6.0

PRECEDENT STUDIES

PREMISE

The precedent studies to follow were done based on the four matrices of architecture namely form, function, context and technology. The investigation sought insight not only into programme but inspiration from the entire architectural spectrum.

Figure - 6.1 - *Photograph of a abattoir worker leading a carcass down to the inspection area (By Author).*

6.1

FORM ONE

Seabird Island School, Agassiz, British Columbia, 1988 - 1991, **Patkau Architects**

This project was chosen as a formal precedent due to its unique tectonic quality. The project was designed for the aboriginal community of the area who strongly influenced the educational program and at the end also the building form. The school is situated in a river valley on a large open field with mountains towering around it.

Design: The school is not exclusive to students but also facilitates lectures which the entire community can attend. Each classroom is accessible from the common outside area which is populated with community buildings and this encourages interaction between the school and other community amenities.

The heavy timber post and beam structural system used, conforms to the traditional Salish building heritage. The structural system constantly changes to adapt to edge conditions and requirements. The northern edge consists of large sculptural closed volumes to shelter the occupants from the harsh winter winds. The southern end of the building is much smaller in scale, but much more open under the large eaves of the roof .

A similar expressive roof structure is envisaged for the abattoir, as this element is to make connections and act as the heart of the abattoir which will contain the majority of the systems.

The planning of the Seabird School also informed the design of the abattoir. The building is orientated along a southern facing porch which stretches the length of the building and allows for the direct accessibility of the classrooms (refer to Fig no.) On the southern side of the porch six teaching gardens create a public teaching interface with the other community buildings.

The organisation of functions around a linear circulation element, which separates public and semi public spaces, informed the treatment of the high street facade with which the abattoir needs to interact. Not only the planning but also the three dimensional quality of the building needs to interact and adopt an attitude towards this condition.

The materiality of the Seabird school was designed to weather with time. The timber would become dull due to sun exposure, as do the shingles which will change colour depending on which side of the building it is on.

The abattoir will have to be more hard wearing than this design, but the real challenge lies in maintaining the intricate tectonic quality of the structure.

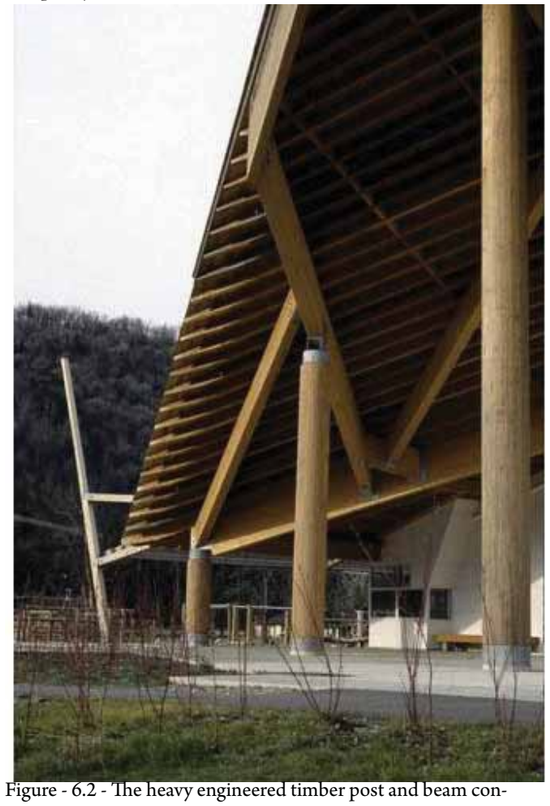


Figure - 6.2 - The heavy engineered timber post and beam construction.

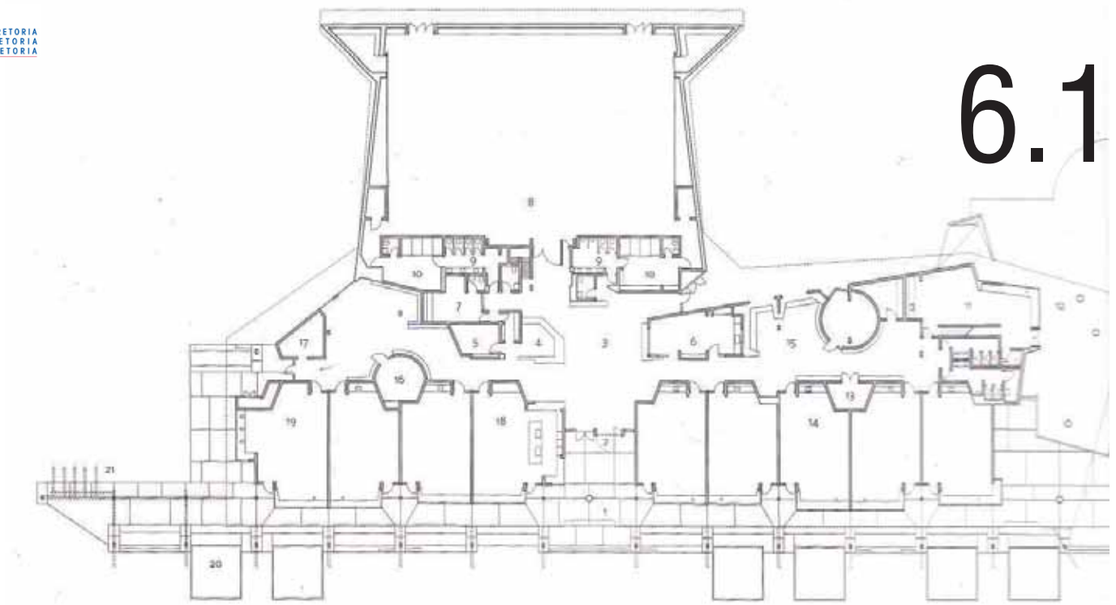


Figure - 6.3 - Ground floor plan.

Figure - 6.4 - The building is organised around the porch with the bulk of the building situated on the northern side and connections to other community activities to the south.

Figure - 6.5 (Above) - The heavily engineered structure was too complicated for the local builders to understand, so the architects built a exact physical model to explain the three dimensional characteristics of the tectonic roof structure. The model also depicts the changing nature of the roof structure and the different approaches to the opposite ends of the building.

Figure - 6.6 (Right) - This image shows the intricate nature of the roof design. The roof constantly changes to allow access into the building, gathering space and shelter and to establish thresholds. The roof acts more like a mechanism, organising movement around and underneath it.

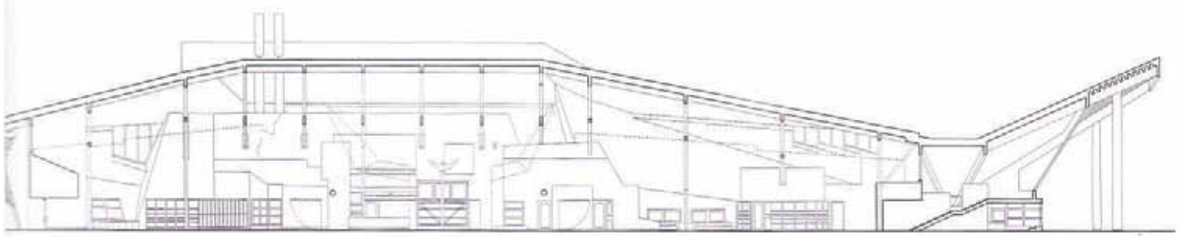


Figure - 6.7 - Sections indication the changing nature of the roof structure.

FORM TWO

Landscape Formation One, Weil am Rhein, Gemany, 1996 - 1999, **Zaha Hadid**

This second formal precedent was chosen due to the way in which the design integrates itself into the surrounding landscape. Landscape Formation One was designed for the 1999 horticulture show in Weil am Rhein. The project forms part of a series of architectural projects eliciting new spatialities from natural landscapes.

"In contrast to conventional urban and architectural spaces, natural landscapes typically contain a multitude of subtly differentiated territorial definitions and smooth spatial transitions. In the context of traditional architectural principles and practice, these features might be considered to lack order and clarity. We disagree with this point of view - believing that they liberate a more complex and nuanced way of ordering spaces."

Zaha Hadid (1999)

Design: The design is conceived as a series of paths which integrates itself into the surrounding gardens. The building is characterised by its horizontality and its alien shape, which blends into the landscape remarkably well.

The building appears to grow from the ground with low concrete walls defining the paths that can be taken over and through the building. These paths trap four spaces between them, forming pavilion like structures. These pavilions house offices, exhibition spaces and a restaurant. The building is orientated in such a manner to maximise the natural conditions in summer and winter and also uses the submerged nature of the design to aid environmental concerns.

This method of organisation assists the abattoir design in the organisation of the entire site. The site is extremely big and contains remnants of previous industrial buildings buried underneath the surface. By adopting a form which grows from the ground, connections can be made to the heritage and the new industry on site. Planted or green roofs can aid in the insulation required for the cool spaces in an abattoir and can counteract the heat island effect. Spaces trapped between connections can be explored as communal green spaces in the abattoir, humanising the monotonous place of production.

In Landscape Formation One, paths extend across the building, the abattoir would rather focus on extending the natural landscape as the abattoir is informed by its immediate surroundings.

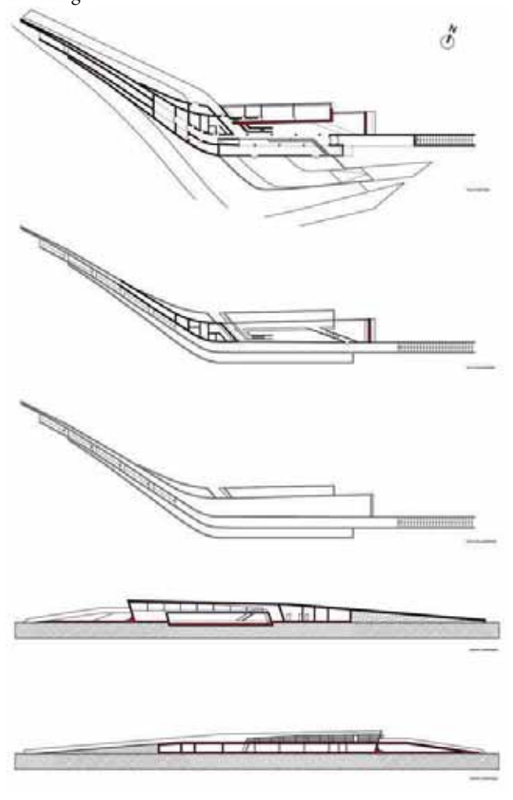


Figure - 6.8 (Right) - Plans and sections indicating how the building integrates into the natural landscape.

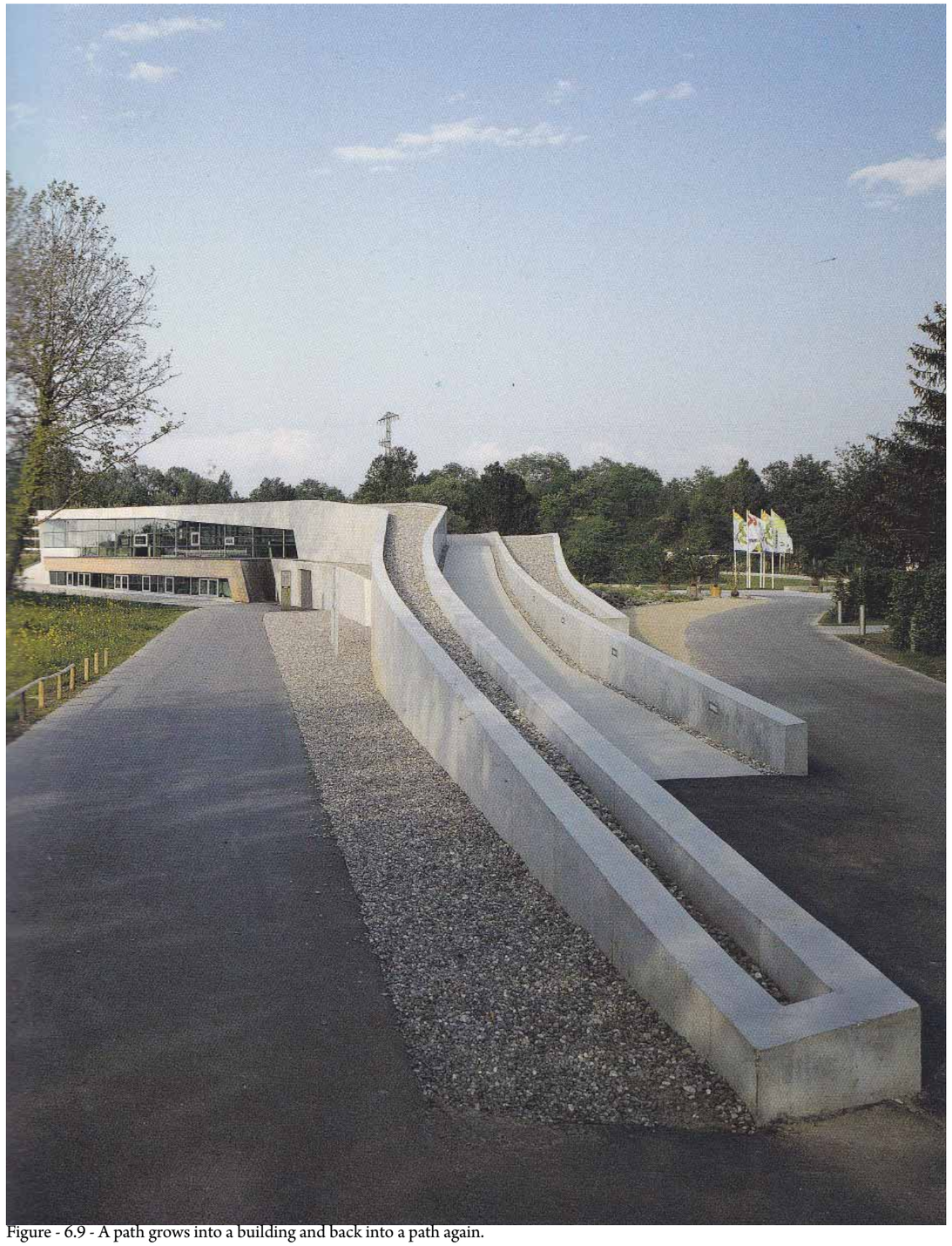


Figure - 6.9 - A path grows into a building and back into a path again.

FUNCTION ONE

Abattoir in Horsens, Denmark, 2000 - 2004, **Arkitema K/S - Jorgen Bach:**

The Horsens pig abattoir is a place where 10 million pigs are slaughtered every year. When architect Jørgen Bach was asked to design the abattoir, he was faced with a moral dilemma. Did he want to be responsible for a place where all these animals are going to be killed every year?

"Internally there were some long discussions about the contract — mostly about the killing part, of course, — and we ended up agreeing: The pigs will die at any rate, regardless of whether we design the building or someone else does it. So we should at least make sure that they are given decent treatment and employees have suitable working conditions"

Jørgen Bach 2007

Figure - 6.10 - A completely different aesthetic was used compared to the typical industrial sheds.

Design: The abattoir in this case was conceived differently compared to the Yorkshire (discussed under the technology heading p. 134 - 135) abattoir. The Horsens abattoir focuses on working environment internally and the public image of the company externally. The exterior of the building has no remnants of the typical industrial abattoir typology. Instead, the 1km long building has a very contemporary feel to it with its colourful cladding and large glazed areas. The architect believes that by investing in the architectural aesthetic and not conforming to the typical industrial typology, stigmas of the abattoir can be overcome, aiding the company in its marketing and public image.

The abattoir was designed for a company called Danish Crown and is one of the most high tech abattoirs in the world. The process is largely industrialised and processes such as deboning, evisceration and cutting are done by robots. It took 100 engineering specialists from around the world to aid the design. These technologies result in a place of immaculate hygiene and performance. Although such systems will not be employed in the design of the abattoir, other, more common, systems used in harmonising the working environment and providing more comfortable conditions for animals were discovered.

One such system is the CO^2 stunning method introduced in the design. It consists of a platform onto which the animal is led, the platform then lowers into an underground chamber saturated with CO^2 which gently puts the animal to sleep before the main artery is slit to bleed the animal. This avoids the stunning process which in many cases does not sufficiently render the animal unconscious prior to slitting (witnessed at the Rietvlei abattoir visit). It also prevents the penetration of the animals skull.

Courtyards, as seen in Fig 6.11 are introduced between production spaces, to allow for views from inside the building and also recreational activities.

Danish Crown pig abattoir represents a new typology model in the design of industrial buildings and processes. By not conforming to the architecture of economy standard and exploring the architectural possibilities within the process, such buildings can become more attractive to the public realm and could be introduced into the urban network.

Figure - 6.11 -
Courtyards are introduced between administrative and production spaces, as depicted in this image. These spaces allow workers to step outside whenever the monotony of mass production becomes too much. The courtyards also allow natural light to penetrate the building and create views from within the building.

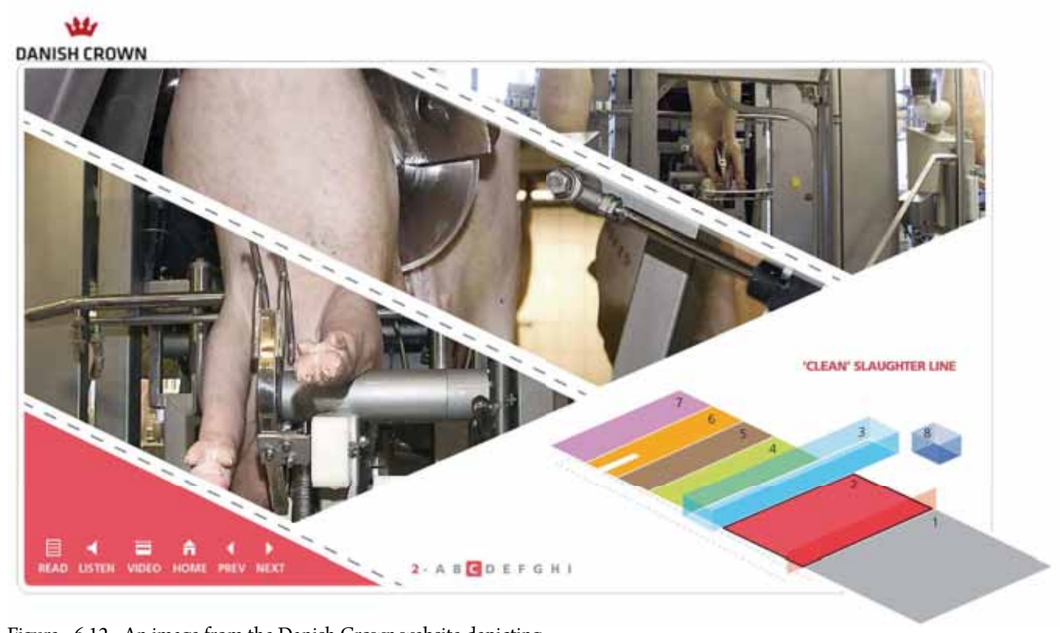


Figure - 6.12 - An image from the Danish Crown website depicting the automation of the processing of the pigs.

FUNCTION TWO

Rietvlei Meat Products Abattoir, Benoni, South Africa, 2004 , **Birmeister Van Niekerk Consulting Engineers:**

To further understand the operations, systems and general function of the abattoir, a visit to the Rietvlei Abattoir in Benoni was made. The visit was done with the guidence of operational manager Robbie Hamilton. He allowed full access to the abattoir operations where the process could be witnessed.

Rietvlei Abattoir is a medium sized abattoir and slaughters up to 150 cattle and 500 pigs per day. Livestock is purchased directly from feedlots around Gauteng Province and they produce a myriad of products from the abattoir. They specialise in canned meat and prime cut meat products.

Design: The abattoir was not designed by an architect, which is evident on arrival and when looking at the plan (Fig 6.16). The building was designed by an engineering firm and is executed in a very engineered manner.

Layout: The abattoir consists of a main building, which houses the slaughtering and processing functions, and a series of smaller outbuildings scattered across the site. Outbuildings serve as offices and basic amenities for staff.

The main building is strictly designed around a process and once the slaughtering starts, around 06:00 am, the building becomes almost inaccessible. Carcasses suspended from the roof stops any circulation within the abattoir during the slaughter process, ducking, diving and squeezing was required to move beyond certain points.

One thing became very apparent during the visit, and that is the separation of the three basic planes of architecture, namely: wall, floor and roof plane. These three elements all become functional within the abattoir, and no wall, floor or part of the roof is not utilised. The roof acts as the system, it carries the animals, provides light, provides ventilation and contains numerous systems hidden in its engineered structure. The wall becomes the working space. Lightweight platforms are suspended from the walls which are occupied by the workers. The animals move alongside these platforms whilst suspended from the roof and are

Figure - 6.13 - A wall of carcasses meets you on entry. (By Author)

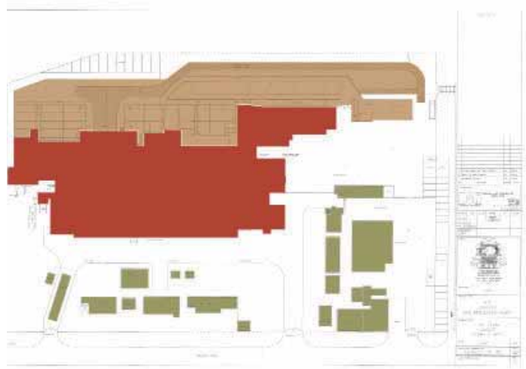


Figure - 6.14 - The massing of the site. Administrative functions are scattered across the site (By Author).

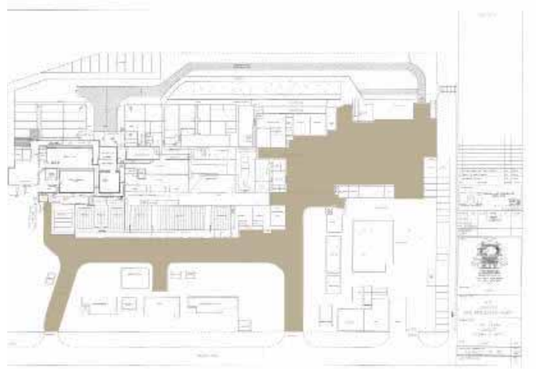


Figure - 6.15 - A large amount of circulation space which is unused (By Author).

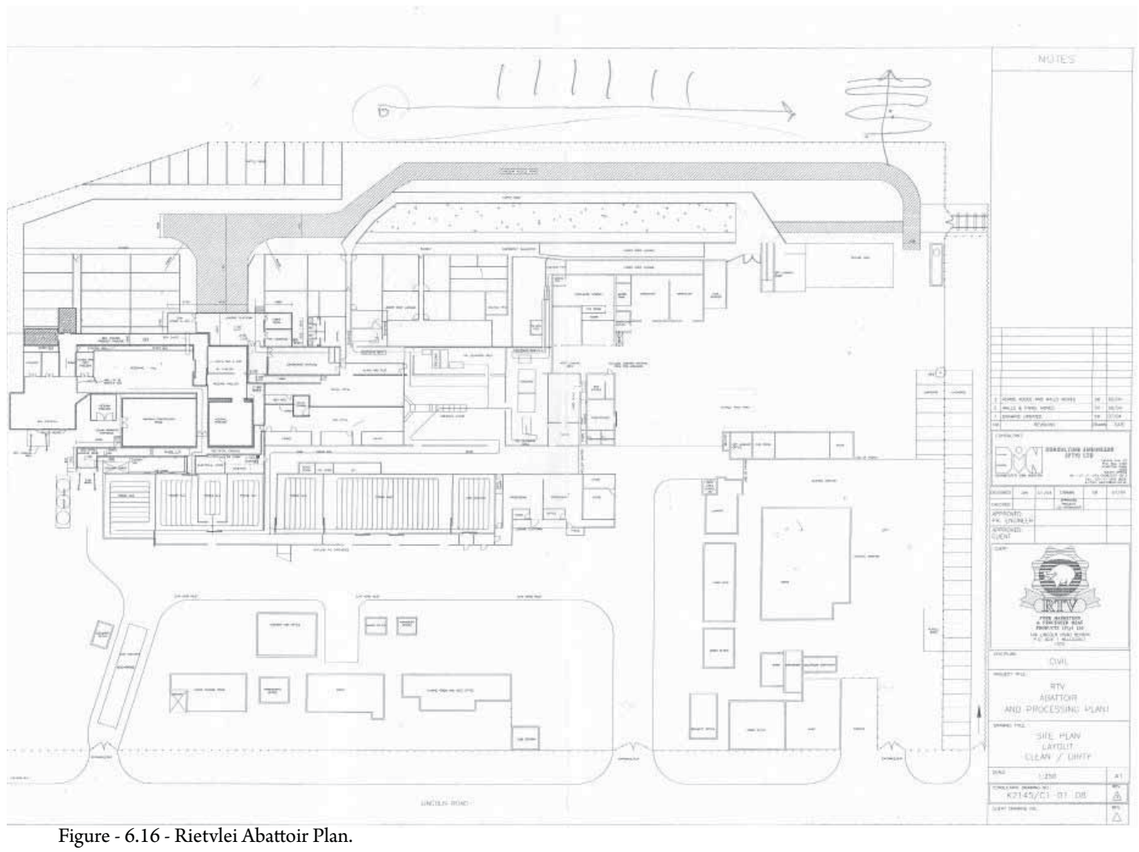


Figure - 6.16 - Rietvlei Abattoir Plan.

Figure - 6.17 - The cattle is hooked and hoisted after it has been stunned (By Author).

then processed. Lastly, the floor acts as a canvas for the capture and flow of water, viscera and blood. As shown in Fig 6.18, the floor is clear of workers and is constantly covered in water and other organic matter. The abattoir is designed in a compact manner and the process snakes through the building. This layout is partly responsible for the inaccessibility of the space. The space becomes extremely cluttered, with different processes happening in extreme proximity to each other. Extreme care has to be taken so that no cross contamination takes place.

After the slaughtering process the carcass has to move along rails suspended from the roof for almost 50 meters to the inspection area. The meat is graded and moved off to an isolated chilling area. Between the slaughter, chilling and processing areas there is no separate circulation for employees. They have to follow the path of the carcass. Once again, this can result in contamination.

The deboning and boxing halls are situated on the western side of the building and are surrounded by chiller rooms which form the edge or envelope of the structure. These chiller rooms open directly onto the dispatch area.

Consumption:

During an interview with Mr. Robbie Hamilton (operations manager) on 20/07/2011, the general consumption figures of the Rietvlei Meat Market were discussed and are as follows:

Water consumption - On average, total water consumption of 200 000 litres per day. 400 - 1000 litres of water per head of cattle slaughtered.
No water recycling systems are in place and all drains are connected to a municipal sewer.

Electricity - The exact amount of electricity was not divulged, but is quoted to be “extremely high”. The abattoir operates for nine hours daily and uses a coal fired boiler to heat water for the scoulding of the pigs. This results in high amounts of air pollution, which is immediately smelled upon entering the site, but in turn lowers the electricity consumption.

The abattoir does not employ any solar or other energy generation systems and makes use of municipal electrical supply only.

Recycling - Rietvlei recycles every part of the animal and sells it to a wide variety of manufactures. All the blood from the bleeding pit is drained into tanks and used for composting on Mr. Hamilton’s personal farm.

Figure - 6.18 (Above) - A row of carcasses hangs as the man skins them (By Author)

This precedent outlined the general problems with abattoirs in South Africa. Opportunities to generate large amounts of energy from the processes housed in the abattoir, such as heat recovery systems, water recycling systems, water treatment systems, etc., are not even considered in the design of such places.

The abattoir as place has no consideration for the worker spending 9 hours, five days a week inside its walls. The place contains no recreational spaces or views outward from within the building, emphasizing the macabre nature of the process. This abattoir makes no use of air recycling or extraction systems to purge the smell within the space, resulting in even worse working conditions.

Furthermore, this abattoir justifies its geographical location on the periphery of the city, as it is a wasteful (water and power) and dirty place, even though it conforms to the standards set out by the Department of Agriculture and the Red Meat Association of South Africa. Local abattoirs, like many other industries, just conform to the minimum standard that seems to be insufficient at best.

Figure - 6.19 (Below) - The Roof structure with all its rails and systems (By Author).

CONTEXT

Quai Branly Museum, Paris, France, 1995 - 2006, **Ateliers Jean Nouvel**

Jean Nouvel's Quai Branly Museum was chosen as a contextual precedent because of the way it interacts with the existing heritage on site in Paris. The museum was designed around a specific collection of primitive art, to as an auxiliary exhibition to that of the Louvre.

"Its architecture must challenge our current Western creative expressions. Away, then, with the structures, mechanical systems, with curtain walls, with emergency staircases, parapets, false ceilings, projectors, pedestals, showcases. If their functions must be retained, they must disappear from our view and our consciousness, vanish before the sacred objects so we may enter into communion with them. This is, of course easy to say but difficult to achieve..."

Jean Nouvel (2006)

Design: The design is realised around a specific exhibition and the control of the environment around it. The exclusion of light and the inclusion of the single ray that enters, are controlled. The building, situated between historical Parisian buildings, is of a completely different aesthetic, but is physically anchored to the old buildings. As seen in Fig 6.21 & 6.26 the western side of the building is connected to an old building that contains the administrative programming of the design.

The new design grows from out of the existing structures as if it is a contemporary continuation of the old. Connections seem to be designed very boldly and is realised by large green glazed screens that connect to the roofs and the courtyards in between. These connections, which at first sight appear bold, are extremely effective and maintains a respectful relationship with the old. On the northern street facade a connection to the existing facade is made and similar rhythms are continued except for the new facade that is completely planted from top to bottom, as seen in fig 6.26

Auditoriums and other exhibition spaces are sunken beneath the ground so as not to negate the form of the above ground structure. Above these submerged spaces is an open park that was designed as a forest in which the exhibition is displayed.

"The resulting architecture has an unexpected character. Is it an archaic object? A regression? No, quite the contrary, for in order to obtain this result the most advanced techniques are used: windows are very large and very transparent, and often printed with huge photographs; tall randomly-placed pillars could be mistaken for trees or totems; the wooden sunscreens support photovoltaic cells. The means are unimportant- it is the results that count: what is solid seems to disappear, giving the impression that the museum is a simple façade-less shelter in the middle of a wood. When dematerialization encounters the expression of signs, it becomes selective; here illusion cradles the work of art."

Jean Nouvel (2006)

Jean Nouvel's approach to the design of the museum is the complete opposite to what the design of the abattoir entails. He hides systems and functional objects whilst the abattoir displays these objects as important organising elements in a designed process.

The precedent was not chosen for its approach to internal spaces, but for its very apparent attitude towards heritage. The building does not shy away from or ignore the heritage, but embraces the aesthetic differences and establishes a juxtaposition on site. The heritage does not get mothballed, instead it is incorporated as a functional part of the abattoir and denotes an important threshold in the design. This relationship, be it bold, creates a synergy, and one without the other would not be as successful.

The remnants on the site of the abattoir need to be incorporated into the design. Two underground bunkers in which whiskey was stored, are situated on the southern boundary of the site.

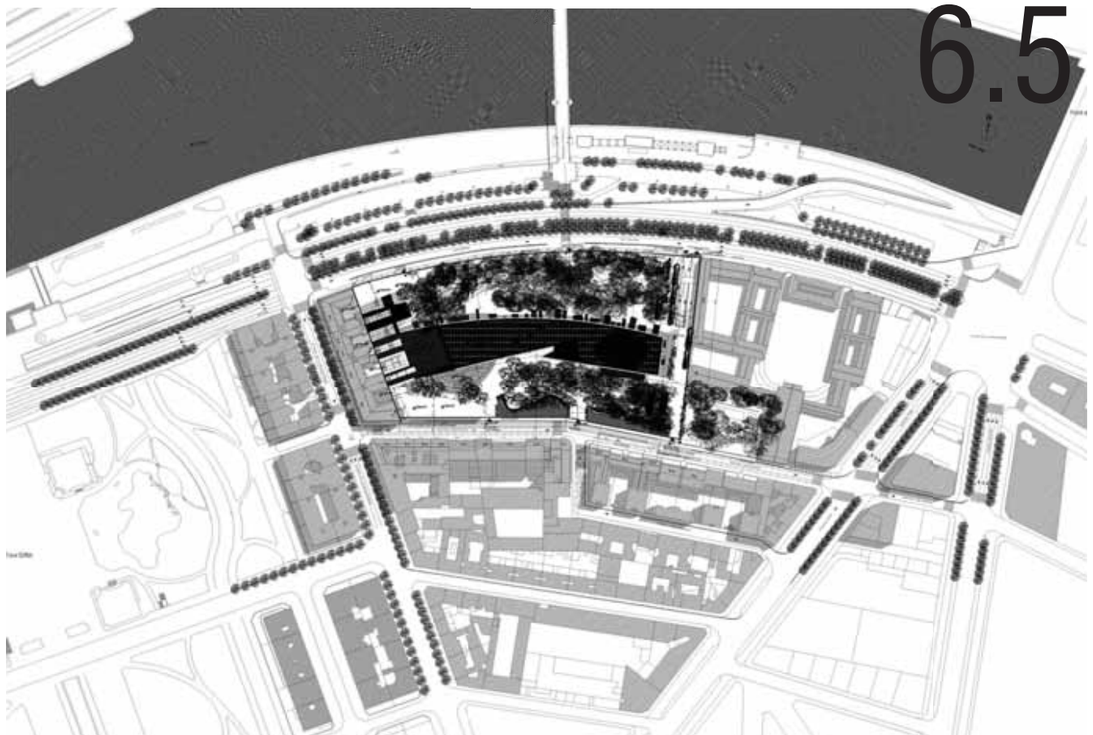
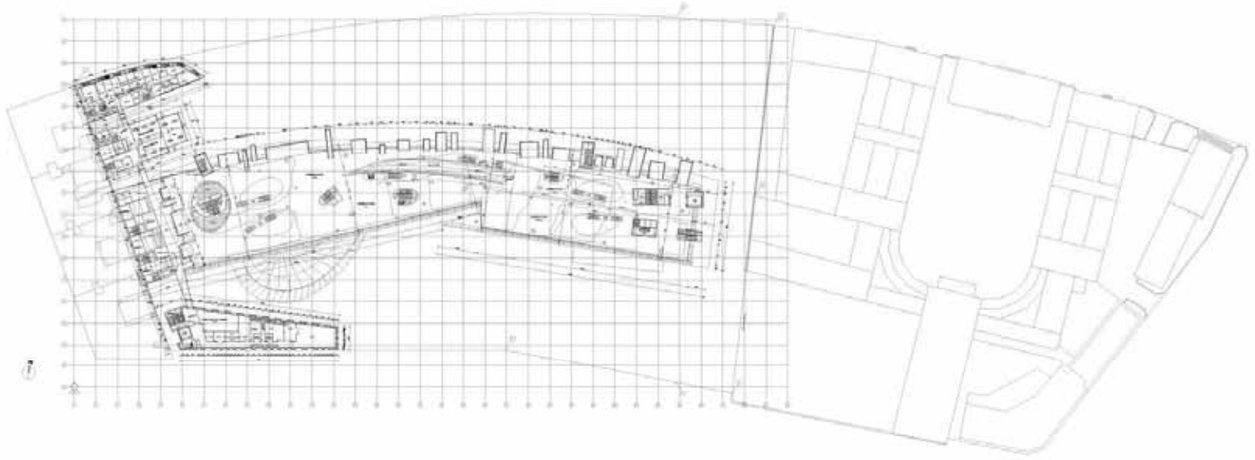


Figure - 6.20- Site Plan indicating how the building grows out of the old buildings.

Figure - 6.21- Photograph from the Eiffel Tower depicting the greater context on the building.



The abattoir does not need to avoid these elements, but can grow from them, clash into them and most importantly revive them into functional objects that can anchor the design.

Figure - 6.22 (Above) - Mezzanine floor plan showing how the building does not only conform to the historical building it is connected to, but also adheres to the axial shift of the building across opposite it.

Figure - 6.23 (Below) - The envelope of the above ground exhibition space consists of a series of adjustable louvres to control the light inside the exhibition. The site is also heavily planted with trees, converting a Parisian garden into a forest with a museum hidden inside.

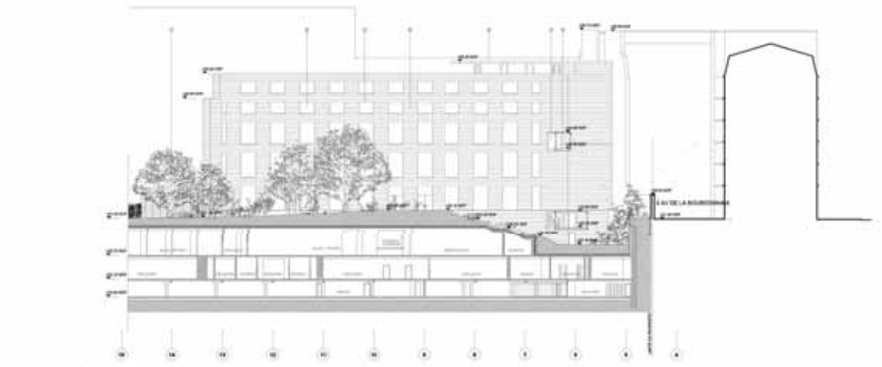


Figure - 6.24 - Section depicting the underground exhibition spaces and its relation to the street.

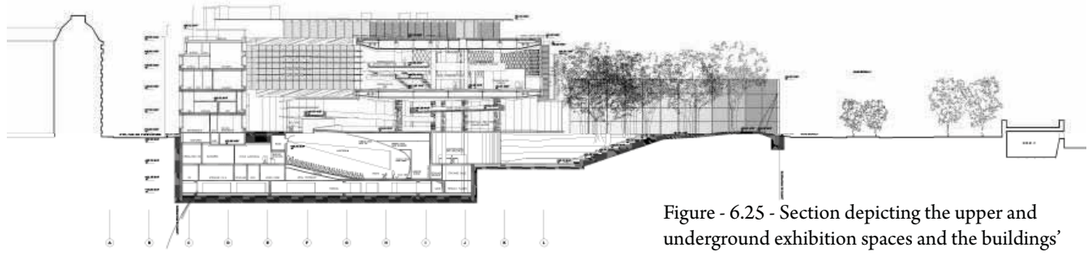


Figure - 6.25 - Section depicting the upper and underground exhibition spaces and the buildings' contextual relationships to the surrounding streets

Figure - 6.26 - The existing building facade is continued, but the new is characterised by large windows and a wall which is completely planted.

6.6

TECHNOLOGY

Environmental considerations in the design of a new abattoir at Cranswick Country Foods, Preston, East Yorkshire**,** 2003 - 2008, Mark Goddard.

This precedent was not chosen for its architectural qualities but for the environmental systems employed in the project. The information listed below is from a presentation by architect Mark Goddard done in 2008.

The abattoir at Preston in Yorkshire was completed in 2008 and makes use of a myriad of systems which mainly focus on:

Energy Recovery

Reduction in water consumption

Energy

Control of emissions

Waste recycling

The following is a brief summary of the technologies employed in the design of the new abattoir.

It was recognised that every environmental aspect of the process required a form of management control to reduce its impact, should it, or a significant part of it, fail. Therefore it was decided that an Environmental Management System (EMS) would be used to exercise the control which included inspection, testing and maintenance of equipment that could be detrimental to the environment. The site now has an integrated management system accredited to both ISO 14001 & BS 18001 (British Standards)

ENERGY RECOVERY

The abattoir process includes the use of gas burners for carcass singeing.

Exhaust gases through the flue generates heat to approximately 450°C.

Installation of a heat recovery system enables water to be heated to approximately 95°C for use in a variety of processes within the abattoir e.g. scald tank, sterilizers and hygiene.

Reduced reliance on gas fired boiler to raise steam & hot water.

Further reduced reliance on electrical elements to heat sterilisers.

Estimated savings of 2.5m kWh per annum 2.5 Year pay back on investment.

REDUCED WATER USE

Reduction in water use have become key to abattoir projects. The Preston abattoir has included the following water efficiency measures:

Use of efficient recycling pumps within the process

Pipe-work reducers to limit flow of water to end users

Water Metering on key equipment

Water metering enables the business to affect control over water use by comparing its use against throughput, thereby limiting cost associated with effluent discharge. Deviations from the base line would be indicative of misuse or leakage.

Methods of waste water treatment to reduce COD, BOD, PH , etc were investigated. This was achieved by adding a biological agent into the drainage system which would then multiply the organisms in the effluent to improve its quality prior to discharge, thereby reducing costs.

ENERGY

The introduction of the heat recovery system has emphasized how energy can be managed in an efficient manner to see real savings in both Gas & Electricity. In addition to High Frequency lighting being installed throughout the factory, the following improvements were made:

Compressed Air Survey to reduce leaks

Power Factor Correction

Voltage Optimisation

Installation of New Refrigeration Equipment

CONTROL OF EMISSIONS

The new abattoir incorporates an odour control system which includes an air scrubbing/polishing facility. Waste trailers are housed within an air lock. Pipe-work from the slurry tanks and tanker filler point, is also routed through the OCS. All waste from the internal processes are vacuumed directly to the air locked waste area.

The methodology of the system is to treat heavy odour from the waste handling unit and exhaust from the slurry tanks through an activated carbon filter scrubber, which provides additional 'air polishing', reducing the risk of odour nuisance. (Filter medium replaced every four years under normal use). The vacuum system will reduce the necessity of waste handling to further reduce odours, as well as reduce noise nuisance issues as FLT movements will be limited by approximately 75%. Strategically placed land banks, fencing and tree planting are included in the project design to further reduce noise to nearby residential properties

WASTE/RECYCLING

Recycling contaminated waste has proven extremely difficult and there appears to be no waste management company that is able to treat it cost effectively. Consequently, all contaminated 'General' Waste continues to be sent to landfill

A mill sized baler was purchased and used to recycle:

Cardboard

Laminate Film (Skeletal Waste from packaging lines)

This precedent displays the recycling potential within an abattoir. The impact of such systems on the operational cost of the abattoir is immense and can increase the competitiveness, output and profit of the company.

The precedent forms the energy model for the design of the Mamelodi High Street abattoir and by introducing such systems, the building can be liberated of its wasteful nature and become safer and more productive within its public location.