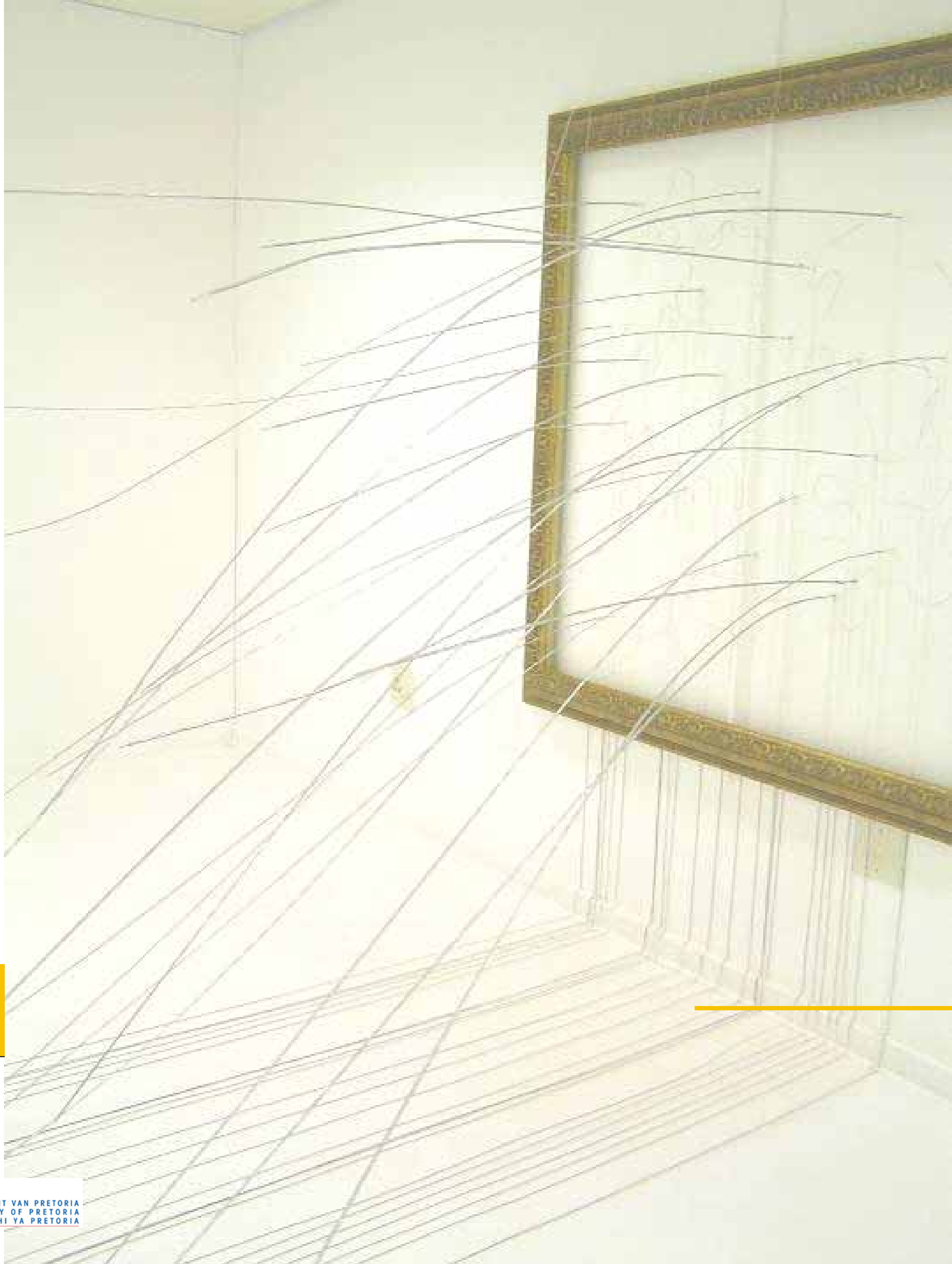

FIG 8-1: JENNA BURCHELL/UNIVERSITY OF PRETORIA

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technical inv

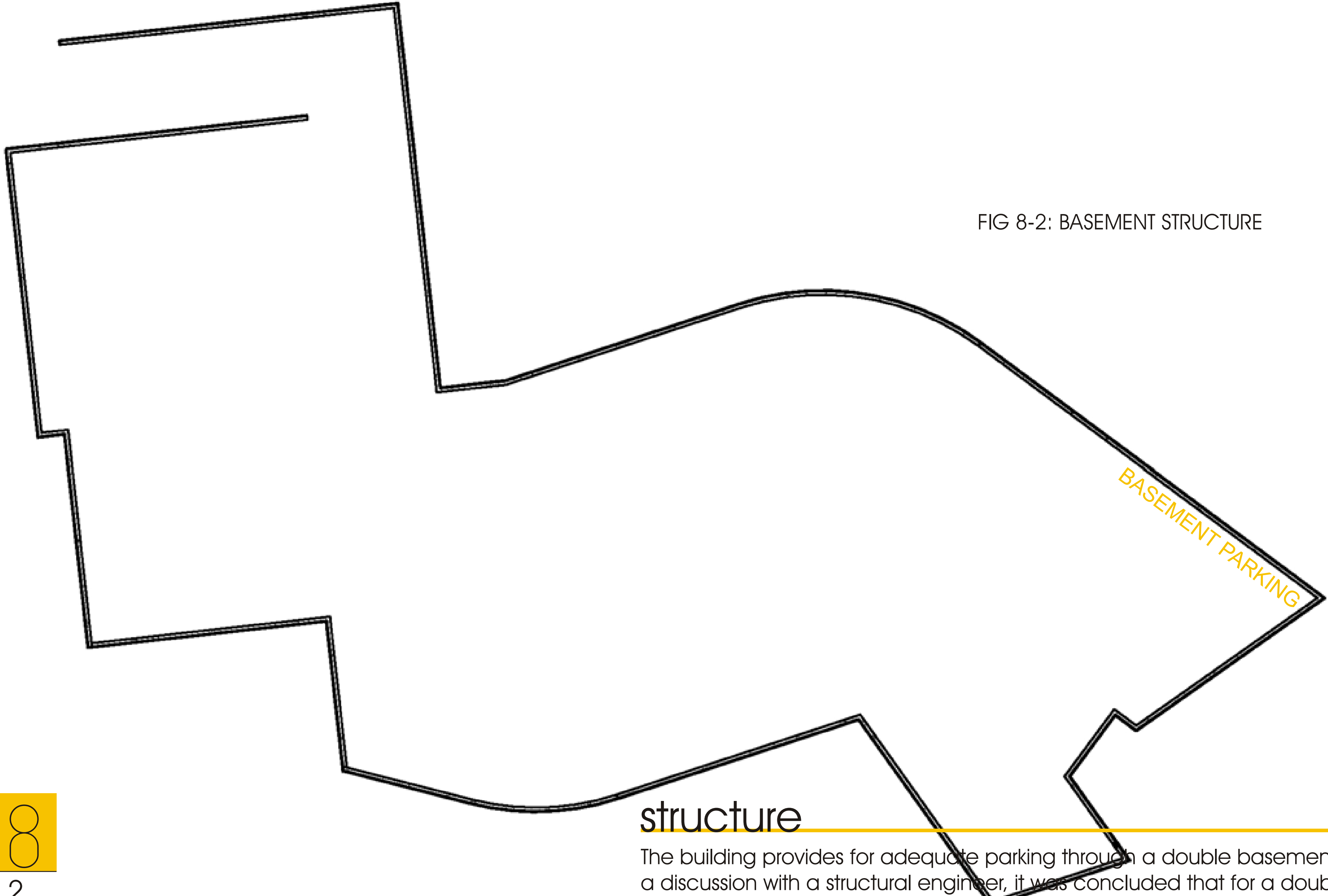

FIG 8-2: BASEMENT STRUCTURE

systems

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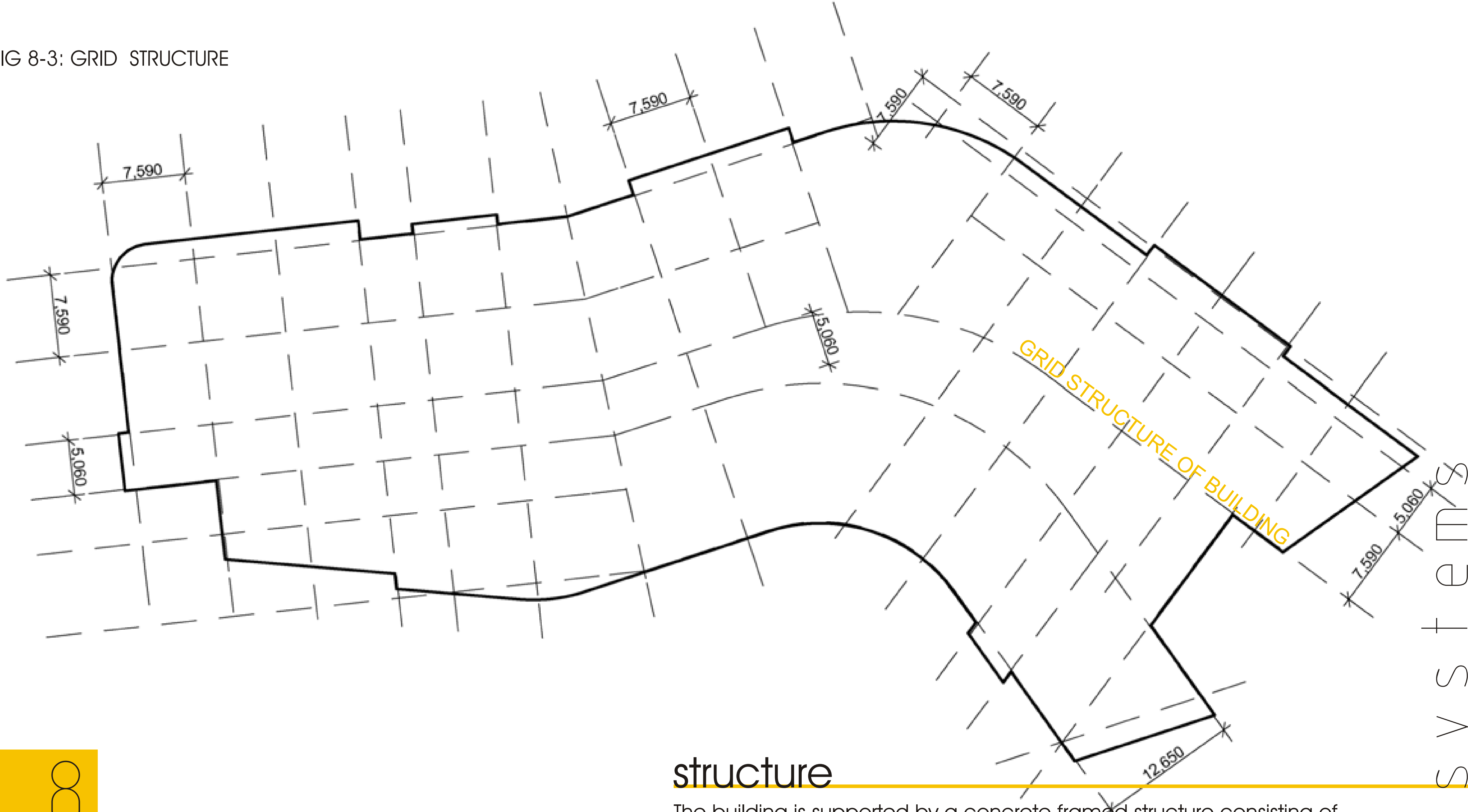
structure

The building provides for adequate parking through a double basement. After a discussion with a structural engineer, it was concluded that for a double basement a 345mm reinforced concrete retaining wall should make for a sound structure. The structural engineer specified a 340 x 1500 reinforced concrete footing for such a retaining wall. The basement surfacebed can be 85mm thick provided that the concrete has a strength of 45MPa.

FIG 8-3: GRID STRUCTURE



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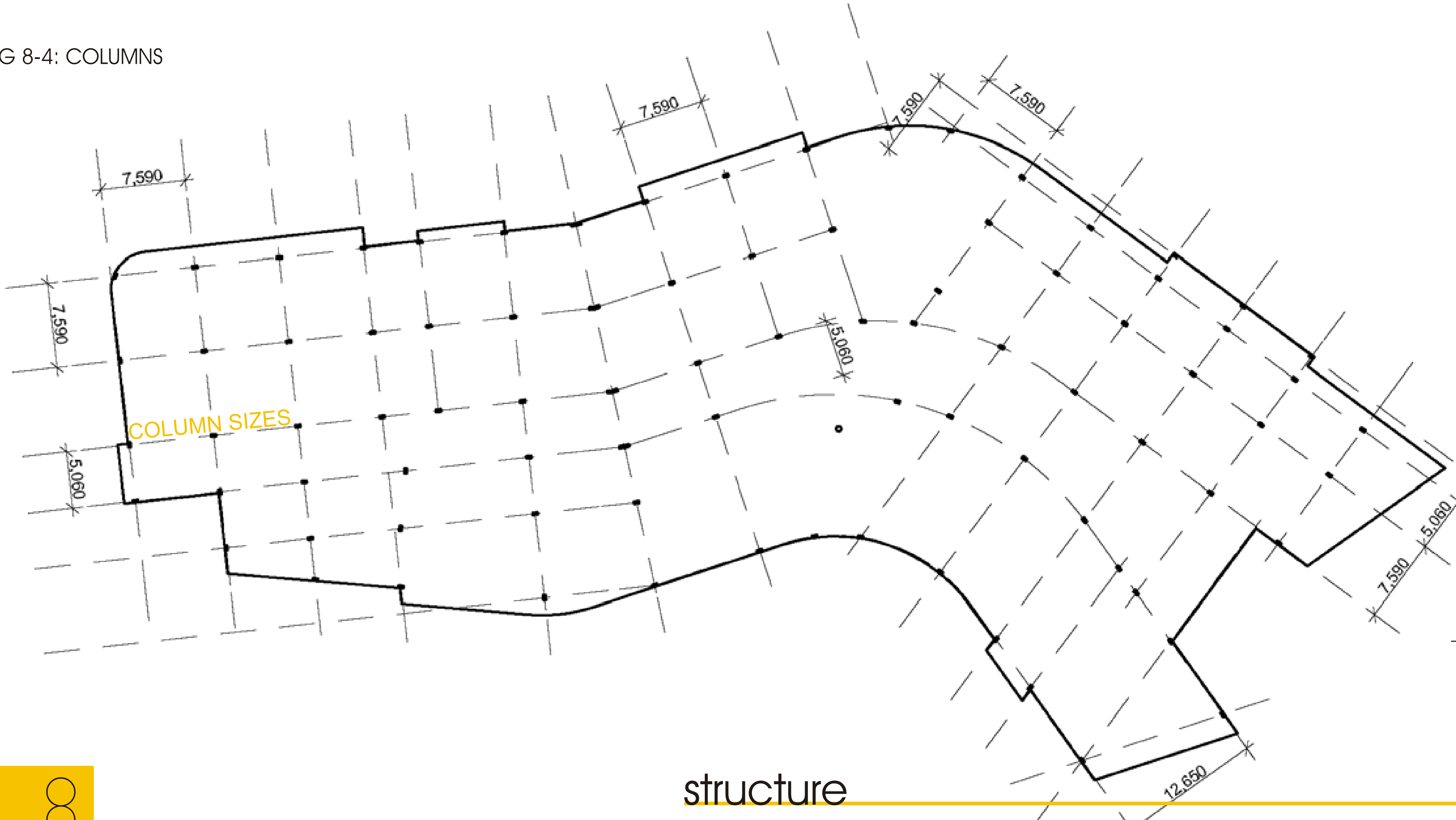
3

structure

The building is supported by a concrete framed structure consisting of reinforced concrete columns, beams and slabs. The position where concrete columns would be placed is determined by the grid structure, meaning where the gridlines intersect. The concrete beams would therefore also be situated on the gridlines in order to be supported by the columns. The gridline spacing is determined by optimum concrete beam spans as well as to suite parking bays which should therefore fit within increments of 2530mm. Therefore the grid structure is 5060mm, 7590mm and 12 650mm according to brick scale.

systems

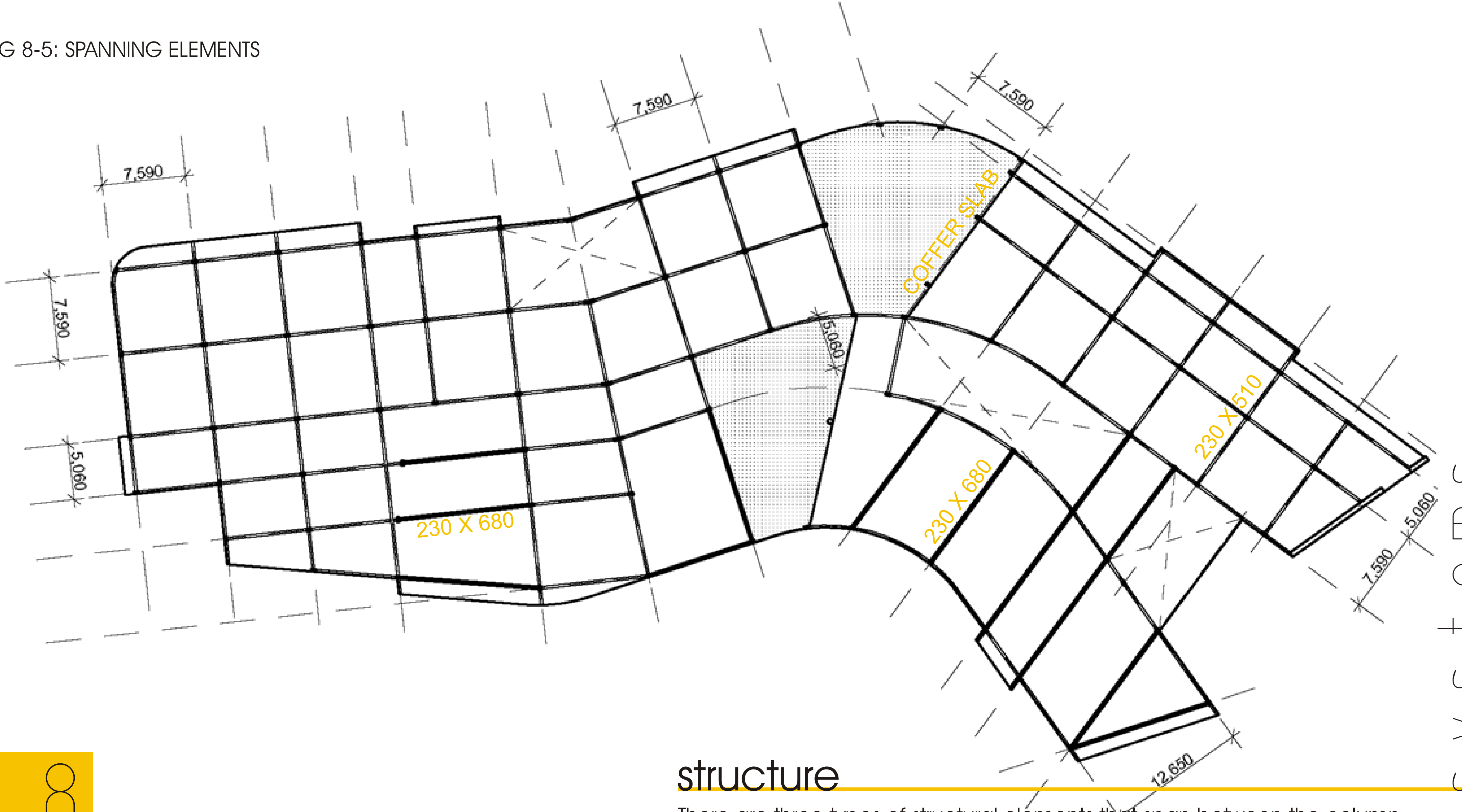
FIG 8-4: COLUMNS



structure

The concrete columns, which would make part of the concrete framework, is a 230 x 460 reinforced concrete column, which shall be according to the structural engineer's design and specification.

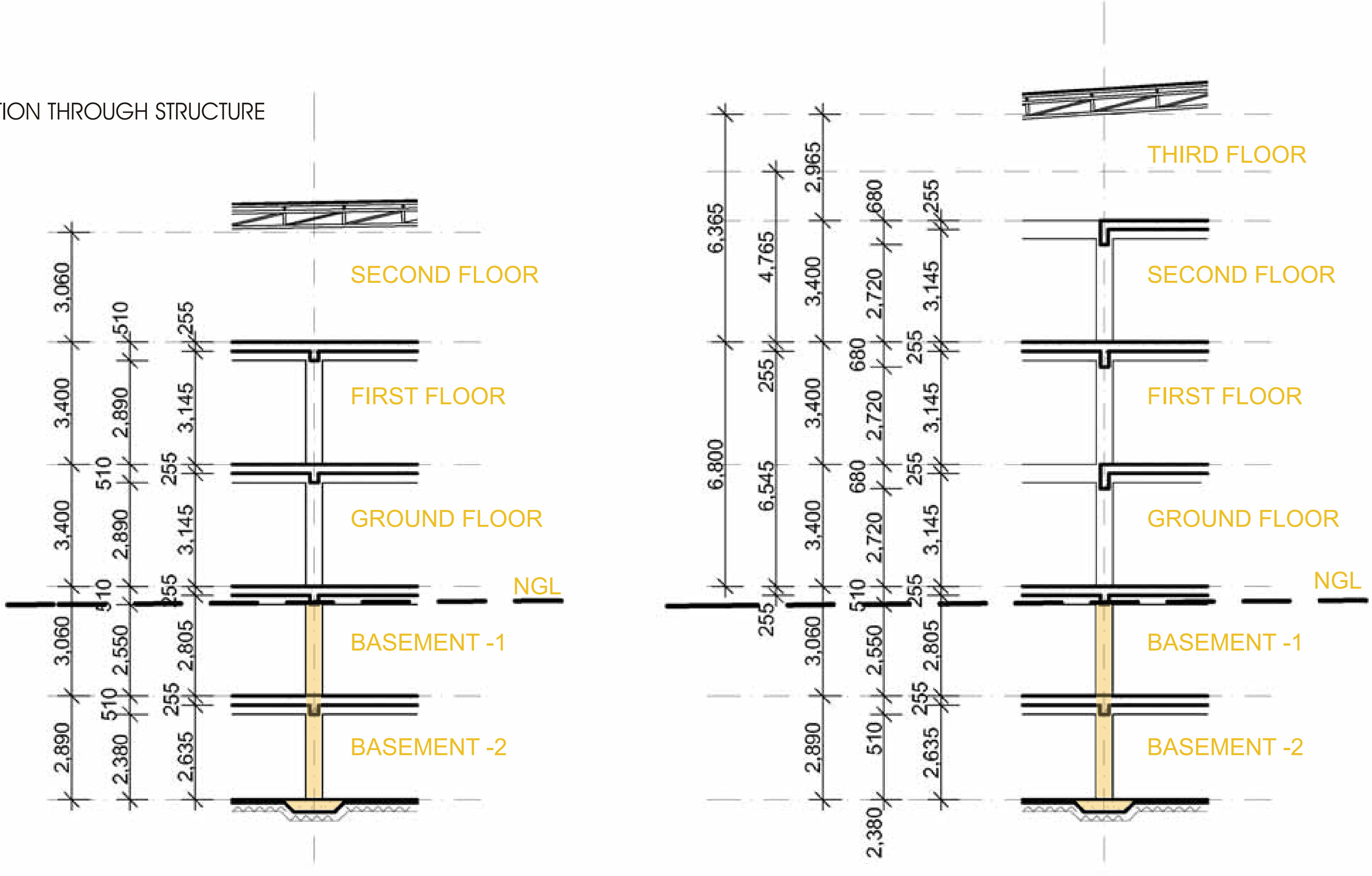
FIG 8-5: SPANNING ELEMENTS



structure

There are three types of structural elements that span between the column supports, namely reinforced concrete- slabs, beams and coffer slabs. The beams span between columns, the slabs span between beams and the coffer slab is a combination of beams and slabs. The slab is a 255mm reinforced concrete slab, the 230 x 510 reinforced concrete beams span upto 7 590mm and the 230 x 680 reinforced concrete beam upto 12 650mm. The coffer slab is used where there are limited supports for spatial reasons and span upto 13 000mm. All members are to structural engineer's design and specification.

FIG 8-6: SECTION THROUGH STRUCTURE



structure

It is a four storey building with two basement parking levels with floor-to-floor dimensions as indicated. The foundation system for a four storey building usually consist out of piles in order to reach the adequate soil bearing capacity. However, through the two basements adequate stable soil will be reached, which allows the columns of the basement to act as piles. The foundations is therefore a 1140 x 910 x 340 reinforced concrete pad foundations to structural engineer's design and specification. It shall be level with the surfacebed for ease of the tanking membrane and provided with expansion joints around it.

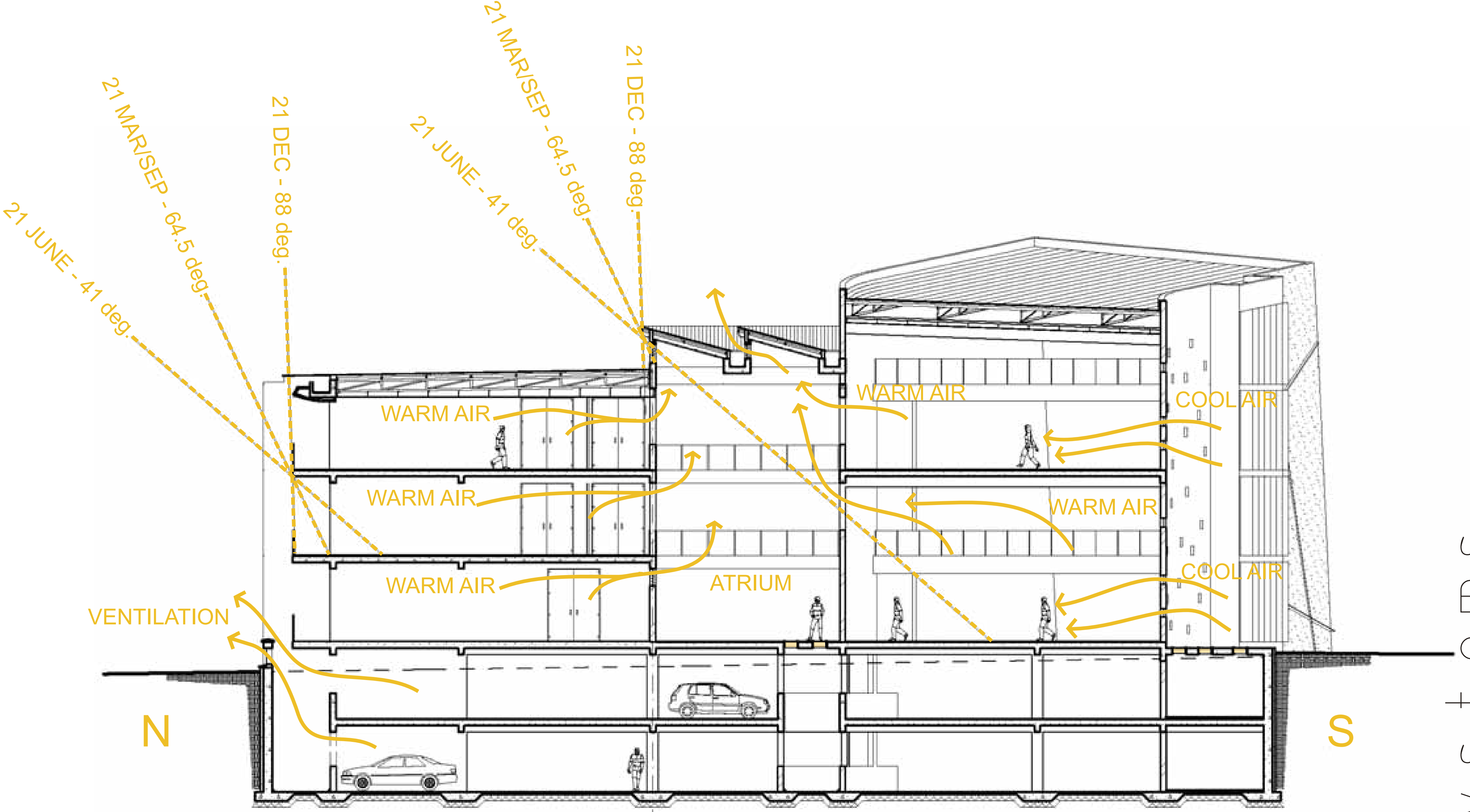


FIG 8-7: SECTION A-A

passive cooling

Through the use of balcony overhangs and roof overhangs, allow the sun to only enter the building between 21March-21September. The atrium provides for stack ventilation as well as cross ventilation to take place through adjustable glass clerestory louvers. Cool air is drawn in from the southern side and stack ventilation is enhanced through solar powered fans situated at the clerestory louvers. Natural light is allowed into the basement through opaque windows in floor slabs. The basement is ventilated through openings and grills which is enhanced through the use of solar powered fans.

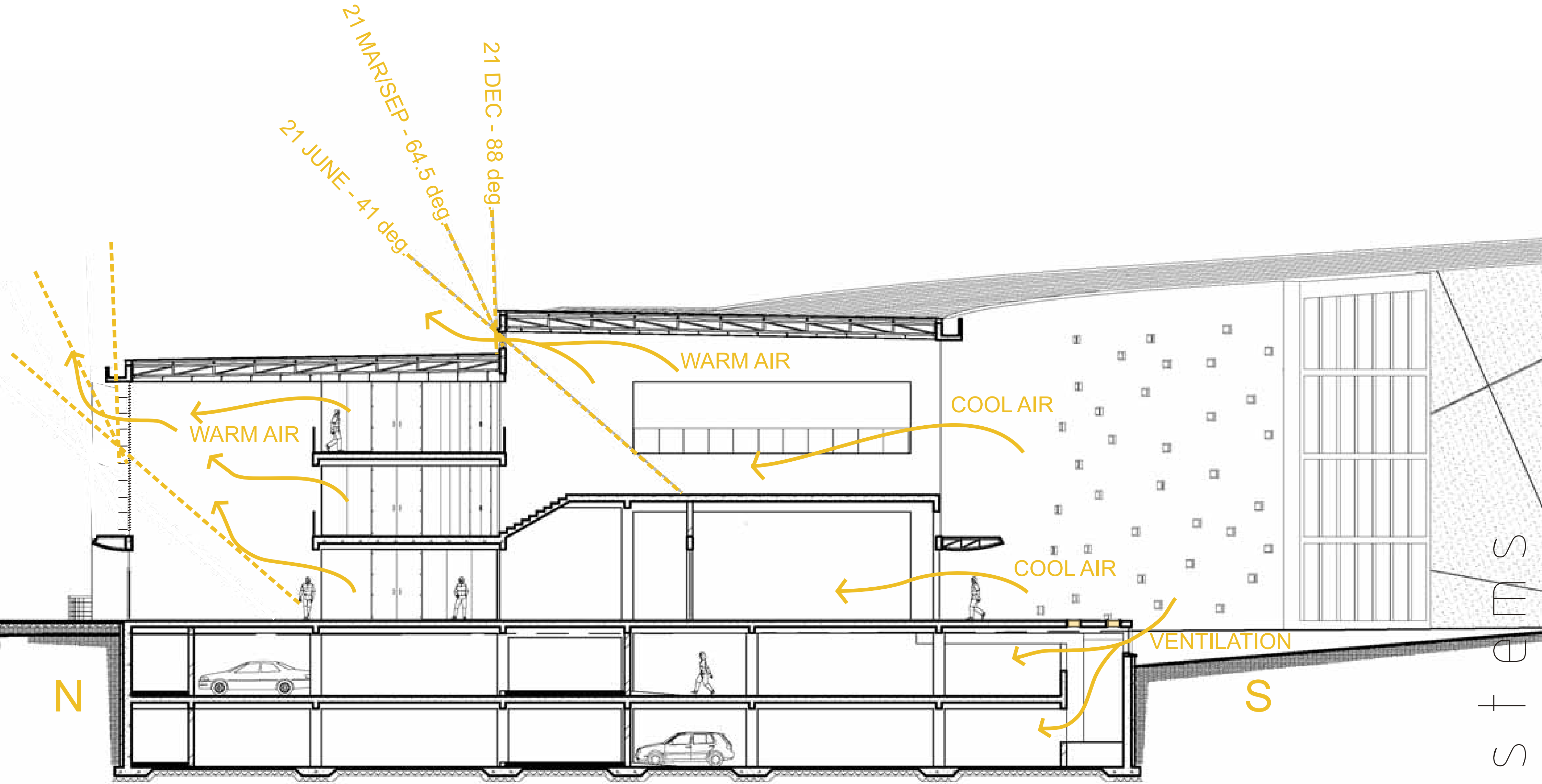


FIG 8-8: SECTION B-B

passive cooling

Through the use of aluminium louvers, allow the sun to only enter the building between 21March-21September. The atrium provides for stack ventilation as well as cross ventilation to take place through adjustable glass louvers. Cool air is drawn in from the southern side and stack ventilation is enhanced through solar powered fans situated at the clerestory louvers. Natural light is allowed into the basement through opaque windows in floor slabs. The basement is ventilated through opening grills, which is enhanced through the use of solar powered fans to the north, in order to draw cool air in from the south.

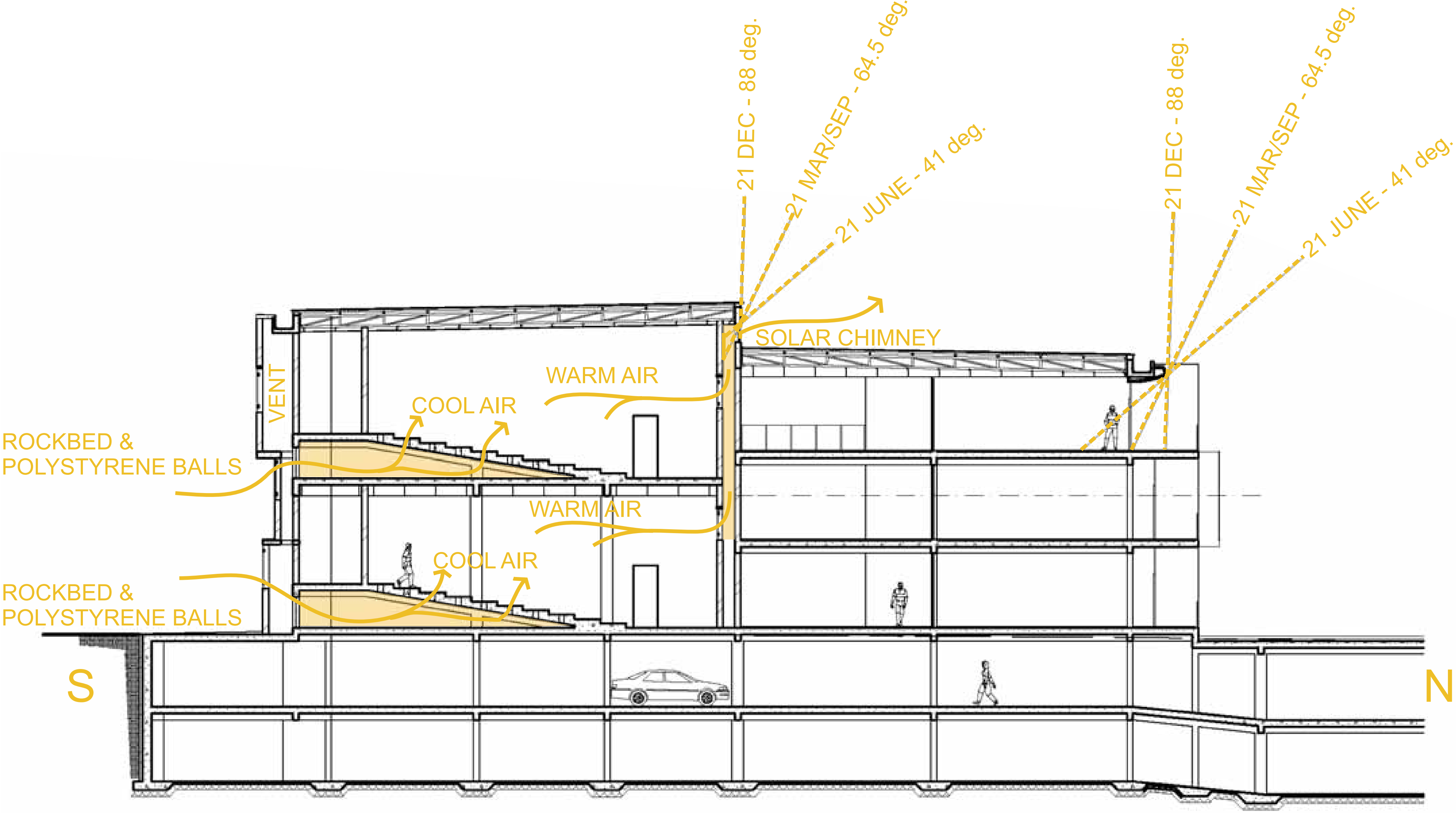


FIG 8-9: SECTION C-C

passive cooling

The auditorium is passively cooled by drawing cool air in from the southern side of the building. It is drawn into a shaded vent which flows from there into a rockbed mixed with polystyrene balls to lessen the dead load of the rocks. The rockbed would then further cool the air to about 18*C . A solar chimney is implemented to provide for an updraft causing a vacuum, drawing air from the rockbed. The process is enhanced through the use of a solar powered fans situated at the top of the chimney. The system is controlled for comfort through the use of adjustable louvers and setting the speed of the fans.

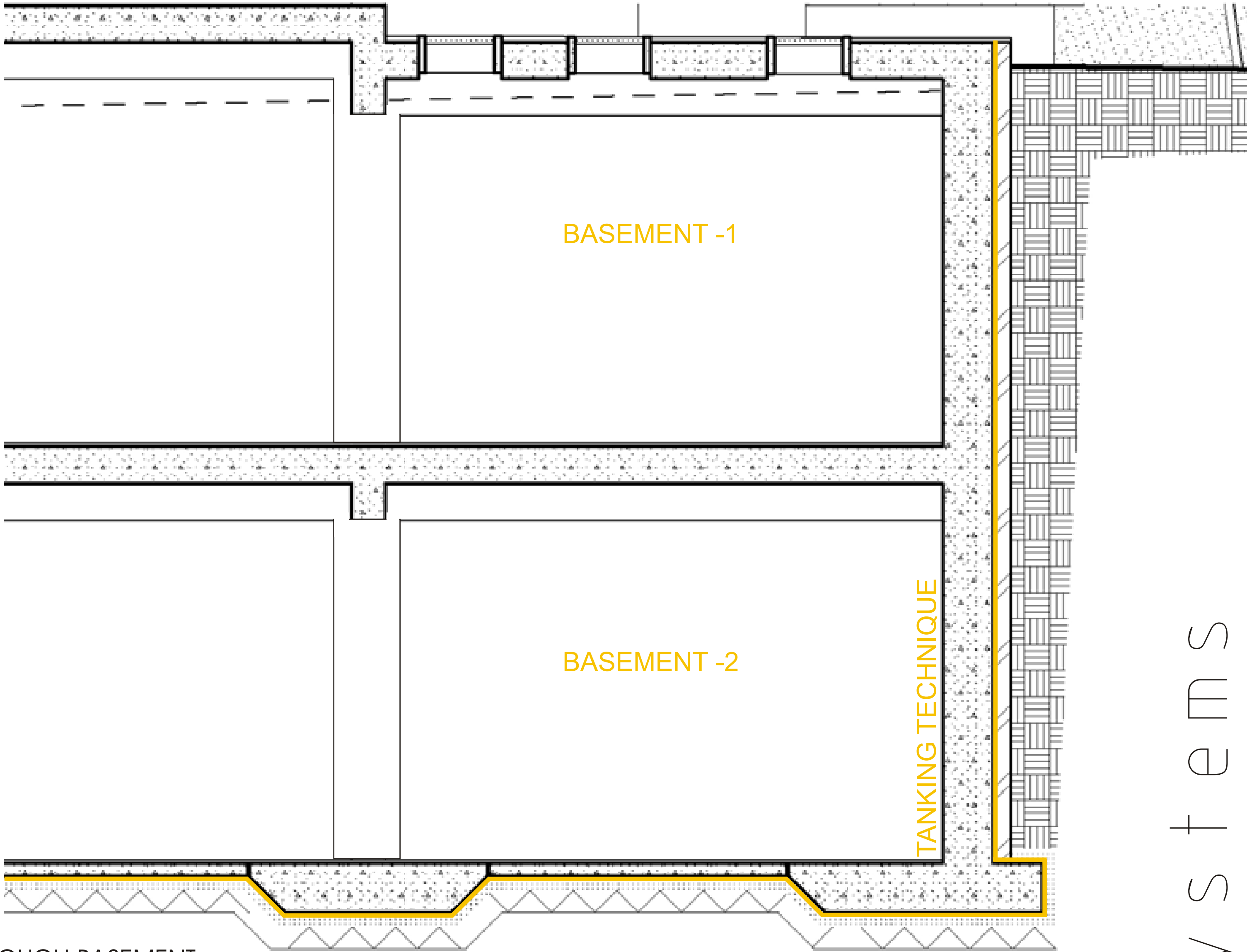


FIG 8-10: SECTION THROUGH BASEMENT

waterproofing

Tanking is a waterproofing technique which renders your basement waterproof, preventing any water penetration into the building. The description of tanking is as a result of the comparison between a basement with a waterproof tank completely submerged in water. The tanking membrane is a 1000 micron Gunplas hyperlastic orange which is protected by a single brick skin at the retaining wall and with 100mm river sand blinding layer below the surfacebed and foundations.

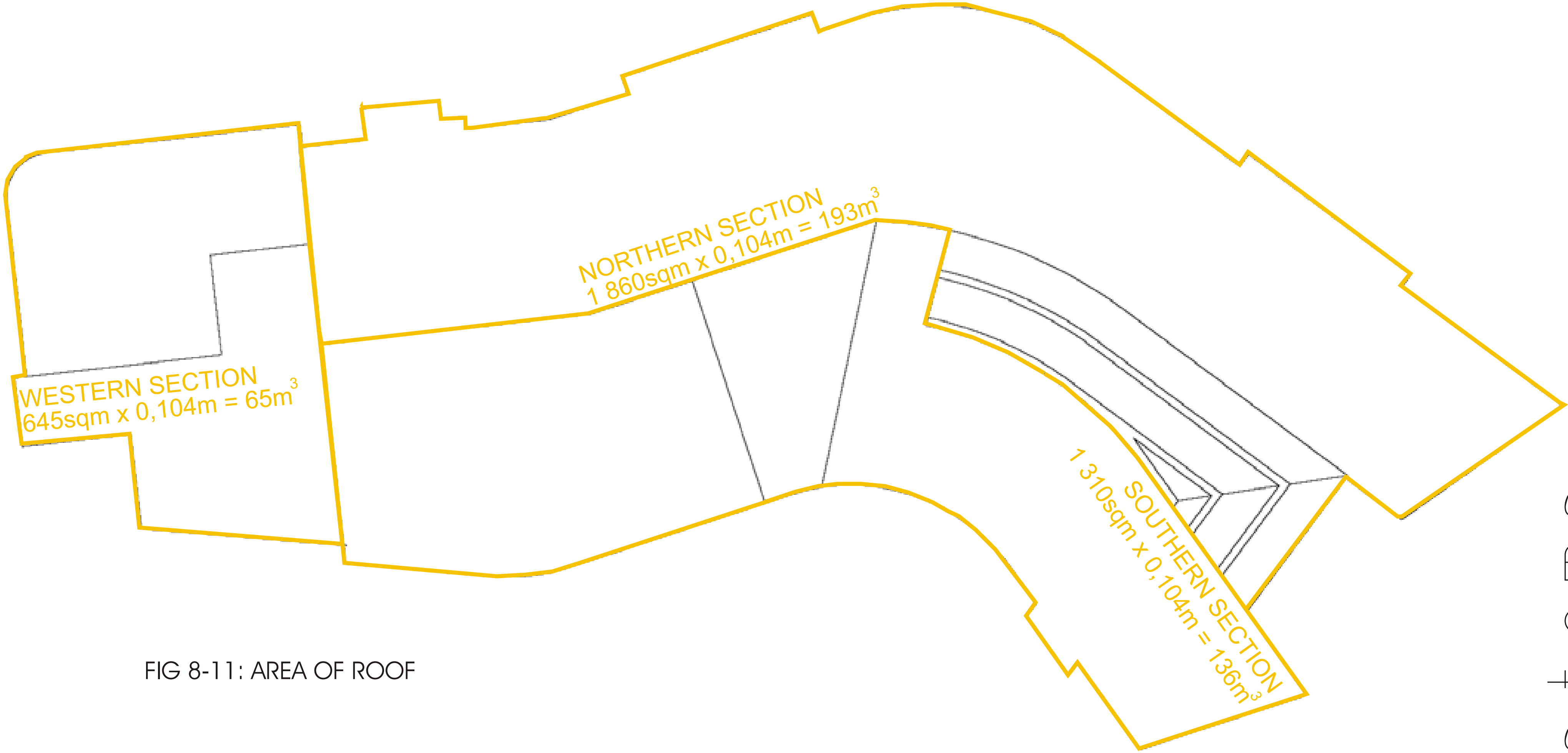
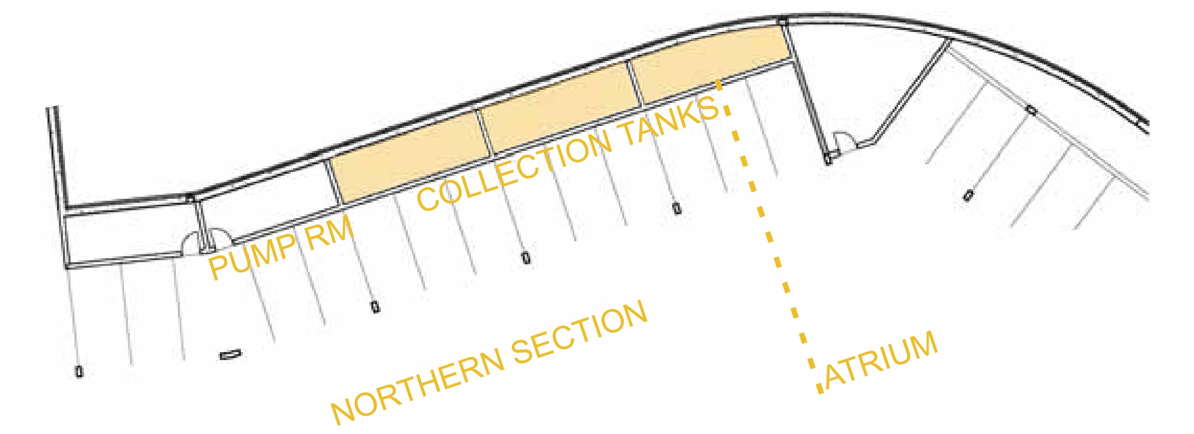
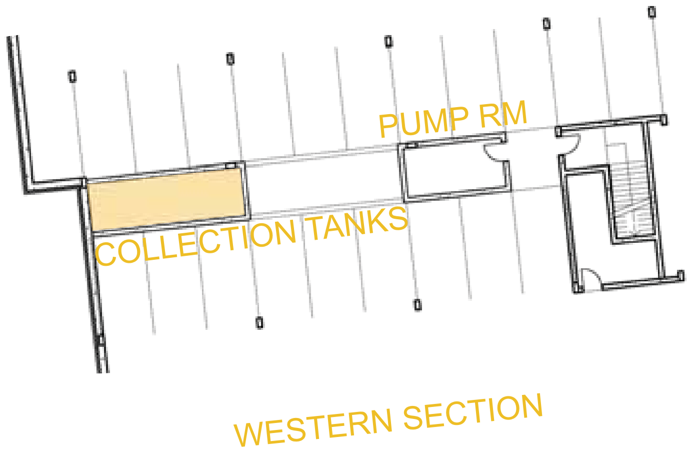


FIG 8-11: AREA OF ROOF

rainwater harvesting

There are three roof sections identified for collection, namely the northern section which includes the atrium, the southern section and the western section. The northern section has a roof area of 1 860sqm, the southern section 1 310sqm and the western 645sqm. The max monthly rainfall for Pretoria is 130mm, for which storage capacity is allowed for. There would also be 80% efficiency on the collection due to evaporation and therefore storage would allow for 104mm.





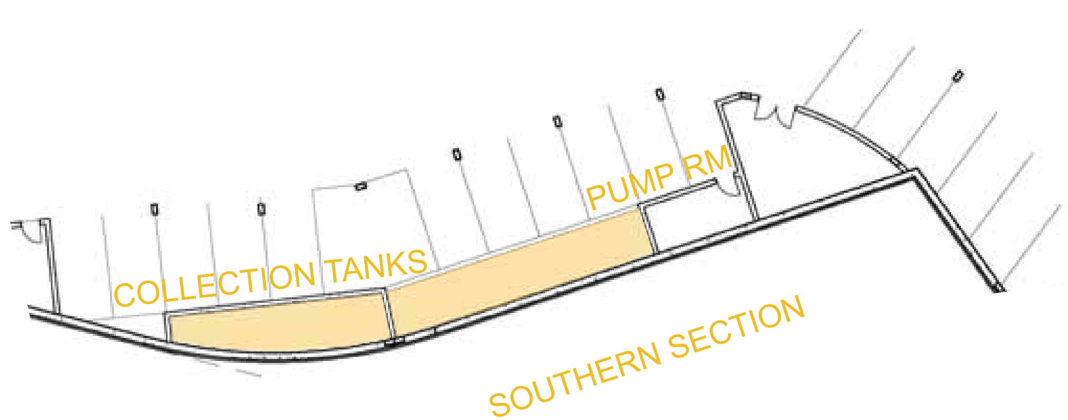


FIG 8-12: POSITION OF RAINWATER COLLECTION TANKS

rainwater harvesting

Each section of the roof is provided with collection tanks in both basements as well as a pump room in the lower basement. The water of the atrium is discharged to the tanks through a 100mm dia. UPVC pipe encased in concrete below the surface bed. The water from the northern section is used for the toilets and urinals on the various floors, whilst the water from the southern and western sections will be used for irrigation purposes. Northern section requires 193m3 = provided 222m3; southern section requires 136m3 = provided 150m3; western section requires 65m3 = provided 67m3

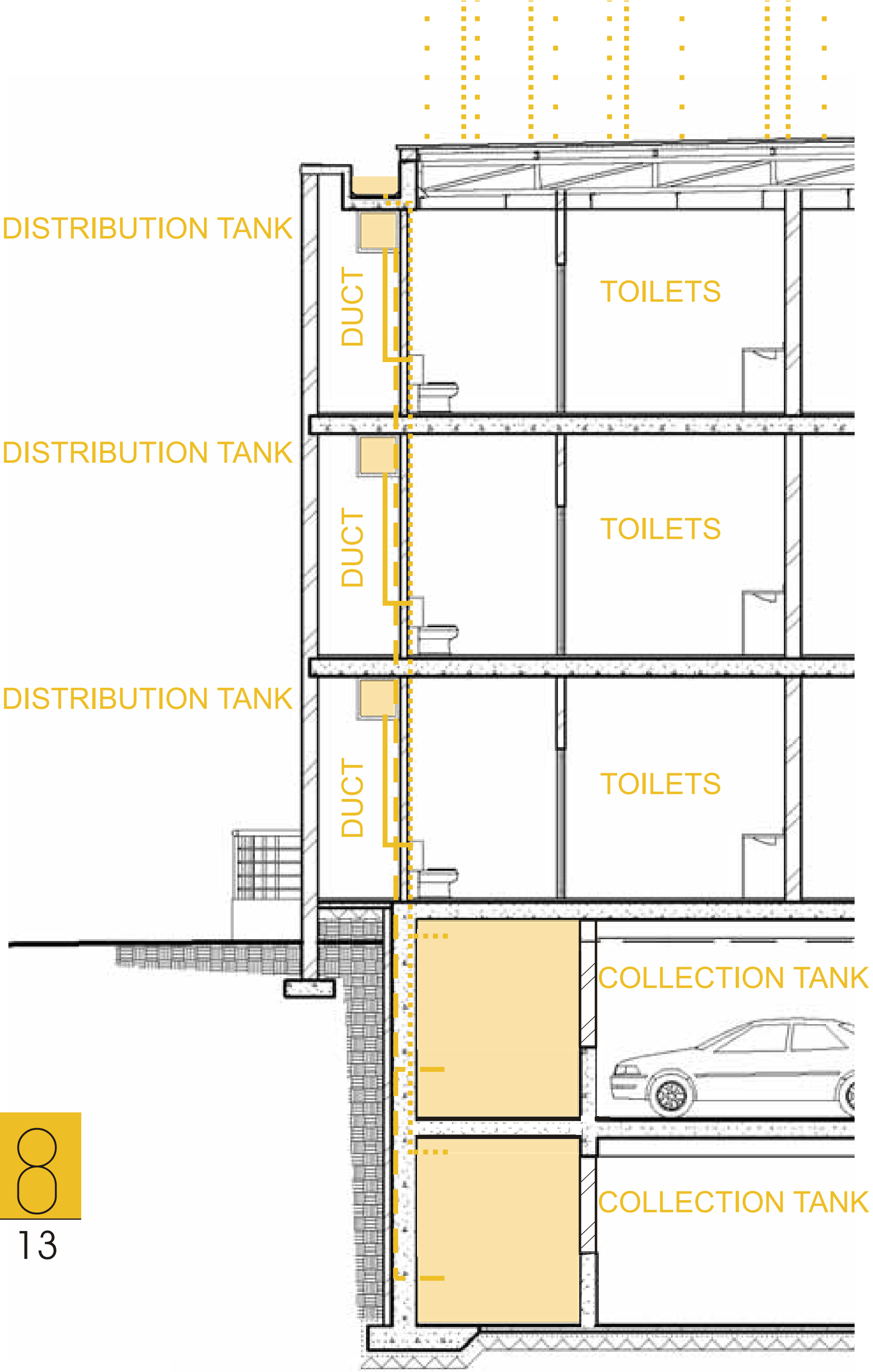


FIG 8-13: RAINWATER CIRCULATION

rainwater harvesting

The rainwater collected from the roof flows from the concrete box gutter through rainwater downpipes, situated in the concrete columns, and into the collection tanks in the basements. From the collection tanks the northern roof section's water is pumped by solar powered pumps through filters up to distribution tanks situated on the various floors. From these 250litre distribution tanks seven toilets and three urinals on each floor are provided with water. The southern and western roof section's water is pumped out directly for irrigation purposes.

materials

CONCRETE has a very high embodied energy and is used as little as possible and thus only for structural purposes and not merely for aesthetical reasons.

CLAY BRICKS are relatively low in embodied energy and is therefore used for all permanent internal walls as well as the exterior walls used as in-fill to the concrete framework.

MILD STEEL which is also very high in embodied energy, is again used wisely and mostly for structural purposes such as the roof trusses and purlins but also for the balustrades.

GALVANIZED SHEETMETAL has a relatively high embodied energy and is only used for the roofs as it is the most effective roofing material for a building this size.

Thermal INSULATION in the roof structure is a necessity to keep a building cool and energy efficient. Therefore a noncombustible fibre glass with reinforced kraft aluminium foil is used for insulation. For acoustic insulation mineral wool fibre insulation is used at the back of the lecture rooms and auditoriums.

ALUMINIUM frames are used for all the windows and doors in the building. Although it has a relatively high embodied energy, it is however sustainable due to its low maintenance characteristics. Through the use of anodized aluminium it is protected from all weather conditions which eliminates rust, rendering it maintenance free.

GYPSUM flush plaster ceiling board are used in the some of the areas and gypsum fibre reinforced acoustic ceiling board is used in the lecture rooms and auditoriums.

sustainability conscious

Due to the current environmental situation, with specific regard to the global warming issue, materials are chosen with sustainability in mind. Materials are selected which has a low embodied energy and is environmentally friendly. Those materials with a high embodied energy, which use is unavoidable, is used wisely and sparingly.

The term "photovoltaic," commonly referred to as PV, is derived from a combination of "photo," the Greek word for light, and "Volta," the name of the Italian physicist, Alessandro Volta, who invented the chemical battery in 1800. A photovoltaic module, also called solar panels or solar cells, does not generate heat, but uses the energy available in sun light and converts it into direct current electricity. This means that solar panels can be used anywhere, from the Arctic to the Sahara, as power generation is dependant on light intensity and not on heat.

Photovoltaic modules are manufactured by using the "Cast" method and normally fabricated using special semiconductors such as a ceramic/silica or polycrystalline material that allows electrons to be freed from their atoms when they are energized due to exposure to sunlight. Once freed, they can move through the material and carry an electric current. The current flows in one direction, and thus the electricity generated is termed direct current (DC).

The direct current (DC) electricity can be used to drive specially developed products such as the fans used in this building or can be used to charge lead-acid batteries that acts as a storage devise. Most appliances including the air-conditioning system used in the building, requires an alternating current and is achieved by drawing the energy stored in batteries through an inverter, both situated in battery rooms in the basement, and changing it from DC to AC.

There are three major types of photo voltaic systems currently available in the market namely an autonomous, a hybrid and a grid-connected system. An Autonomous systems are the most cost-effective source of electrical power, which is completely independent of any other power sources. An autonomous system relies exclusively on solar energy to meet the need for electricity and is ideal for remote or rural areas.

photovoltaic

As indicated on the drawings, solar energy is used for fans in the basement to promote ventilation, at the clerestory windows to enhance the stack effect as well as at the top of solar chimney in the auditorium. Solar energy is also used for the air conditioning system where indicated and the extractor fans of the kitchen. These are all solar powered through the use of photovoltaic cells which is either situated on the specific units, such as the fans, or it is powered through photovoltaic panels situated on the roof for the air conditioning, extractor fans and the rainwater pumps.

Hybrid photovoltaic system, also used in stand-alone systems, consist of PV modules with an additional source such as a wind and/or fuel-fired generator. The additional source accompanying the PV modules makes it more steady and reliable but still cost-effective. A hybrid system is a good option, when there is not enough sun at certain times of the year, or if you want to lower your capital investment in PV modules and storage batteries.

A grid-tied system is connected to the local municipal electricity whilst incorporating photovoltaic panels. This PV system is normally used where the building already has an existing electrical grid system and is then used to synchronize its output with the existing grid to slow down the electrical meter and save electricity. This is the system that this building would operate on, as solar energy is only used for the automatic doors, the fans as indicated, the rainwater pumps as well as the air conditioning system and the cold room of the restaurant. The building therefore is kept cool on solar energy, thus using less grid-electricity making it more sustainable.

The most energy is used with heating a space and especially water. The building doesn't have any showers or baths but where there is a need for hot water for whatever reason, solar water heaters are implemented to eliminate the use of energy for water heating. The solar absorbers are installed on the roof at a angle of 25,5 deg. for maximum heat gain during the year.

There are two types of solar water heaters, namely a direct and indirect system. Through an indirect system a secondary fluid contained in tubes is heated up by solar radiation to act as a heat conducting element to heat up the primary fluid such as the water. With the direct system, which is the system used in this building, the water is however directly heated by solar radiation.

solar water heaters