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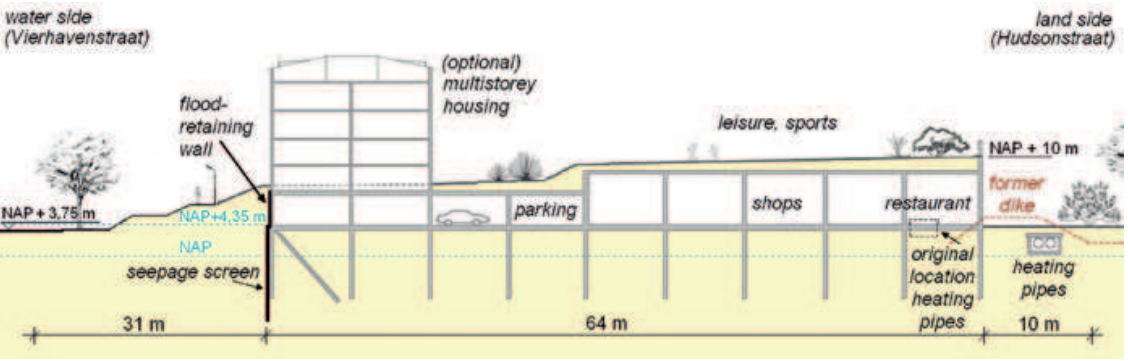
Figure 1. Alternative concept for the Dakpark, Rotterdam (Voorendt 2017)

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# WHAT WOULD AN INTEGRATED DESIGN OF THE ROTTERDAM ROOF PARK LOOK LIKE?

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*'Design principles of multifunctional flood defences.'*

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Several alternative concepts could be developed that would integrate the structure of the Roof Park shopping complex with the flood defense. It is common practice in engineering to develop various concepts, keeping the project goal in mind. This is a creative process that should not be hampered by overly precise descriptions of the desired performance. The provisionary concepts need to be verified in a later design step, to guarantee that the final solution meets the project requirements (see pages 62-65 for an explanation of the design method). This results in a limited number of realistic alternatives, one of which has to be selected for further development. This selection is usually done on the basis of a set of criteria that could be considered 'soft' requirements.

Different concepts for the Roof Park can be obtained by varying the degree to which functions are integrated or by varying the role of different structural elements for flood protection. The water-retaining element is an essential structural element, whose minimum height needs to be related to the current water level, and prepared for expected rises in sea level. The water-retaining element can be located at the water-side, in an intermediate position (somewhere in the multifunctional complex), or at the rear. The choice of location has consequences for the connectivity between the different parts of the complex, the location of entrances, as well as where the complex (or parts of it) is located: whether they are in or outside the flood-protected area. In contrast with the present situation, a design alternative could be developed where the entire shopping complex is located behind the flood defense. This could be considered an advantage: since the entire complex is located inside the protected area, local societal disruption in the case of extreme high water would be considerably reduced. An alternative would be to locate only the shops behind the flood defense and accept a higher flood probability for the parking garage.

Figure 1 shows an example of a concept where the flood defense is located at the waterside. The entrance to the parking is from the landside, at both ends of the complex. Displacing the flood defence to the harbor side would make it possible to reduce the height of the entire complex. Now, the top of structure is 13.2 m above average sea level, but the required height of the flood defense is only a bit less than 6 m above average sea level. Lowering the top of the complex, by making the building one story instead of two, would make the project less of a barrier between the residential area and the harbor. It would also improve the accessibility of the shops from the garage, since elevators and stairs would no longer be necessary. If the present district heating pipes could be relocated, which is said to be very expensive, that would create even more design freedom. Furthermore, there are ample possibilities for creating and varying green and leisure areas. As an extra option, several multistory housing blocks could be planned on top of the garage on the harbor side of the complex. This would lessen the strict separation of housing and harbor, while at the same time improving the urban quality of the residential area.

So, from a structural point of view, it is very attractive to combine the flood defense with the shopping complex. For reasons of governance, however, it might be more desirable to separate the structures. However, this would lead to a less efficient structure in terms of costs (e.g., double walls) or space. The consequences of changing the shopping front from the harbor side to the residential area should be studied in more detail in cooperation with the stakeholders, because of effects on urban quality.

*Ref: M.Z. Voorendt (2017). 'Design principles of multifunctional flood defences.' PhD dissertation, Delft University of Technology.*