applications include granular inert materials with a low liquid content and such components as perlite, vermiculite, expanded polystyrene, coconut fibers, crushed stone, glass, and common concrete aggregates such as gravel sand and aggregates.

Profile:
The LIQUID FLEXI geotextile system installed on the building on top of the parking structure in order on the top of a parking structure has multiple engineered soil blends with protective range from 0 to 9.