

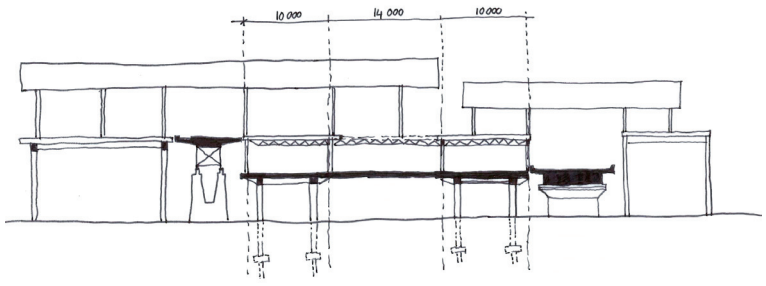
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Between boundaries: a new border post at Beitbridge

Trollip, Daniel Charles Fulton

2014-11-04
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Technical Development

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The technical development is divided between two sections that contribute to the overall structural system of the new border post. The structure in no man's land or the space of cultural possibilities is the primary focus and in particular, the rigid structure in between the existing bridges and the resolution of the floating platforms that connect to this main structure.

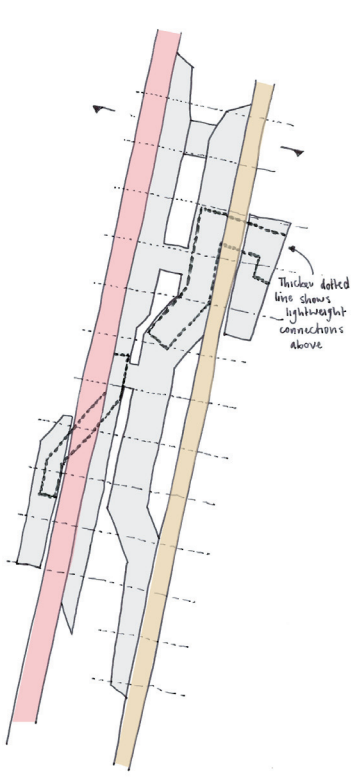
The new structure is situated between the existing stone and steel Alfred Beit bridge (pedestrian and rail) and the new concrete and steel vehicular bridge constructed by Murray and Roberts in 2005. The older rail bridge has a span of 30m between the piers, with the vehicular bridge also having a similar span. The new proposal is designed on a grid with spacings of 15m and is aligned to the spans of the existing structure as indicated in the diagram.

Substructure and Superstructure

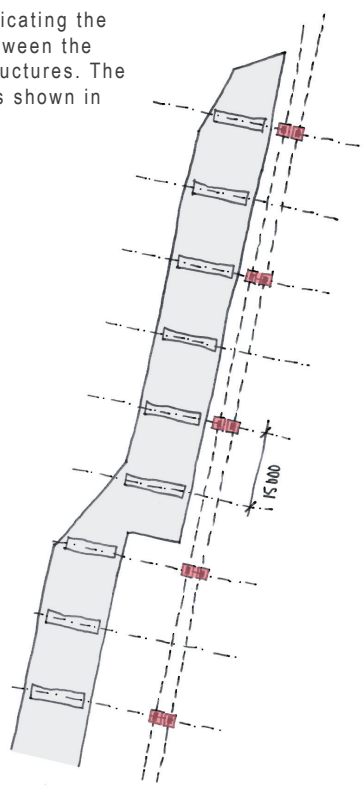
As the new structure bridges the Limpopo River and ties into existing bridge infrastructure, the construction methods used in this proposal are related to bridge construction. The substructure consists of pre-stressed reinforced concrete piers, on top of which sits the superstructure, which is a reinforced concrete slab that would be designed to an engineer's specification. The piers are designed to deal with the forces to which it would encounter in a flowing river. The exact dimensions of the piers would be designed according to a bridge engineer's specification but with regard to the minimum bridge building regulations in South Africa, the width of the piers would be no less than 600mm wide.

The new proposal is divided into two primary structures that are linked in three areas. In section, the structure comprises of two major levels, with lightweight steel connections connecting the various platforms. The main levels are linked to the heights of the pedestrian and vehicular bridges with the lower level resting on the concrete piers and connecting the main structure with the floating platforms.

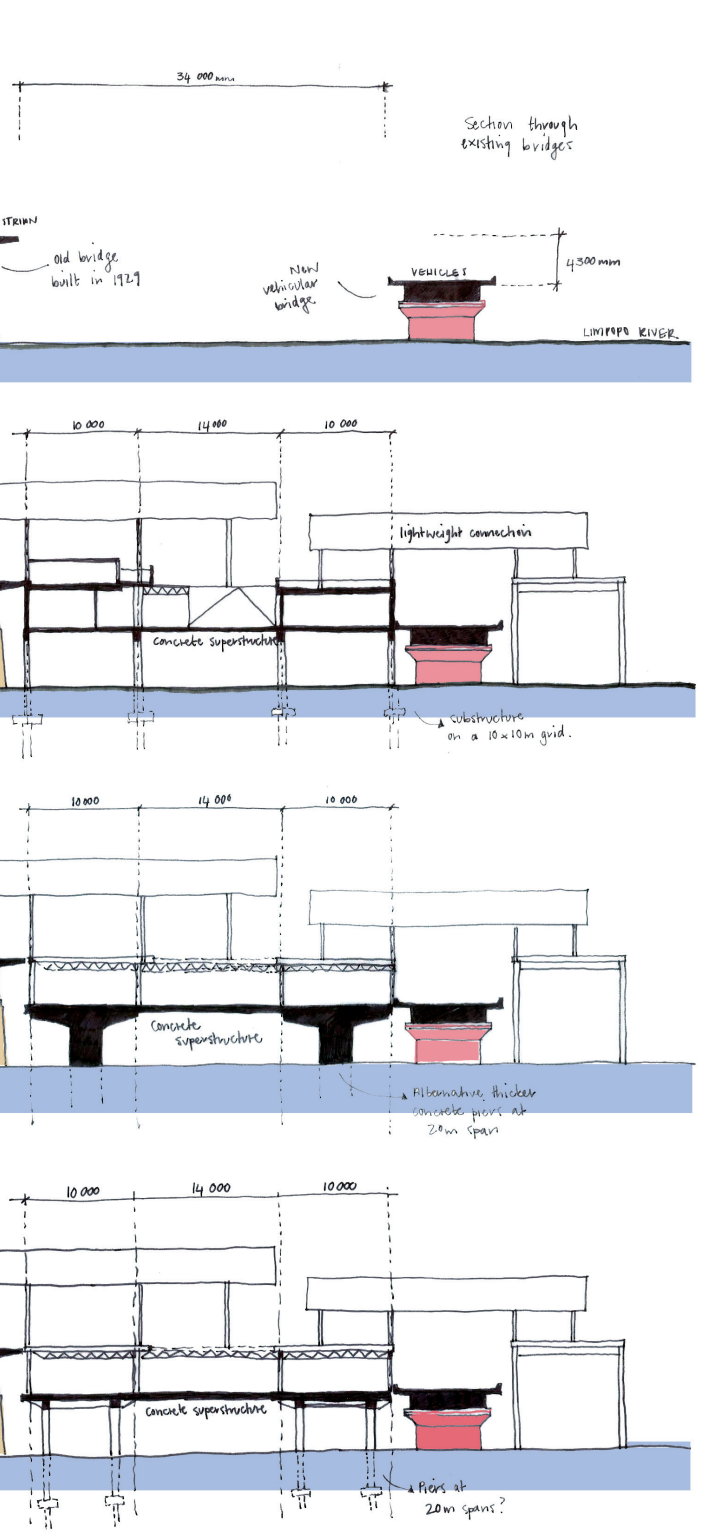
Detailed below are the edge conditions for the new structure, where the new concrete slabs meet the existing bridges. An industrial, rubber dock bumper will be used between the old and new structures as the gap between them is required to be as small as possible to allow a seamless transition for moving foot travellers. A minimum gap of 50mm between the bumper and the existing bridge is required as a connection between the two would transfer unwanted loads from one structure to the other.



Sketch plan indicating the relationship between the old and new structures. The new structure is shown in light grey.



Sketches in section showing the new structure in relation the the existing bridges. These diagrams show a development of the concrete piers used to support the new structure.



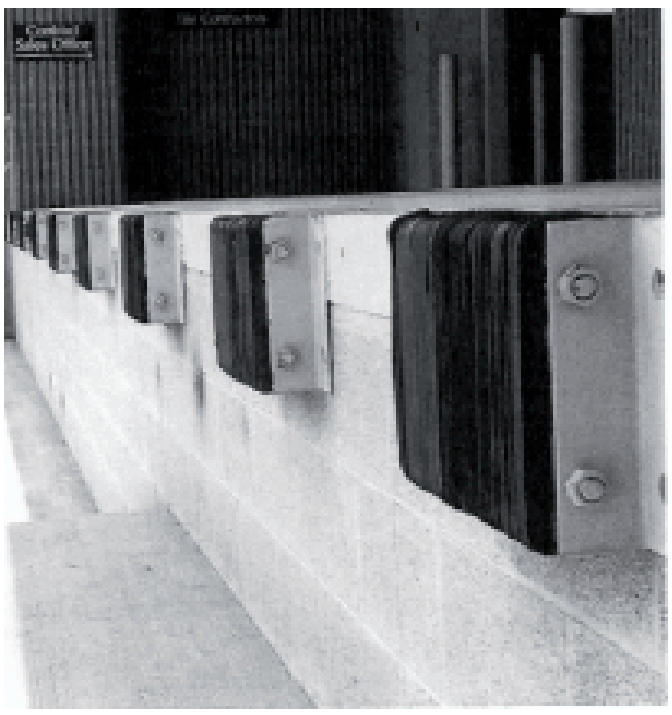
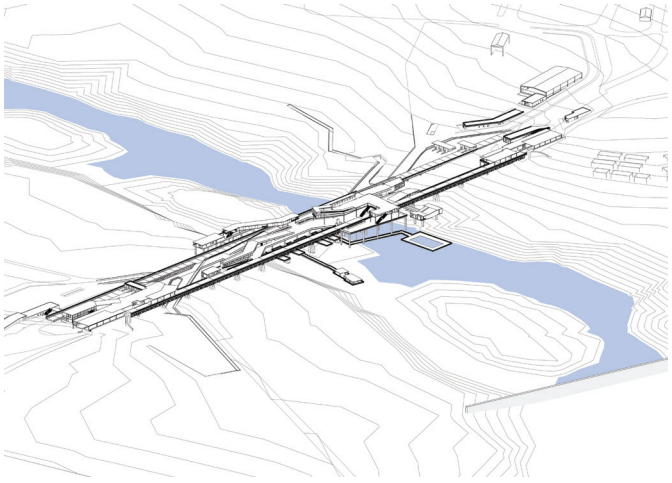
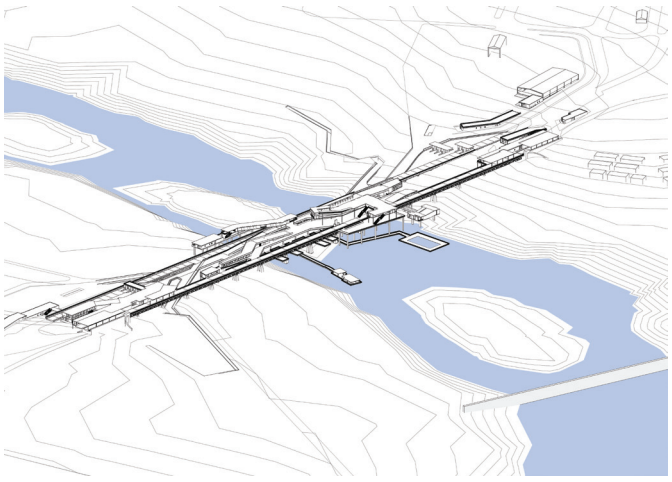


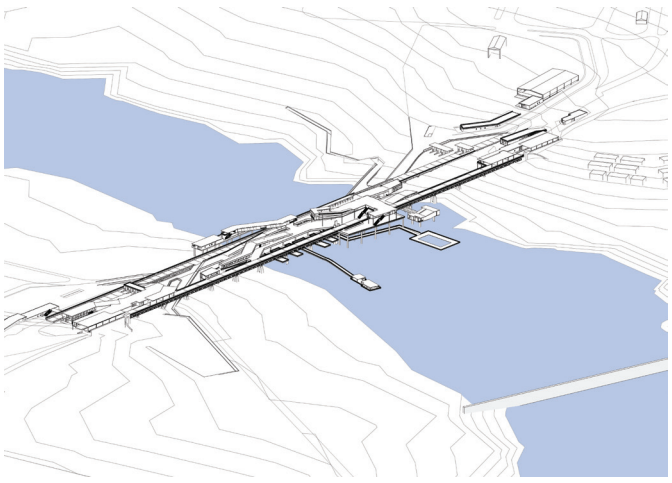
Fig 7.1.1. Industrial dock bumpers will be implented between the old and the new structures.

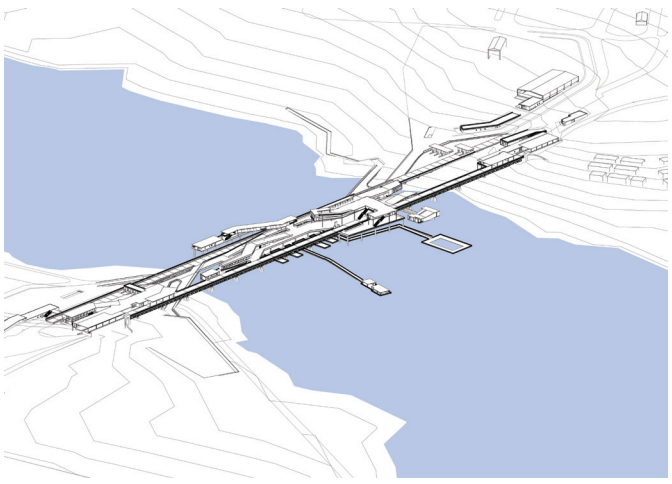


1:200 Sectional model exploring the structural sytem and the link between the new structure and existing bridges.



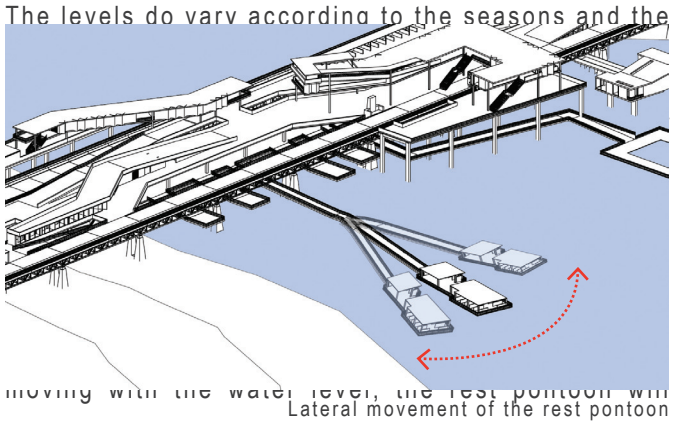






Floating structures

Connecting to the rigid structure are two major floating platforms in the form of a swimming pool and rest pontoon. The swimming pool sits in the deeper section of the river and the bottom of the pool is a steel cage (see detail below) that that will allow the river water to flow through into the pool but protect the swimmers from the wildlife of the region. The other platform is a place of rest and contains small booths with a hammock that can be rented on an hourly basis. It will be a place of quiet and rest and therefore sits furthest away from the main area. Both platforms float and therefore rise and fall with the varying water levels. The dam wall is located east of the border post and controls the level of the river. The levels do vary according to the seasons and the



Lateral movement of the rest pontoon

be able to move freely in a lateral direction and therefore a pivot joint will be constructed at the last landing to allow for this movement.

The swimming pool (see detail) will use the river water as the pool, with a safe 'cage' that will allow the water to filter through but prevent any fish or other animals to enter the pool. A double cage will be required in order to create a safe barrier between the swimmer and any of the rivers inhabitants.

Floating technology varies greatly according to



Fig 7.2.2. Hollow plastic floats used to support pontoons



Fig 7.2.1. A floating concrete platform

various needs. A Finnish based marine company called Marintek is a leading company in floating technology and were responsible for implementing parts of the palm islands in Dubai and the Koralbadet swimming pool in Copenhagen. The typical types of materials used on these pontoons are treated timber or a plastic composite material that is made of a combination of timber and recycled plastics. The plastic composite decking will be used on both the swimming pool platform and the rest pontoon. The two main types of floats that are used in this construction are plastic hollow floats and galvanised steel reinforced plastic fibre cement floats. The cement floats are stronger and require very little servicing and will be used for the proposal of the floating structures in this thesis.

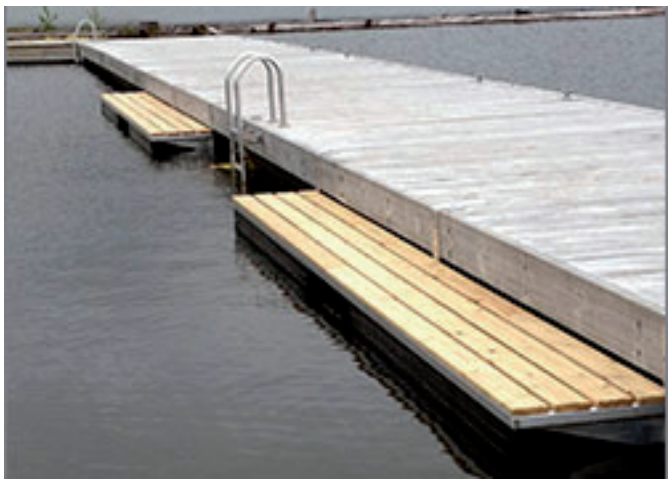


Fig 7.2.3. A floating swimming pool deck similar to the one that will be implemented at Beitbridge



Fig 7.2.4. A lightweight ramp connecting to a floating platform



Fig 7.2.5. Reposaari floating village in Finland.

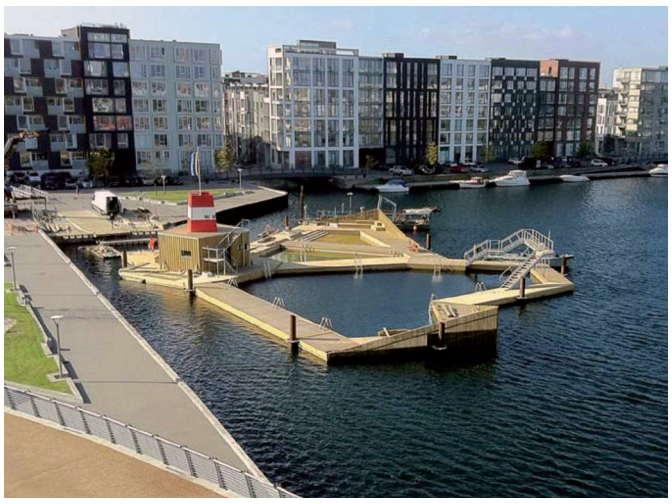
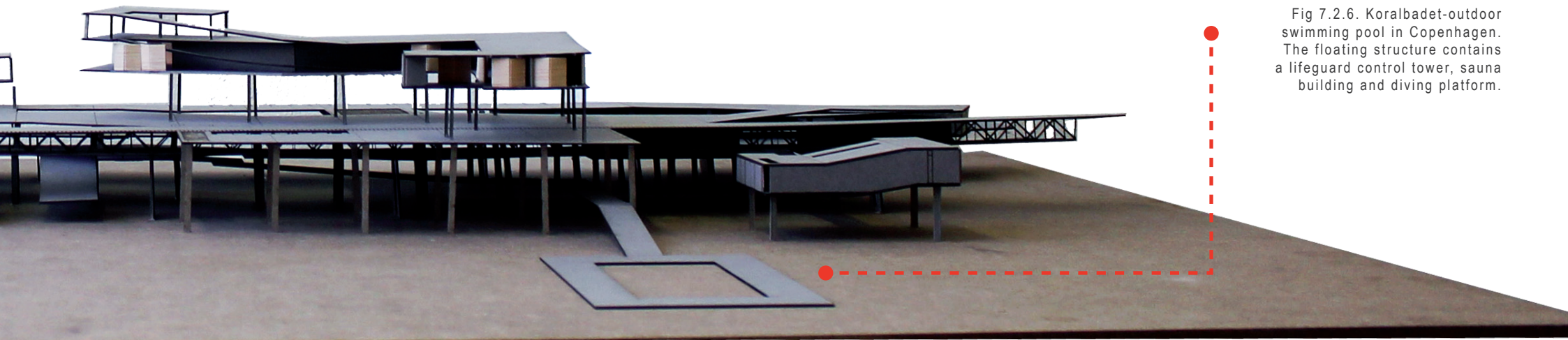
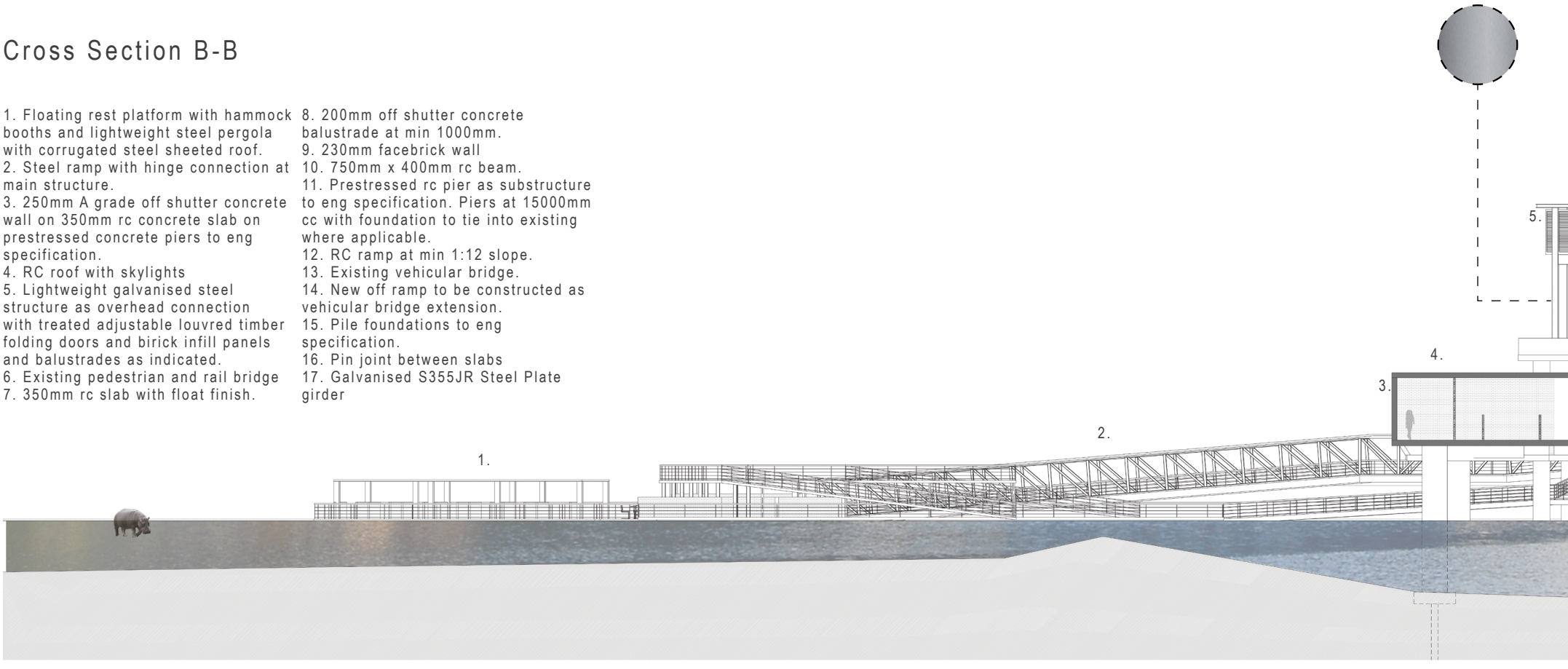


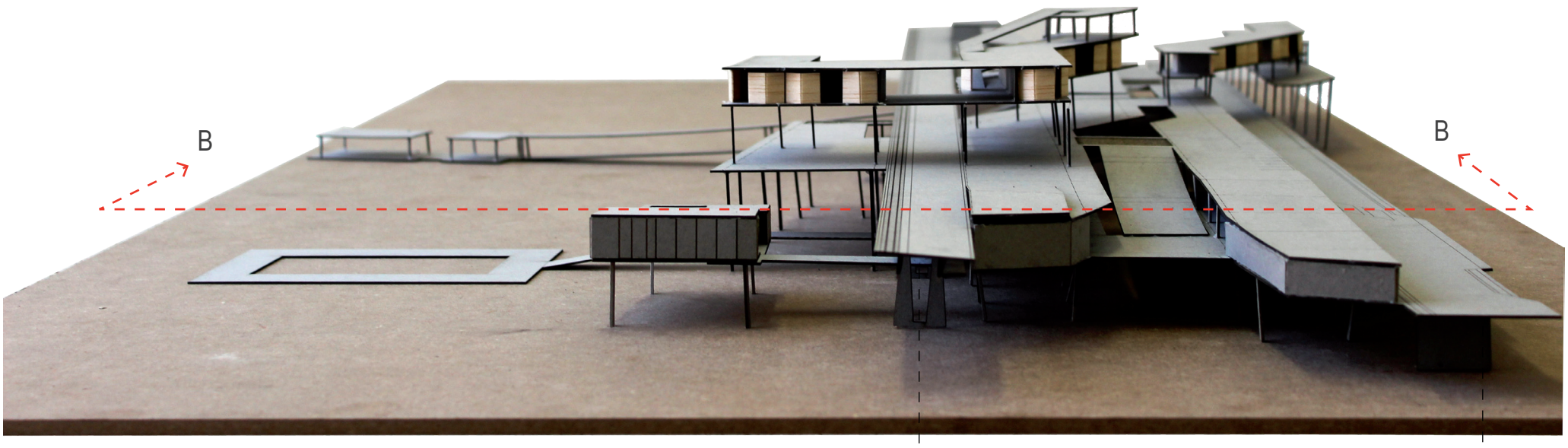
Fig 7.2.6. Koralbadet-outdoor swimming pool in Copenhagen. The floating structure contains a lifeguard control tower, sauna building and diving platform.



Cross Section B-B

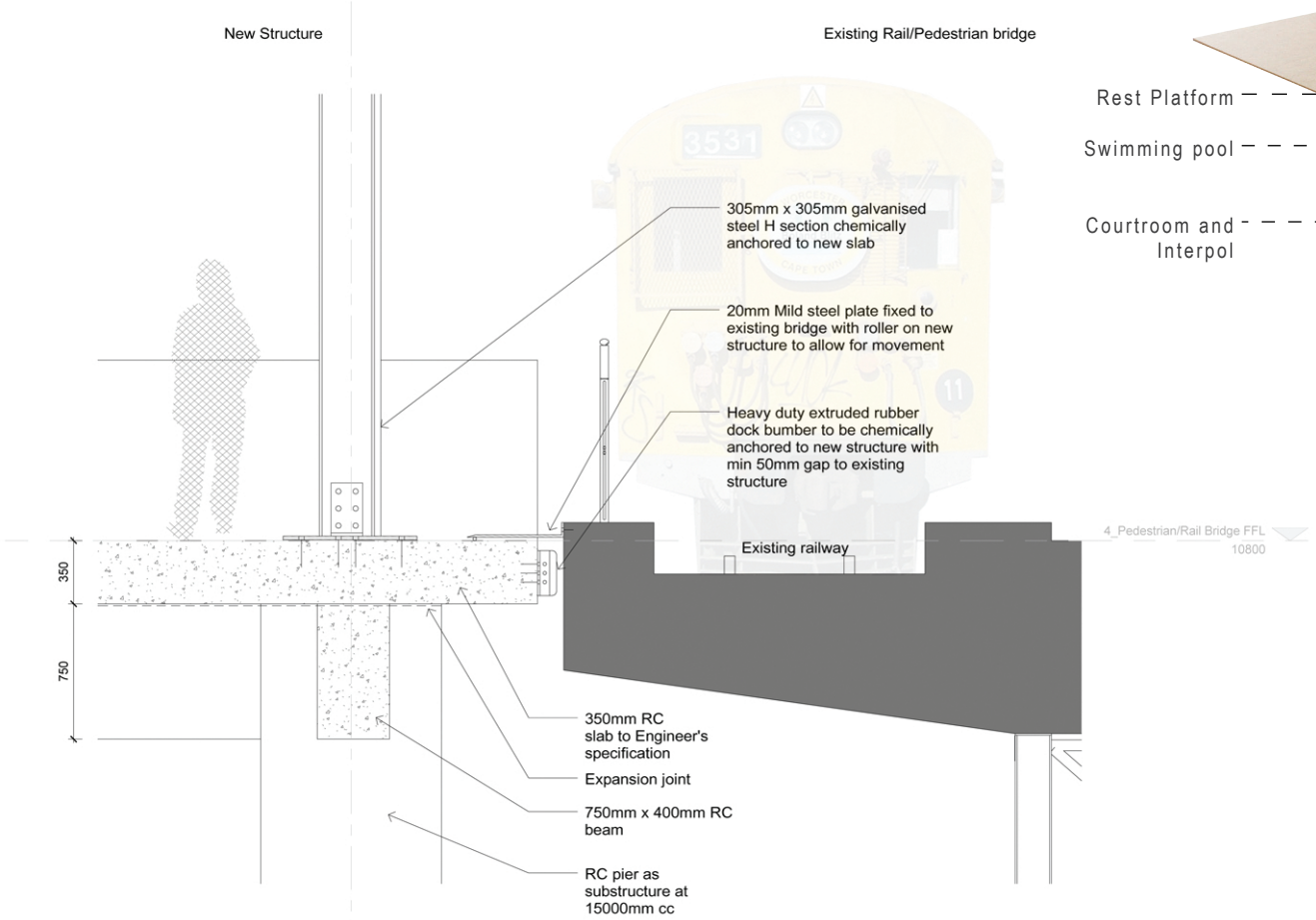
1. Floating rest platform with hammock booths and lightweight steel pergola with corrugated steel sheeted roof.
2. Steel ramp with hinge connection at main structure.
3. 250mm A grade off shutter concrete wall on 350mm rc concrete slab on prestressed concrete piers to eng specification.
4. RC roof with skylights
5. Lightweight galvanised steel structure as overhead connection with treated adjustable louvred timber folding doors and birick infill panels and balustrades as indicated.
6. Existing pedestrian and rail bridge
7. 350mm rc slab with float finish.
8. 200mm off shutter concrete balustrade at min 1000mm.
9. 230mm facebrick wall
10. 750mm x 400mm rc beam.
11. Prestressed rc pier as substructure to eng specification. Piers at 15000mm cc with foundation to tie into existing where applicable.
12. RC ramp at min 1:12 slope.
13. Existing vehicular bridge.
14. New off ramp to be constructed as vehicular bridge extension.
15. Pile foundations to eng specification.
16. Pin joint between slabs
17. Galvanised S355JR Steel Plate girder





1:200 Sectional model exploring the structural sytem and the link between the new structure and existing bridges.

1:200 Sectional model. Aerial view.

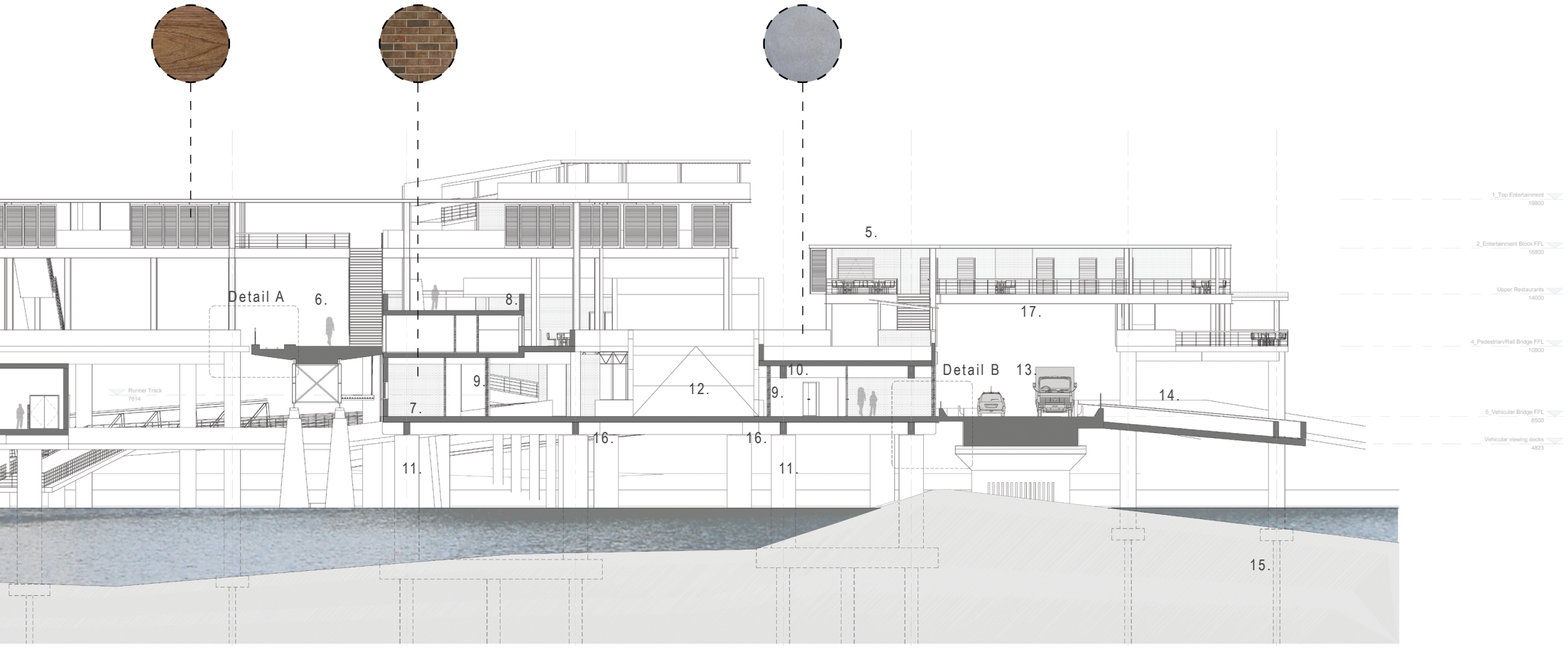


Detail A (Left)

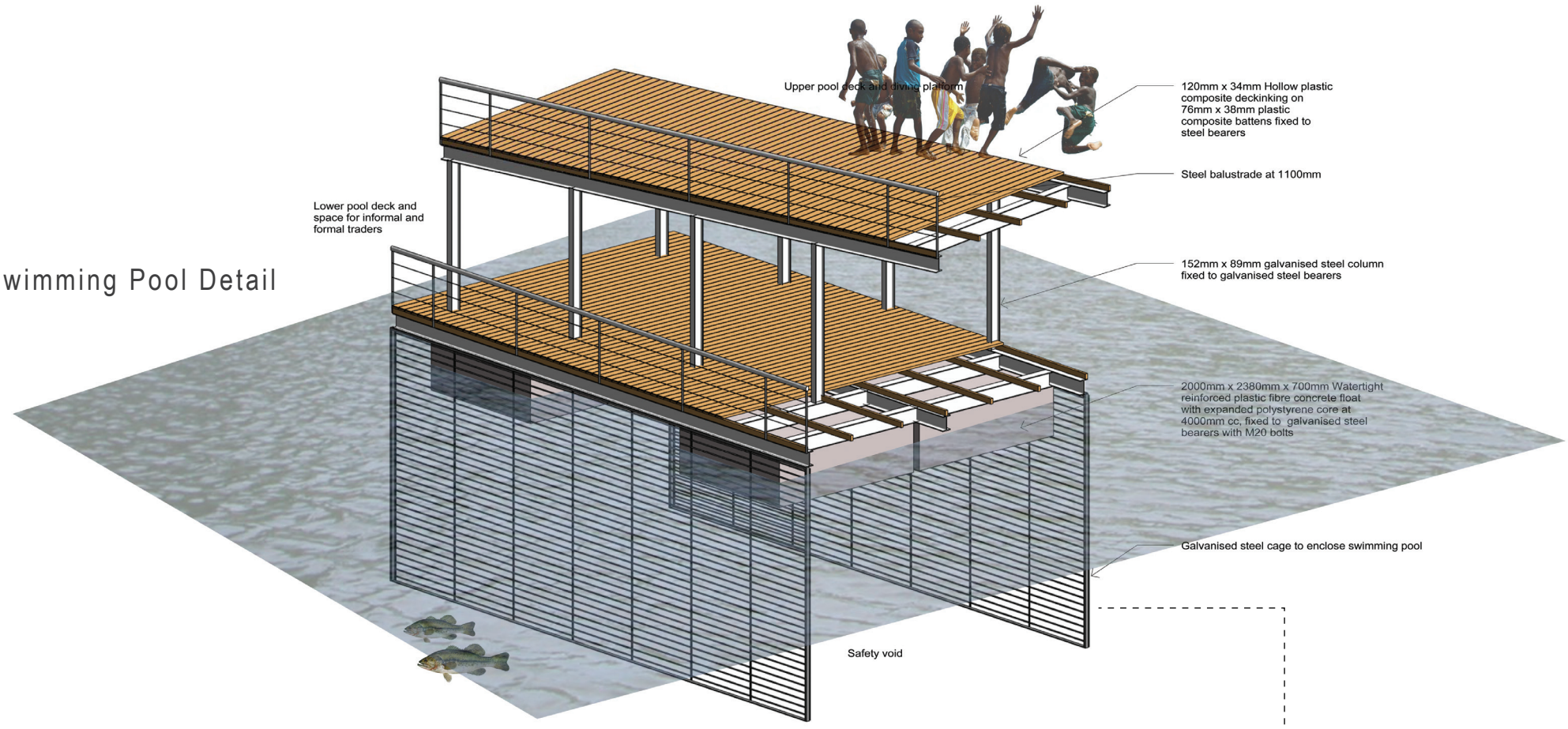
Detail A shows the connection between the upper level and the existing pedestrian/rail bridge.

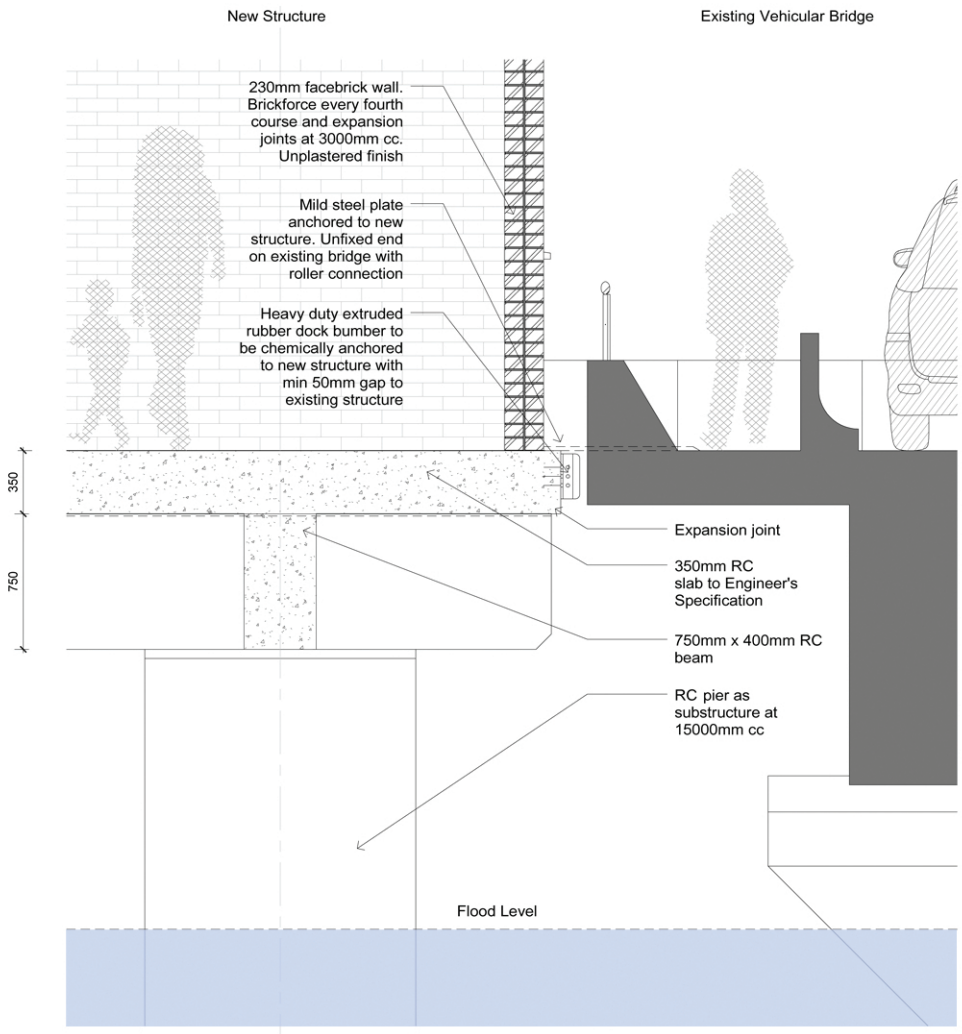
Detail B(Right)

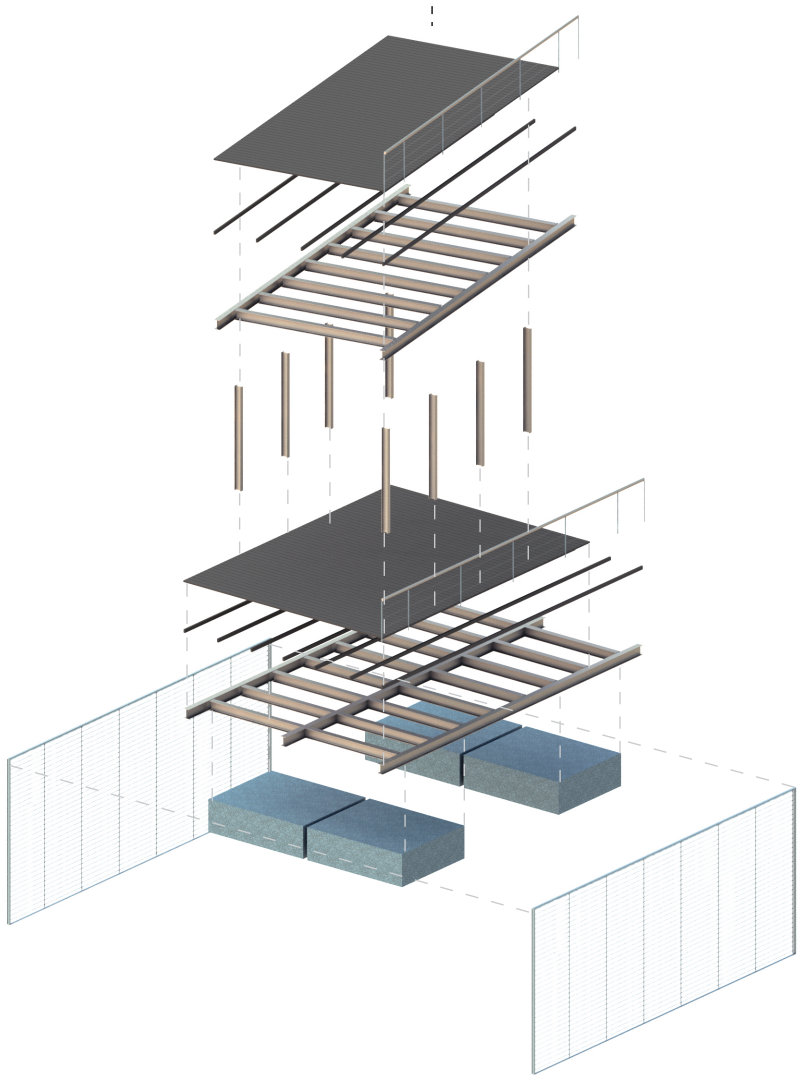
Detail B indicates the connection between the superstructure of the new building and the existing vehicular bridge.The link has to be close enough to allow for a seamless transiton from one structure to the next by a foot traveller.

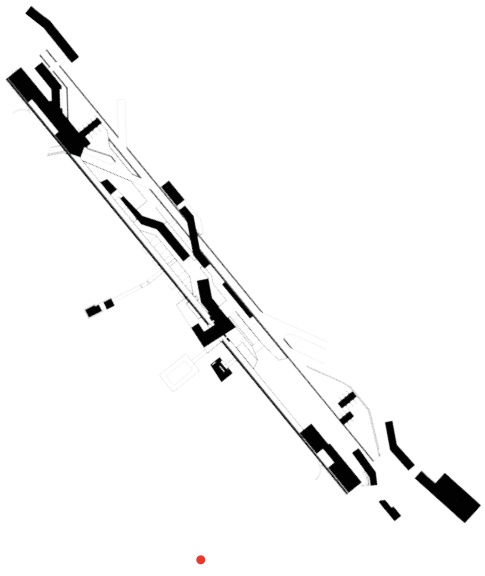


Swimming Pool Detail



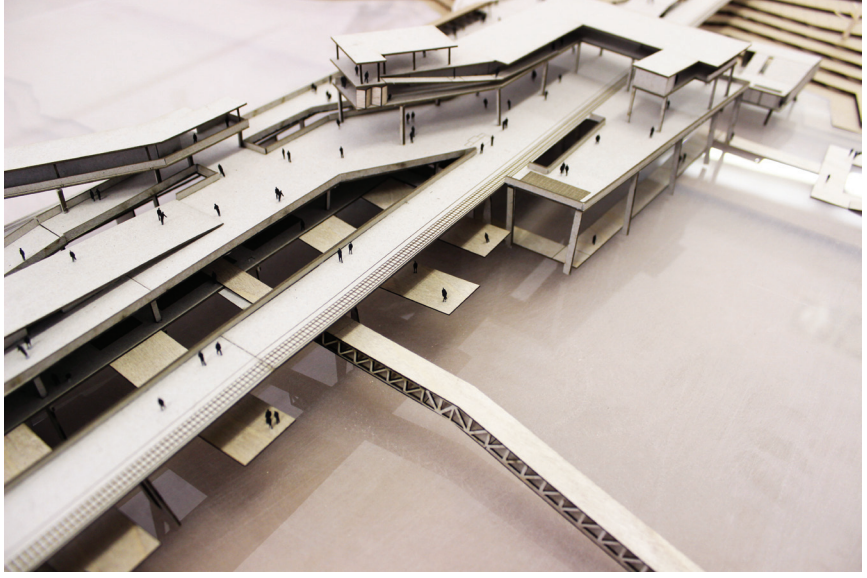


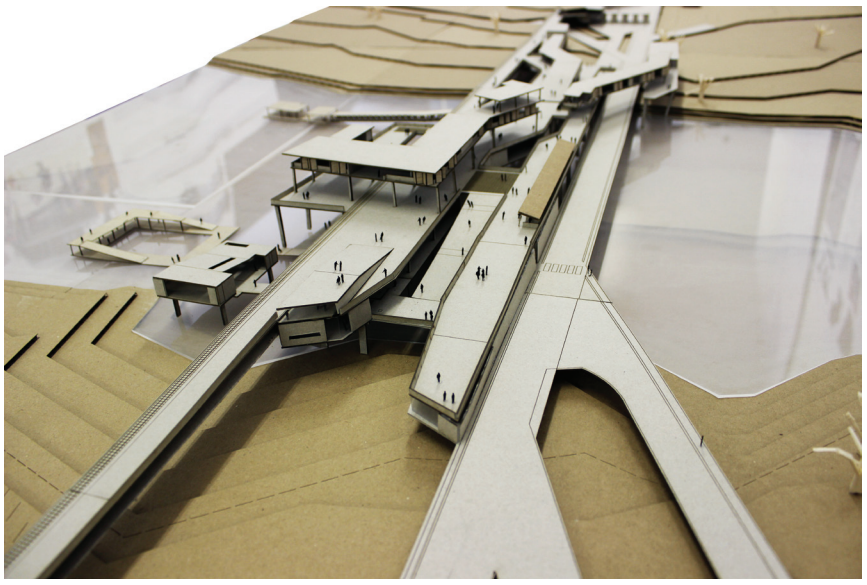


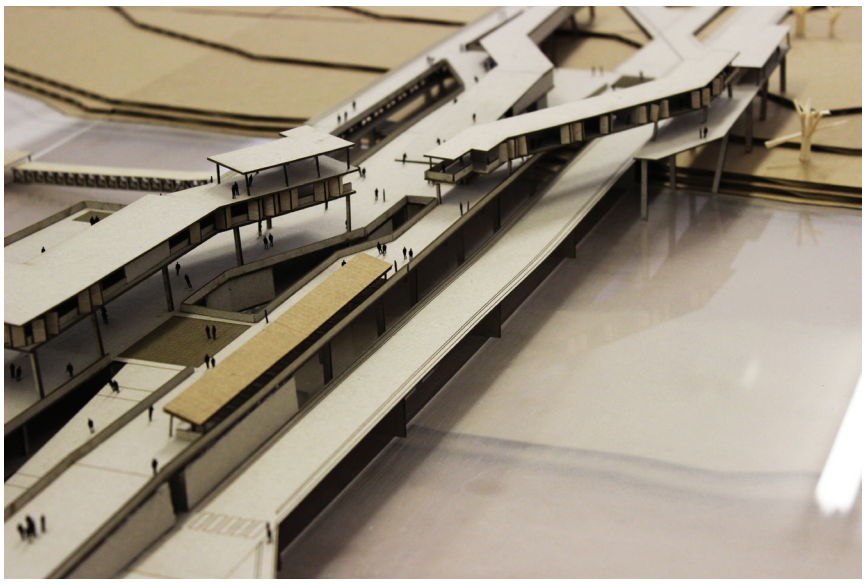


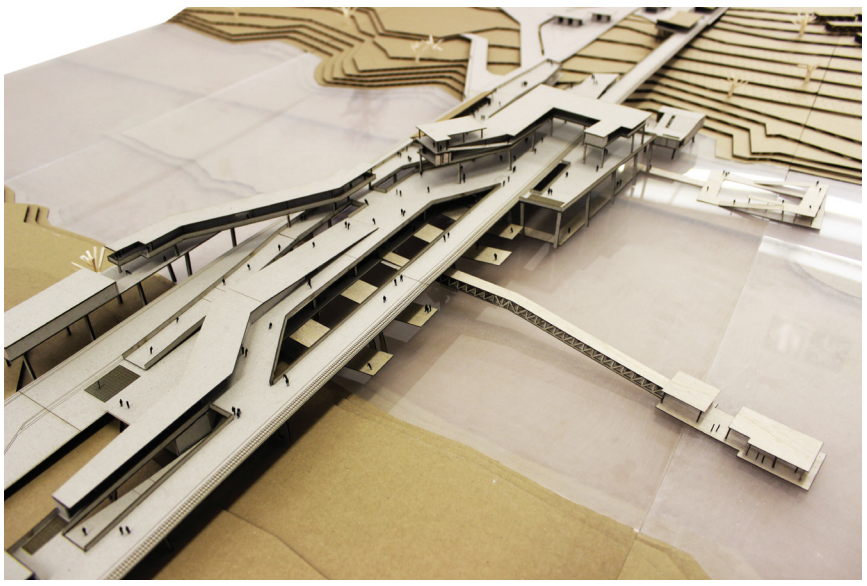


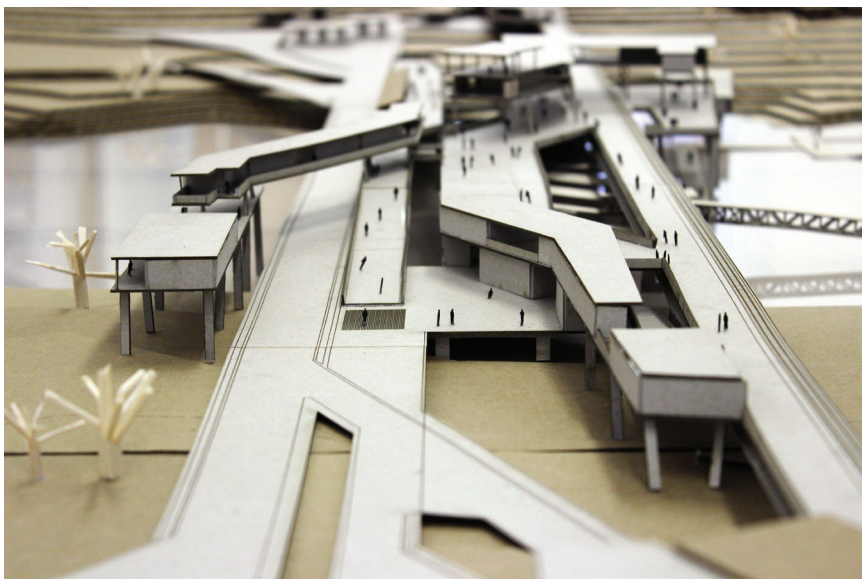




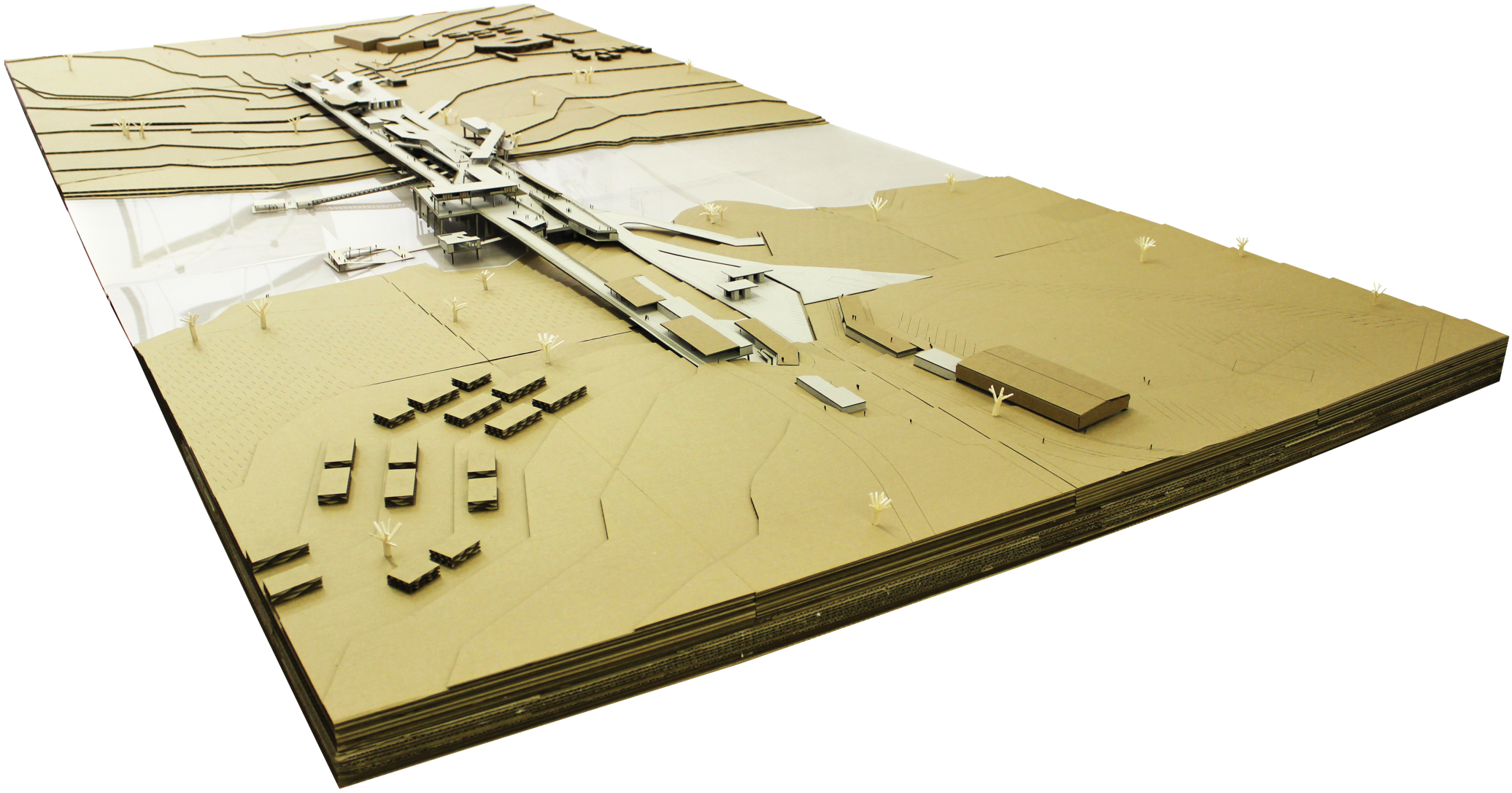


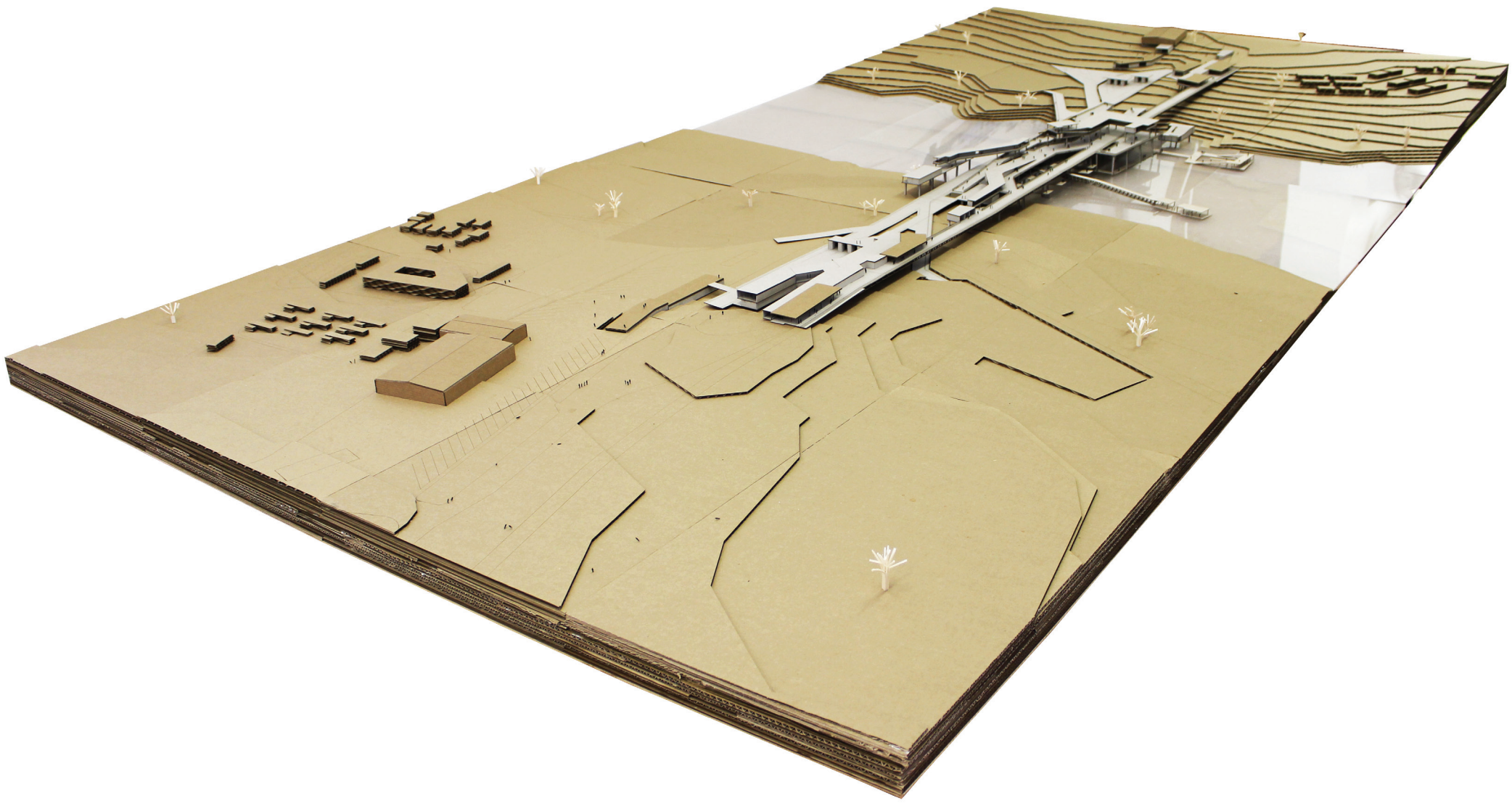






Final Model





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