



technical report

The building is a proposed Learner's Resource Centre situated in Berea Park. The development will be funded by the European Union and managed by a section 21 company of tertiary institutions and government departments. It creates a community facility that is needed in the Pretoria inner city, addressing lack of study space. The main building includes a digital library, offices, auditorium, conferencing facilities and a restaurant. This building is the focus of the technical investigation, while the rest of the campus development is part of the Urban Design scheme discussed earlier in the discourse.

The building is 5m lower than the van der Walt street level on the western edge of the site. The relationship of the building to the site is **multi-dimensional**: The western- and south eastern street facades are harder and **layered** towards the busier street. The eastern façade opens up towards the Apies river channel and the rest of the campus development. The exposed northern façade is limited because of the east west orientation and therefore the building steps to the east in modules, for maximum northern light.

Design approach

The development, being part of the proposed Nelson Mandela Development Corridor and the Apies River Urban Design Framework, emphasises interaction in the east west direction, this is addressed three- dimensionally. The set of building presentation drawings range from the site locality plan to floor plans, sections and three- dimensional drawings to specific plans and three dimensional details. The first drawing explains location (drawing 2), the floor plans show different functions of the building (drawings 3-6) with the sections explaining the verticality and **modularity** of the building (drawings 7-8).

The detailing of the drawings focus on certain portions considered more important to resolve, like the building module. This is the essence of the design. The three dimensional drawings are the most important communication tool, because this is the only way the building can be experienced as a whole. It also contributes to the emphasis placed on the three dimensional quality, **layering** and **modularity** of the building. Through these drawings a level of detail on which the building could be resolved is established (drawing 1). A constant reconciliation between the two- and three dimensional had, as a result, some irregularities which show the development of the technical resolution.

One of the most important aspects of the building is its **adaptability**. The reason for this is it being a community building. It can be changed to cater for personalisation and changing functions. The building at its core has a service **spline** which is

modular and completely dismantlable. This enhances the ease of "servicing" the building and inserting a light structure which serves as the **backbone** of the building. The **spline** clips onto the structural **skeleton** of the building.

A **junction** is created at the main entrance to the building and the rest of the campus. The architecture of the entrance celebrates its function and has a poetic quality. It corresponds to the north- and south east corners of the building which are articulated with curved masonry walls in plan. This articulation is investigated three dimensionally in the entrance (drawing 9, 10).

This general description of the building illustrates the concept: a light concrete- and steel **skeleton**, a lightweight adaptable steel service **spline**, a heavy western façade and a pivoting **elbow** celebrating the entrance.

The building's **layers** are read from the northern- and south eastern ends to the junction and from the west to the east as solid/ closed to transparent/open. This is in response to

introduction

modular

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context: the Apies river and campus development to the east of the site and the harder street edge to the west. This **layering** creates an experience of the different architectural elements and an awareness of the different layers of architecture. These different space-defining elements explain the meaning of different architectural elements.

The ramps in the building circulate from the main entrance foyer of the building and connect with the building through the service **spine**. This restricts the circulation through the building to the service **backbone**, with the fire escape staircases at the north- and south east ends of the spine. Together with the curved roof and angled columns of the main entrance, these sloped ramps enhance the dynamic tension of the foyer, giving it a readability and legibility (drawing 9).

The building consists of **modules** made up of similar elements (drawing 5,6). These modules are discussed and resolved in more detail. The **module** is repeated through the

building and consists of the western concrete wall, a concrete corridor/ walkway linking the different modules, the steel service **spine** and the eastern open **functional** space including the digital library, offices, exhibition space, conferencing, restaurant and auditorium.

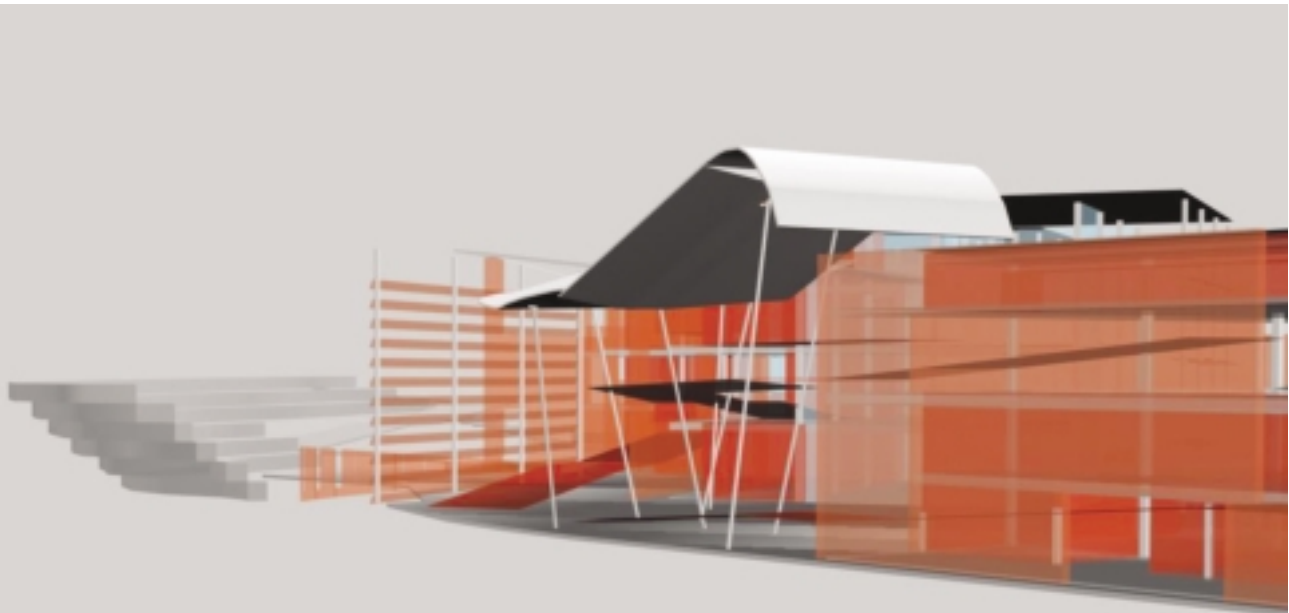
The three dimensional resolution of a module addresses the context, interaction and functionality all simultaneously. This brings the building together as a **coherent whole** consisting of **layers** and **modules**.

The module

This report should be read together with the technical drawings.

The spine

The service spine forms the **backbone** of the building and it



adaptability

a light concrete and steel skeleton,
a lightweight adaptable steel service spine,
a heavy western façade
and a pivoting elbow
celebrating the entrance.

bridges the gap between the western walkway **layer** and the eastern functional **layer**. All the services in the building including electricity, ventilation, wet services, maintenance, ablution, fire escapes and staff are located in this spine. All services run vertically in this spine, spilling out horizontally to adjacent western- and eastern **layers**. The reason for the spine is to have a **serviced-service space**, ensuring that the building is modular, adaptable and flexible. The building will mainly be passively regulated with mechanical ventilation as a back up. These systems will be specified, approved and certified by an environmental/ mechanical engineer.

The structure

The structure consists of steel columns with a concrete deck on permanent formwork. Through investigation the structure changed from concrete to steel due to recyclability, better structural properties and because steel is perceived as being a "lighter" material.

The structures on the western- and south western facades of the building are off shutter concrete walls that carry the structural beams. The mass of the wall helps with thermal comfort in the building: shading against the western sun and thermal mass properties allowing the stack effect ventilating hot air out of the interior.

These concrete walls create the illusion of free standing walls punctured with holes. This achieves certain views, vistas and entrances through the building.

The western façade consists of a 420mm off shutter in situ reinforced concrete wall on a 450 mm deep by 1100mm

wide reinforced concrete strip foundation. This structural wall carries the 305 x 165 x 41 and 406 x 178 x 54 structural steel I-beams of the skeleton. Structural conditions are according to the engineer specifications.

The eastern façade, 270 x 270 x 6mm hollow square steel columns are placed on a 7100 x 6800mm grid. These columns are filled with concrete for extra protection for structural failure in case of fire. To withstand fire the structural elements will be designed bigger or painted with a 12mm coat of special epoxy/ ceramic material for 2 hour fire resistance.

A 4000mm floor to ceiling height will ensure adaptability and maximise free usable space. This is achieved with all the services and equipment restricted to the spine, specifically the stack chimney space and the cavity interior wall.

The main structure of the service **spine** will be 152 x 165 mm T-section columns welded to a 200 x 200 mm mild steel footplate, bolted to the concrete floor. In between these columns a 100 x 100 mild steel angle track will be bolted to the concrete floor (drawing 11).

1200 x 1200 mm wall **module** will consist of 75 x 50 x 20 x 2mm mild steel lip channels screwed together to form a frame. 12, 5 mm wall board will be screwed to the steel frame. A galvanised mild steel plate/ polycarbonate sheeting/ Cor-Ten plate will be custom profiled to be water proof and to form a tray that will be screwed, as a cover, over the wall board, to the module. The module will be screwed to the steel track. The modules will be stacked on each other and fastened by screws through the interlocking lip of the profiled tray. The interior wall of the spine will be a cavity wall of these modules, to

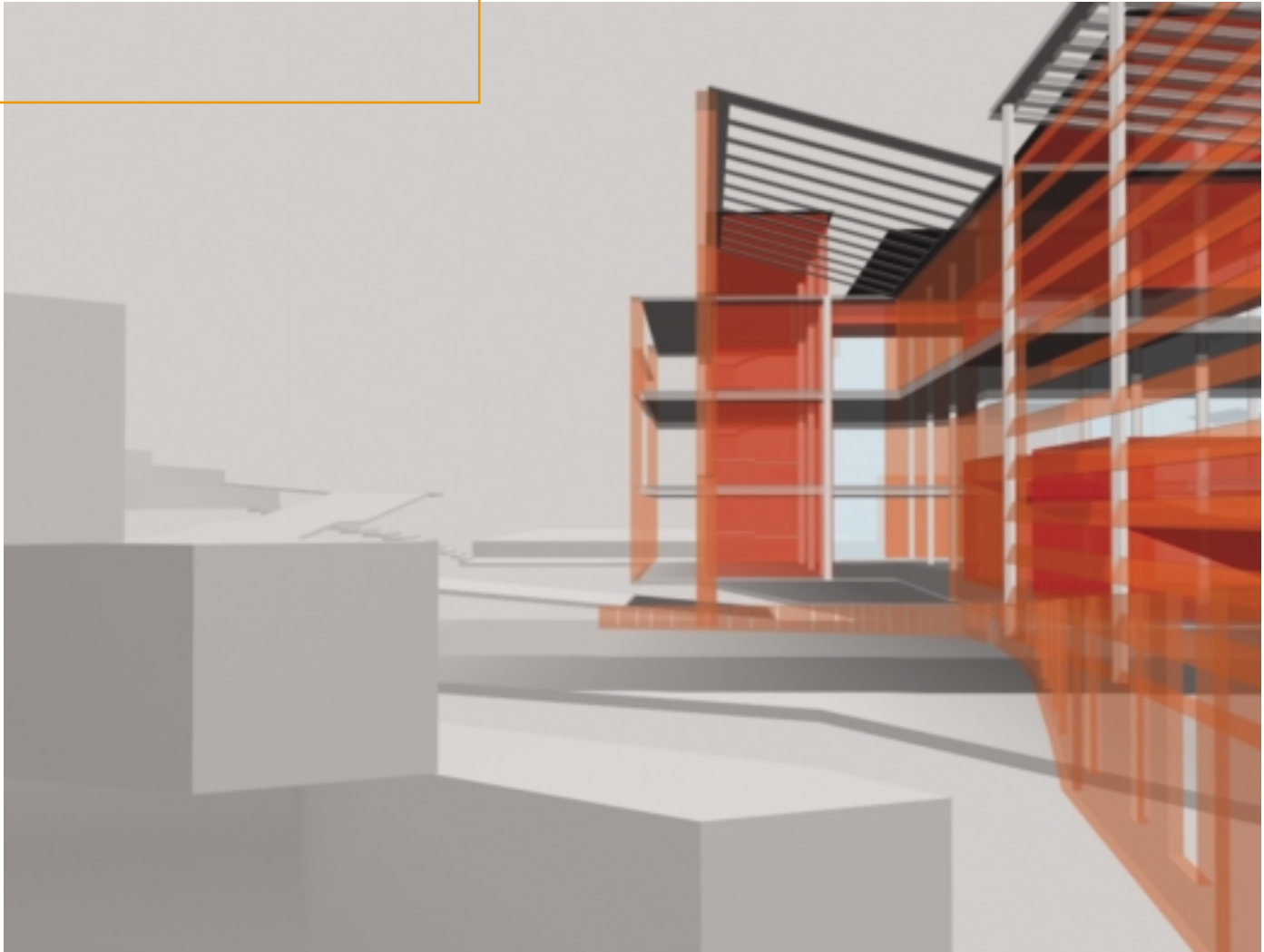
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accommodate services. Maintenance will be easy by just removing one of the modules. Where a window is needed, one or more of these modules can be removed, and a steel frame, sliding window inserted. All the doors in the spine will be sliding and comprises of 30 x 5mm mild steel flat bars welded together to form a frame. Wall modules will be screwed to this frame. The door will slide along a 75 x 50 x 20 x3 mild steel track (see detail).

The walkway layer includes the ramps and corridors

linking the different modules of the building. The ramps and floors consist of Bond- Deck permanent formwork for a composite steel and concrete flooring system.

A steel decking manufactured from 1,2mm thick ASTM 446 Grade C steel galvanised to Z275 is used in the **functional layer** (library, auditorium etc.). A custom made Cor-Ten (High -strength, Low- alloy steel) decking according to specifications will be used in the **walkway - and spine layer**. Each sheet will have a cover width of 900mm, with a rib



height of 75mm and interlocking male and female up stands. Accessories include steel end closers, self tapping screws, pop rivets, hammer drive screws and flashings. The decking will be fastened to the 305 x 165 x 41 and 406 x 178 x 54 I-beams by the self tapping screws. A light mesh for shrinkage control and reinforcing for large spans will be inserted. All specifications will be done by the manufacturer and structural conditions must be certified and approved by the structural engineer. The reason for the Cor-Ten use is to give the soffit/ceiling in the circulation areas and spine texture, and the galvanised steel in the functional spaces will be a more uniform finish. This will create a separation between the different layers.

The thickness of the concrete will be 200mm for the ramps and 250mm for the floors. A textured, pigmented concrete screed to be laid in situ, single bay and saw cut will be used for the ramps. The floors in the functional spaces will be primed and coated with two coats of Epoxy enamel according to the manufacturer's specifications. A secondary 152 x 89 x 16 mild steel I-beam will be placed at 2500mm centres, between the primary beams to accommodate the larger spans of 5 – 7 m.

Because of the simple and fast erection, the permanent formwork above a conventional concrete slab saves costs and provides a finished ceiling. Dry and wet services can run in the ribs of the decking. Double volume openings are placed strategically in the decking to accommodate air movement and natural lighting in the interior spaces. The primary structural columns are 270 x 270 x 6 mild steel hollow sections welded to a 350 x 350 x 5 galvanised steel footplate bolted by M20 anchor bolts to a 450 x 1100 x 1100 reinforced concrete footing. All beams and columns are welded to a 5mm galvanised steel footplate and bolted together by hexagon bolts, M22, 50mm length, 5MPa strength spread, finished with corrosion resistant coating.

Glass & Shading

The eastern façade is a combination of a glass curtain wall and a custom made modular wall panel with a steel/polycarbonate panel cover. The curtain wall consists of 1200 x 1200 x 6mm safety glass complying with SABS 1263 in a 50 x 50 x 3 mild steel frame screwed to a concrete screed.

The glass panels are fitted together by a 100 x 100 x 2 stainless steel patch fitting bolted together and sealed with a silicone sealant (drawing 12). The curtain wall is supported by a 200 x 6mm safety glass fin bolted to the concrete floor by means of a mild steel fin support box.

The shading device consists of an adjustable light

weight system shaped like an aerofoil and clad with semi translucent light polyolefin weaved netting; Teflon coated according to manufacturers specifications. The mesh/netting must be sag-resistant with a **memory** to return to its firm state.

Each frame is 1500 x 3400mm and consists of 42 x 4mm mild circular hollow sections welded together. An aerofoil shaped steel plate will be welded to this frame. 8mm diameter cables will span between the aerofoil plates to give form to the netting. A simple crank system enables **individuals to regulate** the climate from within the building. This consists of gears which enables two louvers to be moved by a handle on a worm screw. Specifications to system will be according to the mechanical engineer (drawing 12).

The shading device at the south east auditorium and restaurant space is a **timber louvered shutter** operated manually. This shutter functions as a pergola for the restaurant and auditorium spaces when opened up. It consists of a timber frame of 30 x 30 timber slats screwed and nailed together. The frame has grooves for 25 x 5 mm timber louvers glued into it. A 50mm diameter mild steel circular hollow profile strut is fastened by a pivot joint to 100 x 8mm mild steel flat bar backing, screwed to the timber frame. The strut is clamped in a 75 mm diameter circular hollow profile welded to a 100 x 5 mm mild steel footplate. This is bolted to 12 mm diameter reinforcing starter bars cast in a 400 x 400 x 50 pre-cast concrete footing (drawing 13).

The roofs

The entrance roof is a post-stressed concrete slab cast in situ. This curved roof will have a 900 mm thick centre towards the middle of the entrance, consisting of a cavity cast into the concrete. This will taper out to a 85mm thick edge of the roof. This will be according to engineer's specifications. It will be supported by slanting hollow circular columns. 245 x 6 mm circular hollow section columns, painted with a epoxy finish for fire resistance, will be used. A 600 x 5 circular mild steel foot plate will be welded to the base of the column and bolted with M32 anchor bolts to a 600 x 1100 x 1100 reinforced concrete footing (drawing 11).

The **connection** between the columns and the roof is celebrated. The column and roof connection will be a 600 x 10 mm mild steel head plate welded to the top of the column. The top of the column will be cast into the concrete roof with a circular hole around the head (see detail). This 600mm circular hole will articulate a shadow line around the head of the column. The angle of the columns is determined to carry the roof as well as the ramps connecting the loose standing



spine
walkway
shading device
natural lighting
timber louvered shutter

modules of the building. The ramps act as bracing for the columns. Through this the amount of columns are kept to a minimum. These angled columns together with the curved roof also create a visual dynamic that celebrates the entrance as a pivoting **elbow** and orientating element.

The **steel roof of the module** in the east west orientation is a monopitch steel column and beam structure. The 270 x 270 x 6 square hollow section columns extend to the roof. The main roof structure will be carried by a custom made mild steel beam made up of 10mm steel plate welded together. The beams taper to the ends, with the deepest central point 406mm deep to accommodate the large span of 10m. A 305 x 102 x 25 mm mild steel I-beam, forms the top flange of this composite beam. This beam supports the purlins, roof cladding, solar – and roof panels. A 102 x 203 mild steel structural T- profile frame will be welded in between the consecutive I- beams to form a tray for the panels. The solar panels will have a frame of welded mild steel flat bars according to manufacturers specifications, bolted to the T-section tray. The roof panels will be *Zincalume* (Zinc and Aluminium galvanising with a matt finish) galvanised mild steel panel or an opaque polycarbonate panel, custom profiled with a gutter to facilitate water run-off. The panels will be screwed to the T-section tray. This is to prevent glare to higher neighbouring buildings, to have smaller areas of water run off and to minimise maintenance. 75 x 50 x 20 x3 mild steel lipped channel purlins will be welded in between consecutive I-beams. The roof cladding will be a clip decking with specially designed roll form ribs for greater locking strength. The steel trays have 700mm coverage, a 42mm high rib and forms a 233mm trough between ribs. The decking will be fastened to the purlins by specified clips fastened by self locating tabs. The steel will be coated by polyvinyl fluoride to minimise corrosion and the insulation fastened in between purlins, will be a reflective foil laminates complying with SABS 1381, part 4, class A (drawing 12).

The **flat roofs** of the south east modules as well as the walkway layer are concrete on permanent formwork. A screed with a 3:100 fall to a 100mm diameter rainwater outlet running down the columns, is cast on the roof structure. Over the walkway layer, on two modules with an east west orientation, the two concrete roofs are used **expressively** to differentiate between different functions in this **layer**. Holes are cut in these slanted roofs, so extra reinforcing will be used and the concrete will be deeper. This accommodates sun patterns on the vertical and horizontal surfaces in these spaces and creates an awareness of the climatic elements. The user will intentionally not be protected against wind and rain in this space. This creates another **layer** in the building.



Ventilation, Lighting & Water

Natural lighting of interior spaces is achieved by a glass curtain wall on the eastern façade and indirect lighting from the clerestory window under the monopitch steel roof. Light will be reflected by light surfaces into the spine and through 1000 mm openings in the floor decking.

Ventilation of the building is based on the fact that warm air moves up and is replaced by cooler air. A stack chimney is created by extending the spine above the concrete roof level with a steel mesh floor panelling. Larger services will run in this space. This part of the spine will consist of dark painted corrugated sheeting fastened by hook-bolts to 35 x 35 x 3 steel angles welded to secondary mild steel I-beams columns. These columns are bolted to the primary beams of the roof slab. A glass wool insulation backing is screwed to the secondary I-beams. A heat build up is created in this space and warm air will be pulled up through the spine and functional spaces by means of cross ventilation and released by a southern open-able window in the stack chimney.

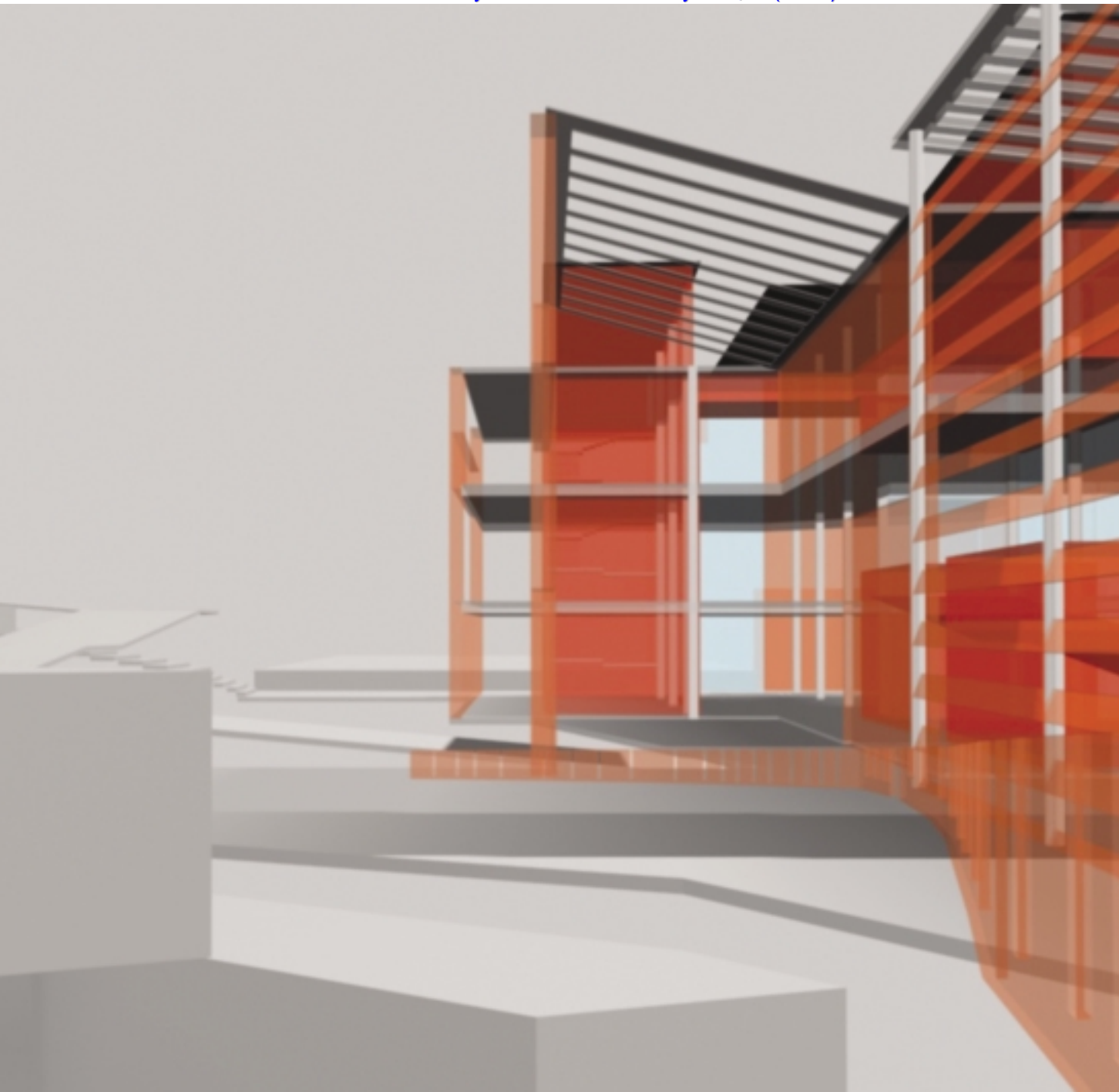
The steel roof also has louvered clerestory windows that will let air out. In winter time these windows can be closed up manually. Another ventilation system is the vertical 1000mm openings next to the western wall where a temperature difference between inside and outside will cause air to move up these openings and escape higher up. The suction ventilates the walkway- and spine **layer**.

Rainwater harvesting by catching rainwater from the roof and draining it through down pipes to tanks on the ground floor. The water will be filtered during this process and pumped up by a solar panel to the roof again where it will be reticulated through the building by gravity and used for grey water. Once through the cycle the water will be used for irrigation. These systems will ensure responsible energy consumption and resource use. This will be designed in conjunction with an environmental engineer (drawing 14).

Circulation

Circulation through the building is mainly by ramps, with two fire escape staircases at the ends of the building. These staircases become visual architectural elements. Being behind a glass façade it enhances the articulation of the ends of the building.

The staircase has a structural balustrade of 10mm structural steel cut and welded together, according to specification. A 60 x 2mm handrail will be welded to the



structural steel. The balustrade is bolted to a 200 x 200 x 10 steel angle welded to a 200 x 300 steel footplate, bolted to a 2400 x 1000 x 750 concrete footing. A 1200 x 300 x 50 fibre concrete light weight tread is bolted to the steel balustrade. A 25 x 25 x 3 mild steel angle nosing is screwed to the tread (drawing 13).

The ramps as discussed before, are of concrete on permanent formwork. The structure of the ramp is, as far as possible, part of the entrance structure. The main structure of the ramps will be 305 x 133 castellated I-beams spanning between 100 circular hollow section columns at 7 meters centres.

This integrates the ramps with the spine and the rest of the building. The secondary ramp structure will be smaller rectangular hollow sections with I-beams.

The auditorium

The auditorium is placed in the south east module, in the functional layer. It consists of a dismantable I-beam structure. On this primary structure a secondary 200 x 75 galvanised mild steel angle welded to a 70 x 10 steel plate, bolted to the beam structure, serves as support for the treads. The tread module consists of a steel tray of 100 x 3mm flat bars welded together, bolted to the angle. A 1500 x 300 x 50 precast fibre concrete lightweight tread with a slip resistant profiled surface, will be bolted to the steel tray.

This ensures the dismantability of the auditorium structure. The building, being a community centre, needs to be adaptable and this extends the life of the building. Timber acoustic panels will be fastened to the structural columns according to acoustic engineers specifications (see detail) (drawing 13).

The exterior spaces will be landscaped by a specialist. The outdoor spaces are so designed to strengthen the campus atmosphere (see site plan). The level changes in the landscaped spaces are to drain water away from the building to storm water drains.

All other services in the building are discussed in depth in the Baseline document.