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B U D A P E S T

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CONTENTS

ABSTRACT

The present state of Egypt is the most influenced by the growing population, the lack of useable areas and the political changes.The impact on the education system is also noticeable - so many children attend a school, class, the school building is not suitable for accommodating so many students. They tried to solve the problem of the lack of place by the reorganization of the teaching day.

Egyptian new-built schools are based on several patterns these involve various mistakes. Learning from these shortcomings and mistakes, we would like to design a school that could be a model later, and to create more livable circumstances for students there.

The project involves a lot of challenges because we need to design in a dry and hot climate area. We should consider both climate, orientation, ventilation, fit into the environment, and the program plan. The venue is Luxor, the center of New Gourna. In the immediate neighborhood of the locate, there are the Mosque and the Khan, as well as the Theater, these are the determinative parts of the area.

One of the most important aspects of school design is to answer the climatic conditions. The right orientation can be used to control the sun exposure, and to maximize the warming. During designing the building mass is necessary to ensure adequate ventilation and to control the flow of air consciously. Using local materials, we strive for organicity, energy saving and sparing.

The school, which is built on a desert climate, has cooling heat load of the building was largely due to solar radiation exposure. Reducing cooling heat by passive means is extremely important, so we envisage a method for cooling the heat storage mass of a school building, which reduces the peak demand for building cooling the next day.

According to Hassan Fathy's "School of Architecture for the Poor", the two school plans make the establishment of inner courtyards a necessity for community building purposes. During the planning, community spaces play a prominent role, while facade formation should be aligned with the distinctive elements of surrounding buildings.

Based on the projections, the well-known school buildings planned by Francis Kéré, and the work of László Mester Parajdi and the various African schools that he knows, we would like to summarize their lessons, so our goal is to design and use the right methodology in New Gourna.

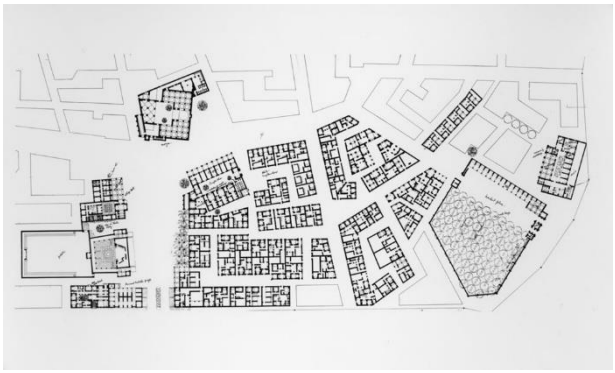
THE STORY OF NEW-GOURNA

The village of New-Gourna (Al Qarnah) is located in Luxor, Egypt, on the west bank of the Nile. The designer of the sample settlement is Hassan Fathy, whose works build on principles, which place the values of vernacular architecture in foresight. During his life he designed buildings based on traditional principles, but still in contemporary stye. He studied the aesthetics of folk architecture, it's answers for the difficulties of the local climate, and it's economical structures. The patterns of his designs accommodate to the specialties of the region, besides his works also take into account the local traditions, the regular technics and material usage of the previous ages.

The village of Gourna (former New-Gourna) was built on the hills of Thebes on graves of nobel families. This settlement of five tribes also attracted the interest of the Supreme Council of Antiquities with the constant robberies of these underground graves. First there have been regulations only, but afterwards they had to introduce radical steps in favor of keeping the ancient artifacts safe for the posterity, during which the whole village had been moved to the district of today's New-Gourna, east from the hills of Thebes.

Because they wanted to create the new village cost-efficiently, Hassan Fathy, who already met with rural poverty during his work multiple times, had been asked for the job. His basic drive was to improve people's life with providing them better living conditions. The primary consideration was that the new area had to be the farthest away from the graves. A tillable piece of land was choosed, which is located near to the main road and the railway.

F.1.- Old Gourna



F.2.- New Gourna in plan

In his plans, Fathy focused deeply to the enchachement of handicrafts, schooling and also wanted most of the locals to take part in the construction and planning. It was important to make people believe in the certain future. Four wide roads were built which were the refferences to the four quarters of Gourna and therefore the various tribes could live together separately. Also with these roads the natural ventillation was guaranteed. In the quarters narrow streets show up which suggest intimacy so that the mass of houses can shade these streets. The houses have no module elements, Fathy designed the ground plan and the size them to suffice the needs of the families.

In the geometrical centerpoint of the town lies the Mosque. The Khan is almost in front of it, because he wanted to encourage the tourism of New-Gourna with it. As at the marketplace, the broadening near the mosque was also the scene of social life. The dense city cooporation set back the spread of the long families so the vertical growth of the buildings began.

F.3.- The Mosque and square

F.4.- The Khan years ago

The buildings of Fathy were unsuitable for this, because of their domes and vaults therefore only few of the houses preserve his memory. Egyptian specific ferro-concrete pillar with brick filled buildings started to show up in New-Gourna. The salient irons show constant incompleteness. The reason why New-Gourna has not become a succesful sample is because the lack of language between the arhitect and the residents. The village did not want to leave Old-Gourna, an outer compulsion lead them to do so.

Furthermore we can discover another problem in the remaning buildings. Fathy planned his houses with great care to achieve the greatest convenience possible despite the hot weather. Nevertheless the leaking water in the soil weakens the buildings without pedestals, so they loose their stability one after another. The UNESCO also noticed these fading values so they took the first steps to restore them.

F.5.- Hassan Fathy' house in spring

F.6.- Pink house

F.7.- The typical houses

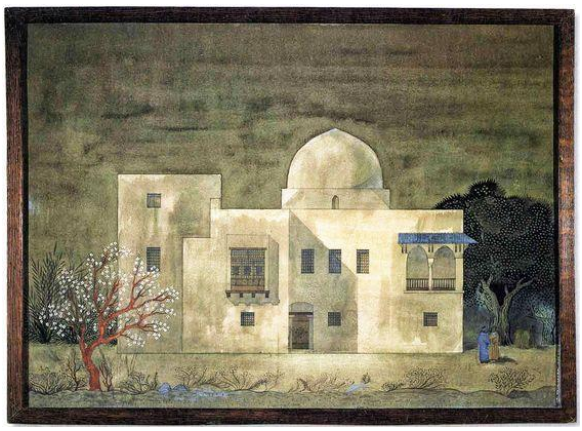
DESIGN VENUE

Our design area takes place in the neighboorhood of the Mosque. The Khan and residentals are opposite. Starting from the broadening in front of the Mosque, passing by the Khan we can spot the locale. In the current state it is at the edge of the agricultural zone with two of the buildings which are planned to be demolished and next to a few palmtrees. The formation of the Mosque's frontage comes with a modest but also conscious symbol. The most emphatic part of the Khan is the domed archway, which could serve the expected booming tourism.

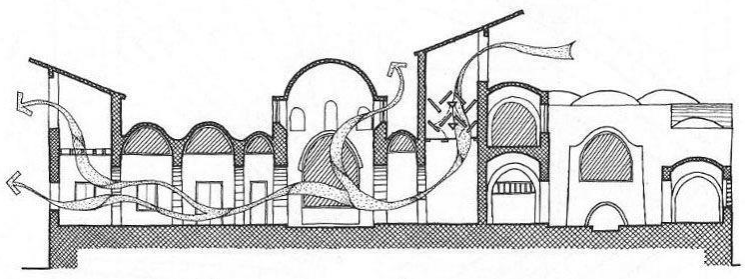
F.8.- Design venue next to the Mosque

ARCHITECTURAL OBJECTIVE

The greatest challenge in the plan is that we have to design a building with proper comfort to a land with dry and torrid climate. We have to consider both the climate, temperature, orientation, the possibilities of the ventillation and the integration to the enviroment. With the right orientation we can set the sun exposure. The openings at the north and south could help achiving this, because the sun is always high. Furthermore it is needed that the windows should always be in shadow, with that the obstruction of the premises' warming can be enhanced. With the appropriate ventillation the flow of the air can be controlled. The above mentioned devices can ensure not to warm up the building, and that being in them is paired with a good feeling. These tools showed up in Hassan Fathy's architecture as well. In many of his construction we can discover the following: controlling the sun expososure with the right orientation, walls with great heat storage capacity (adobe), shading with roofs and mashrabya, brick-build courtyard which grants the ventillation.



F.9.- Hassan Fathy's blueprint



F.10.- Air movement

We would like to mention Francis Kéré as well, who has became famous in 2001 with his school designed to his birthplace, Gando (Burkina Faso). Ever since he schemed many buildings to his homeland, like schools, teaching apartments, libraries, women's center, etc. Total simplicity and functional clarity features his architecture. He solves the problem of heat balance and ventillation with passive methods.

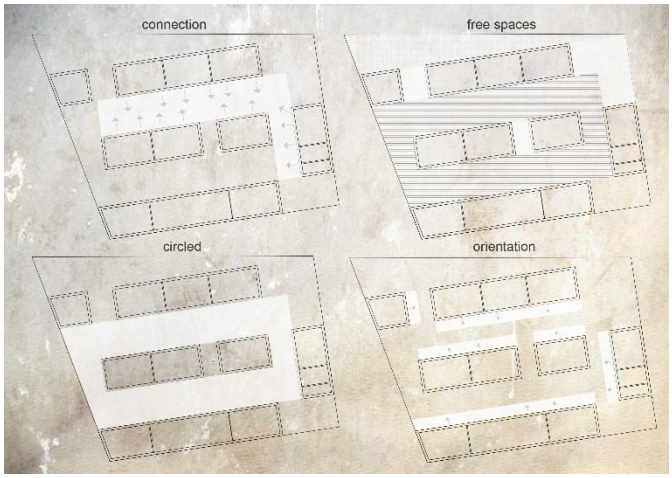
F.11.- Primary school in Gando, Burkina Faso

It is important for us to use those kind of elements which are certainly located in New-Gourna, paying attention to the frugality and energy awareness. On the other hand the restriction of cooling heat load passively is extremely ponderous. For this we imagined a method which can be used to cool the heat storage mass of the schoolhouse, which therefore lessens the next day's building cooling peak demand.

Our project is aiming to propose a solution for passive cooling system for the Egyptian school in New Gourna. The main problem with the current facility was due to the overcrowding and the high internal temperature of classrooms. With taking into consideration the limited resources available we avoided applying a high and expensive operational technology. The solar wall offers an appropriate solution, thus it is a relatively cost-effective way to reduce cooling needs. Further significant savings were achieved with the proper design of the building, where we used proper wall thickness and material. Applying external shading had a positive effect on reducing the thermal load of the exterior walls and windows of the facility.

THOUGHTS, PLANS

Based on the fieldwork in spring and the examination of the previews we consider the harmony with the surroundings and the nearby buildings indispensable. We would like to utilise the available place in the design area as well as we can, so even from the beginning of the design project we haven't considered a building consisting a single mass, only multiple separated ones. In that we way we'll get a house with airy spaces, which can be walked around.



Concept illustration

The most prominent element of the Arabic houses is always the courtyard. With it's intimate atmosphere it is one of the most important tools for tempering. This internal open space is also a very effective tool for generating airflows. Besides that because of the separate building blocks there can be formed various corners in the courtyard for the kids to hang around in the school breaks.

F.12.- Courtyard in New Gourna

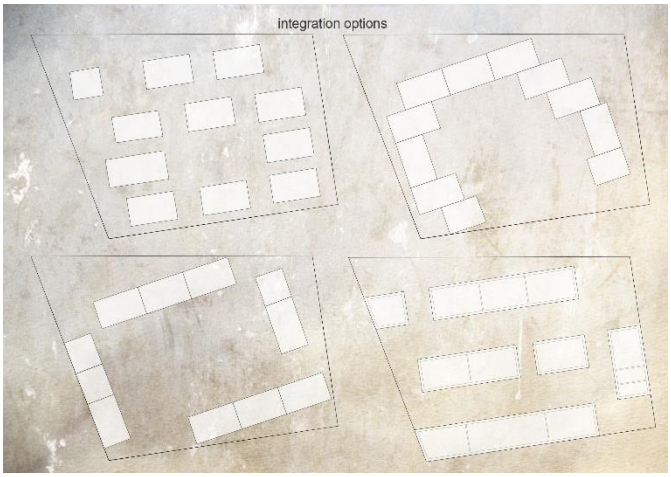
For the sake of harmony with it's surroundings we've only considered a one-floor building, like the nearby Khan and the Mosque.

DESIGN PROCESS

There were choices among the possible integrations, but in the centre of all there've been the capability of walking around. It was already mentioned above, that we haven't considered only a single mass from the beginning of the design process.

By the first version all of the classrooms were separate buildings, but in this case there would have been too much material usage, furthermore the small buildings impart massive amount of heat to each other.

By the second and third version we considered a central space organization. By the second to the centre of the circle, where the issue of orientation wasn't always solvable. By the third the rooms were organized around the centre of a square. In this case a too big internal sunny courtyard has emerged.

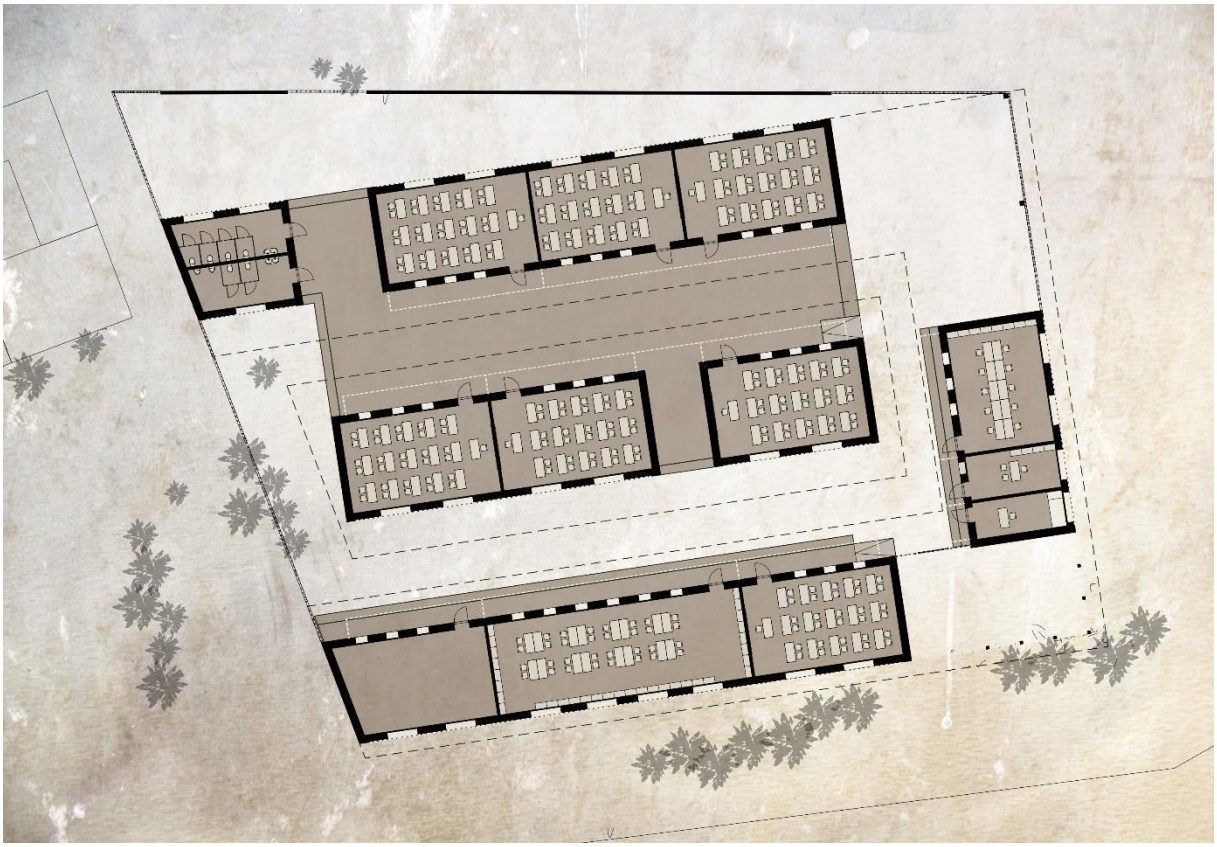


Integration options

We've came on this path to the final solution. We summarized the mistakes and contracted the different types of spaces. For the orientation of the building we took into account the usage of the particular rooms during a day - for example the classrooms are more frequently used spaces than the teacher's room. In the three sections we put the classrooms to the north side and to the centre. The commonly used spaces are located behind the facade facing to the street. The teacher's room and the headteacher's room are placed perpendicularly to the sections, so the courtyards are well visible form there. The entrance is in the south-east corner in order that the approach of the school to be the best from the nearby residential area's direction.

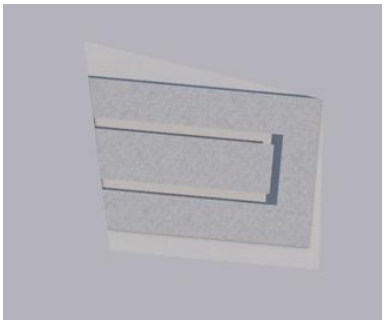
During the composition of the buildings we were paying special attention to the organisation of the courtyard as well. We found important, that there'll be places, where the children could play alone and in groups as well partly in shady, partly in sunny areas. Based on that we formed a sunnier, in the corner a shadier, and between the buildings a changeable space.

Site plan

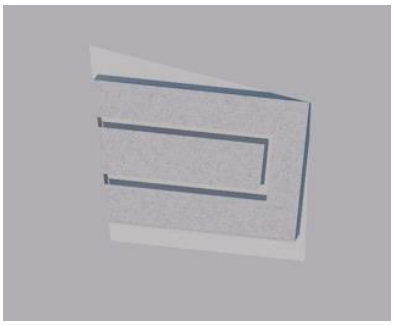


Floor plan

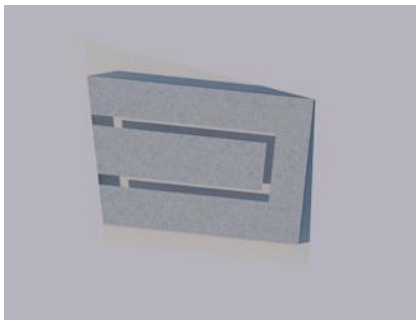
We made several sun exposure tests to get the exact extent of the roof's overhang. The building is elevated from the ground in order to stop the dust getting in the house easily, so ramps and stairs had been formed from the level of the courtyard. The identically used blocks have been linked together.



Morning shades



Midday shades

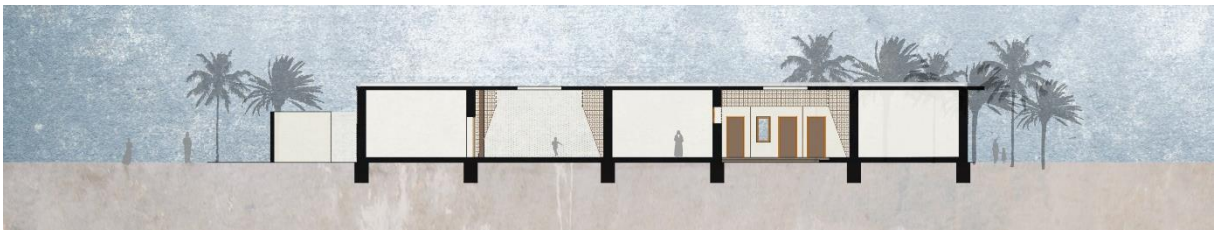


Afternoon shades

We wanted to use the whole site from the very beginning, so we put the wall fence on the property line. The fence doesn't reach the ceiling, so the wind can easily flow through the whole area. In order to maintain a lot of heat, the walling had to be thick. Today the most currently used material in Egypt is the small solid brick, so we found that the most efficient solution is to make the walling from that.

There are two types of windows in the building: the ones open to the internal courtyard have a lower parapet stance, in turn the others, which are facing to the street, have a higher one. Becasuse of the 4 meters high inner height the air has space to lift off, and if it is necessary, the rooms can be aired through the upper windows. We used glazed windows everywhere, so if they are closed, the cooled air can't escape through them.

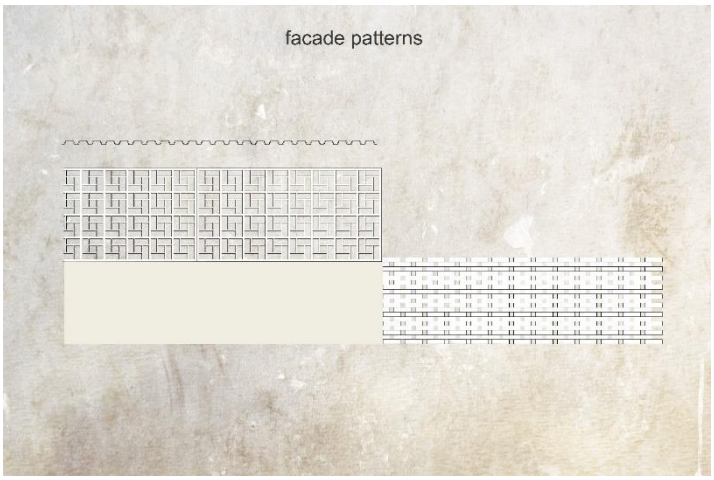
Afternoon shades



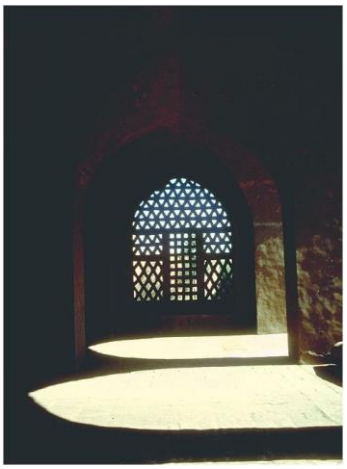
Afternoon shades

On the facade we wanted to picture nice, simple, linear motives. We think so, that the nearby buildings with their simplicity suggest awareness, that's why we also pursued a kind of softness and simplicity during the shaping of the facades. It is built from the rhythmic alternation of three main motives: these are the plain, plastered wall, the brick fence with gaps in it and the shades, called mashrabya-s. The mashrabya is a type of shade in traditional Arabic architecture made from carved wood latticework. In this case they are made with balusters in geometric order, and they have a versatile role: they let the light in, but reduce the strong sun exposure, and also lower the temperature of the throughflowing air. These kind of shading structures are not only practical, but fairly pretty as well. Only pale colours appear on the facades and on the roofs too, so they absorb less from the Egyptian heat.

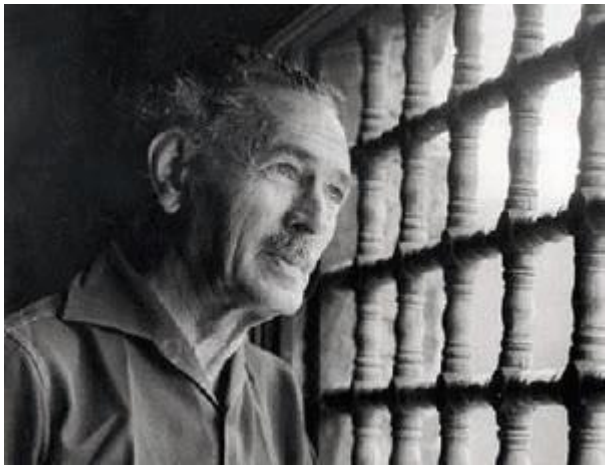
The solarwalls will be placed on the concrete roofs, but these won't be affect the architectural design. With the breakthroughs in the ceiling we can introduce air into the rooms.



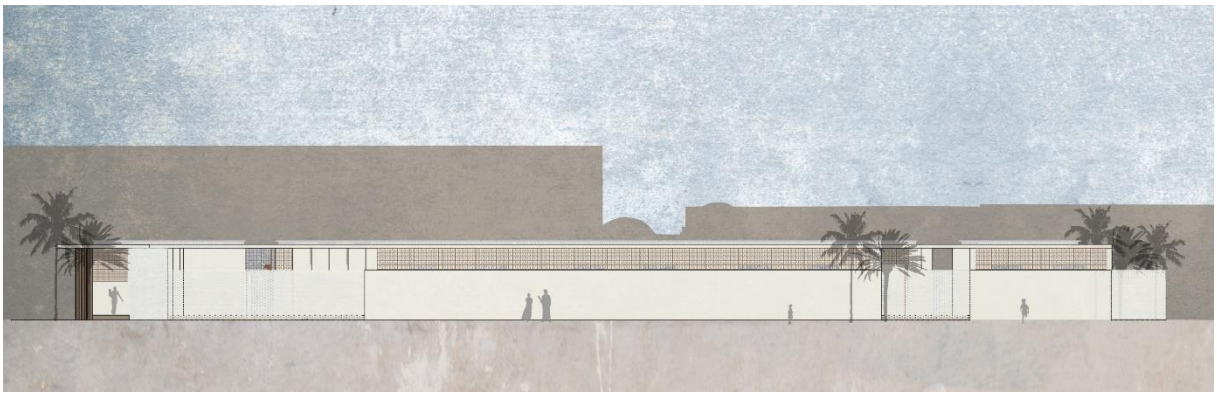
Facade patterns



F.13.- Brick ornament



F.14.- Hassan Fathy with mashrabya



North facade

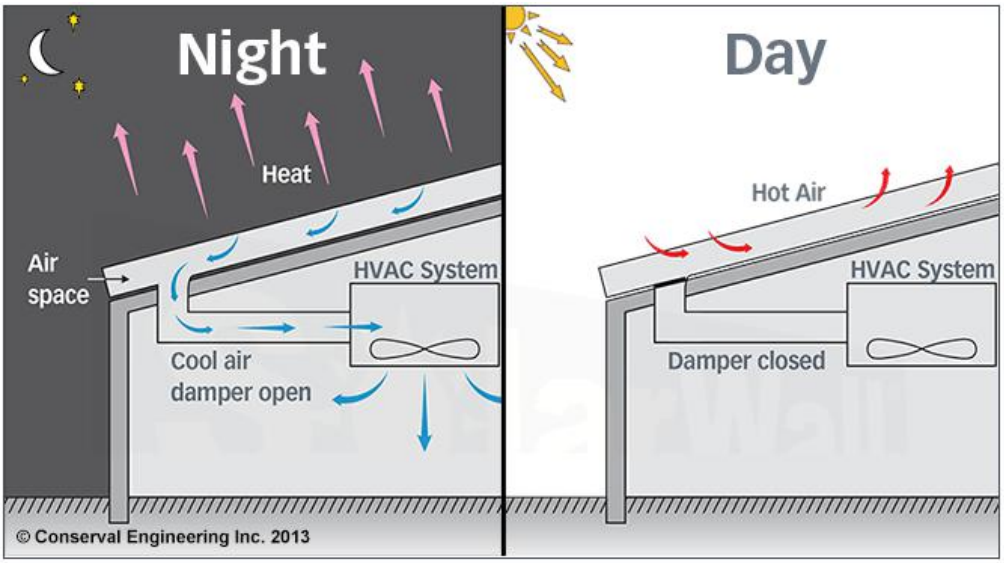
East facade

West facade

South facade

COOLING WITH SOLARWALL

Due to the increasing cooling energy demand, passive cooling systems are becoming more and more prominent, as passive cooling reduces the summer's electrical peak demand caused by air conditioners. Numerous studies have shown that nocturnal ventilation of the building mass with night cooling air reduces the peak demand for cooling the next day. This beneficial effect can be enhanced by cooling with nocturnal long-wave radiation. The solar wall provides a way to increase the cooling performance of nocturnal ventilation with a radiator which cools down below ambient temperature under nocturnal longwave radiation to the sky. Outdoor air passes the radiator as it is drawn into the ventilation system, and it reaches lower temperatures than ambient, providing more cooling performance than simple nocturnal ventilation.



F.15. – Solar wall function during daytime and nighttime

For free cooling (or passive cooling) three natural heat sinks are available (the sky, the atmosphere and the earth), into which the excess heat can be led without the use of compression chiller. A straightforward use of the atmosphere as a heat sink is night-time ventilation of buildings, also called nocturnal convective cooling. Whenever the outdoor temperature is cold enough to cool down a building's structure over the night, it is led to the interior either on a natural or a mechanical way, creating a colder thermal mass for the next day.

CALCULATION

In order to determine the needed amount of cooling, the MSZ 24140:2015 standard was used, as it is acknowledged by the ASHRAE association. The Cooling Load Calculation consist of multiple steps:

1. Determining the thermal transmittance of the external walls and roof
2. Calculating the amount of internal heat gain (occupants, lightning, electrical devices, etc.)
3. Calculating the amount of external heat gain trough the walls and windows
4. Calculating the amount of external heat gain through the roof with and without the application of the solar wall
5. Taking into calculation the effects of shading and orientation

Concerning the intensity of light exposure [W/m2], the European Commission's PVGIS1 database was used

RESULTS

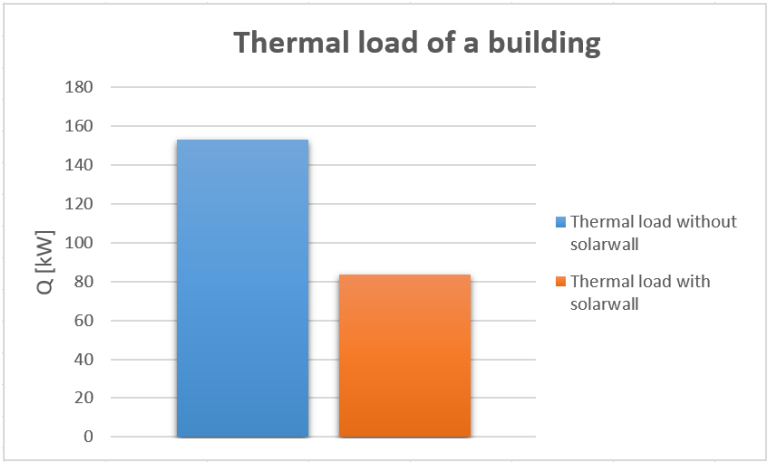


Table 1 – Reduction in heat gain

Thought the Cooling Load Calculation applying the solarwall we obtained a 43 percent reduction of external and internal heat gain. This lead to a significant decrease of thermal load, fulfilling the aim we set to achieve for this project.

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APPLIED ILLUSTRATION

F.1. – https://en.wikipedia.org/wiki/Kurna#/media/File:Gournah.jpg

F.2. –https://fundacion-jakober.blogspot.com/2016/01/?view=snapshot

F.3. – Bielik Judit's photo

F.4. –https://www.aucegypt.edu/news/stories/auc-contributes-hassan-fathy-archives-restoration-new-gourna

F.5. –Bielik Judit's photo

F.6. –Bielik Judit's photo

F.7. –Serfőző Fruzsina's photo

F.8. – Vasáros Zsolt's photo

F.9. –http://islamic-arts.org/2012/elegant-solutions/

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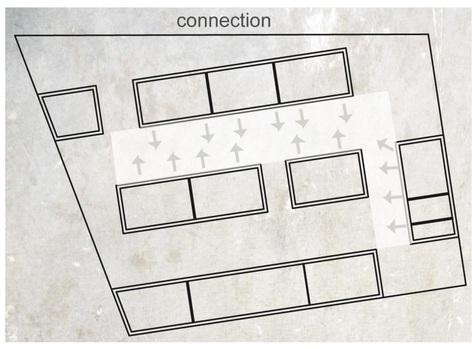

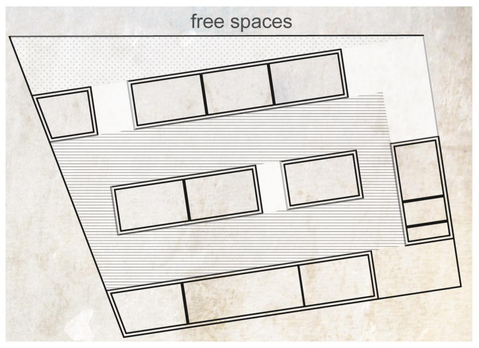

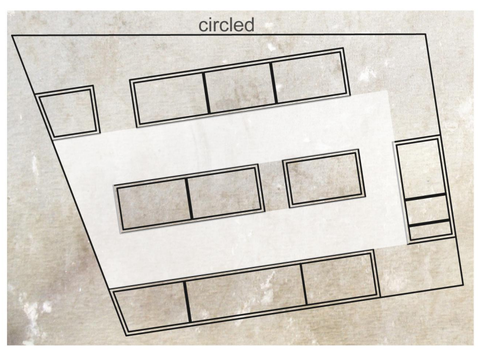

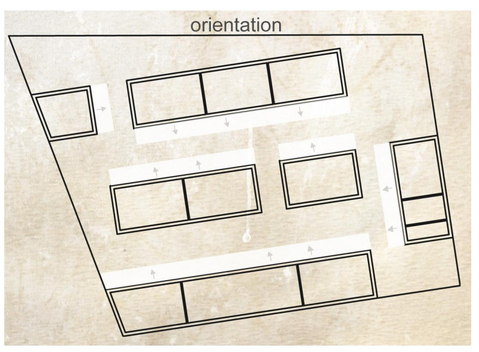

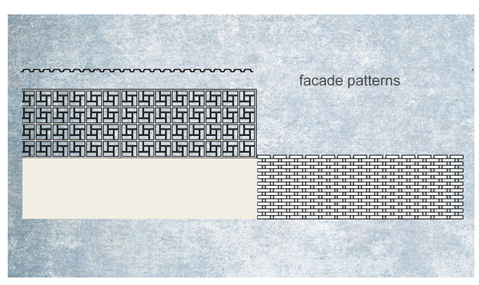

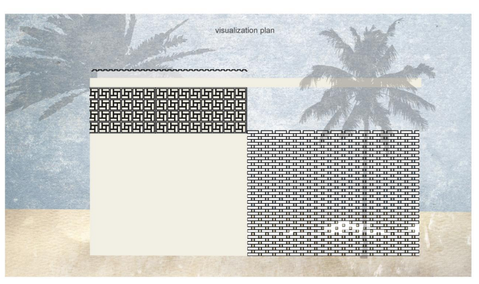

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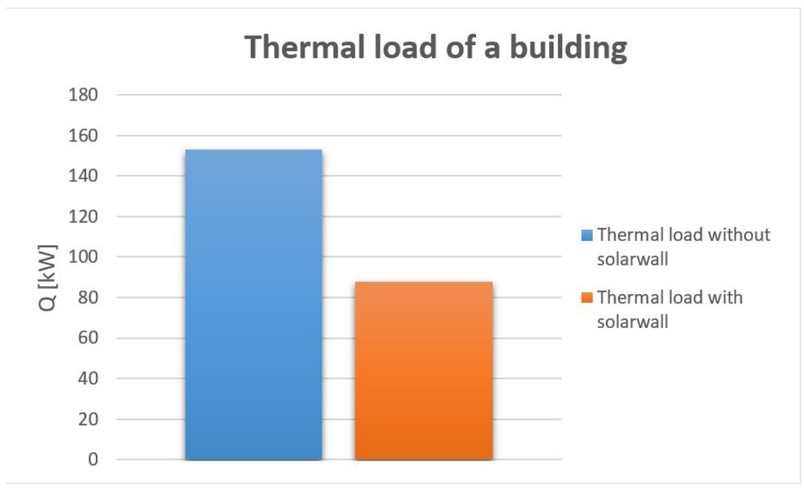

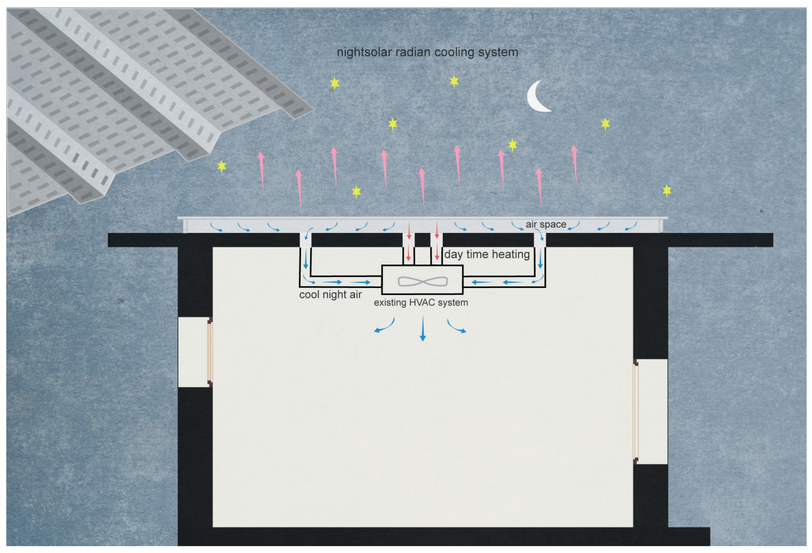

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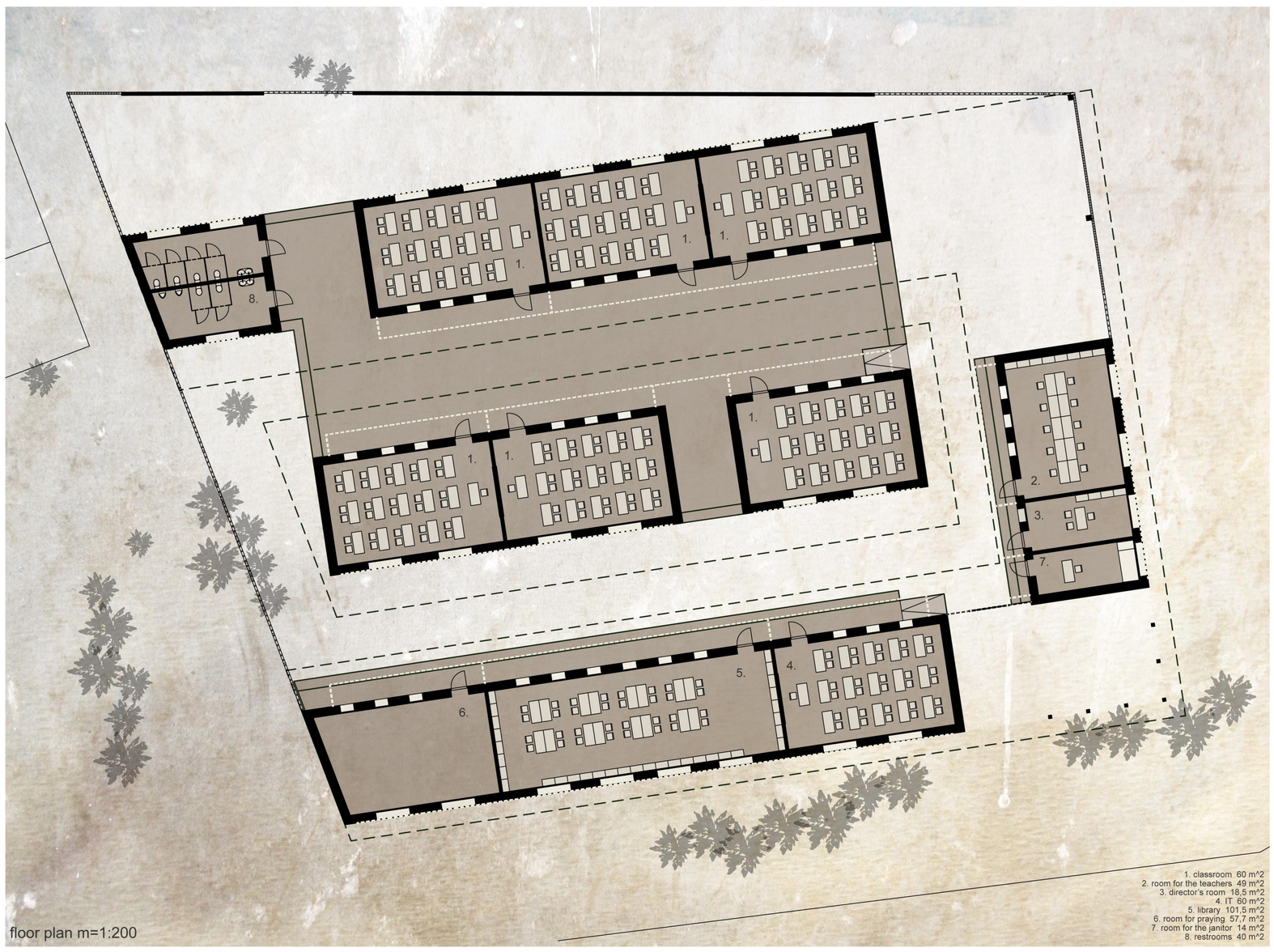
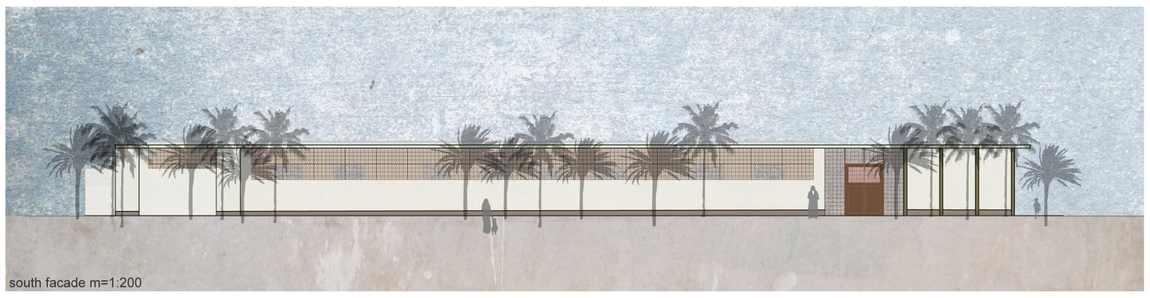
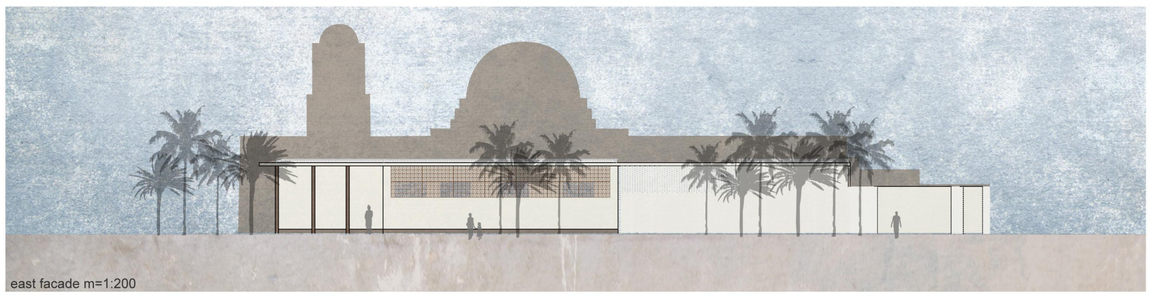


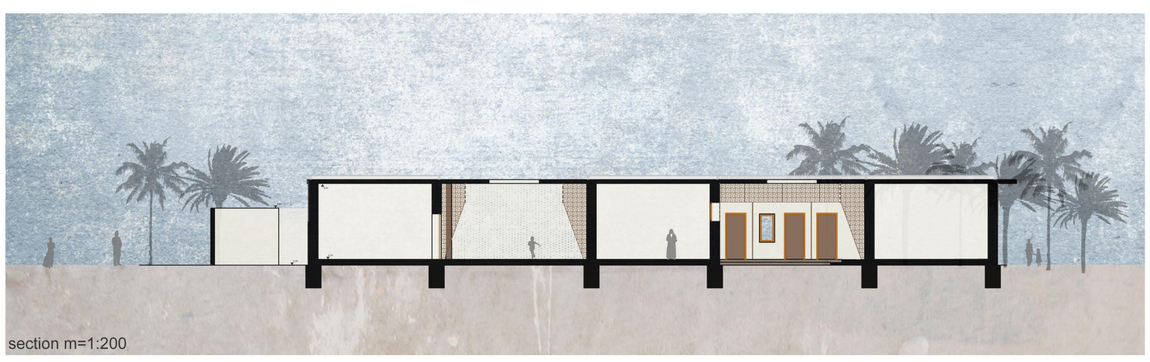
floor plan m=1:200

By the first version all of the classrooms were separate buildings. By the second and third version we considered a central space organization. We summarized the mistakes and contracted the different types of spaces. For the orientation of the building we took into account the usage of the particular rooms during a day - for example the classrooms are more frequently used spaces than the teacher's room. In the three sections we put the classrooms to the north side and to the centre. The commonly used spaces are located behind the facade facing to the street. The teacher's room and the headteacher's room are placed perpendicularly to the sections, so the courtyards are well visible form there. During the composition of the buildings we were paying special attention to the organisation of the courtyard as well. We found important, that there'll be places, where the children could play alone and in groups as well partly in shady, partly in sunny areas. The building is elevated from the ground in order to stop the dust getting in the house easily, so ramps and stairs had been formed from the level of the courtyard. The identically used blocks have been linked together. We wanted to use the whole site from the very beginning, so we put the wall fence on the property line. The fence doesn't reach the ceiling, so the wind can easily flow through the whole area. In order to maintain a lot of heat, the walling had to be thick. Today the most currently used material in Egypt is the small solid brick, so we found that the most efficient solution is to make the walling from that. The solarwalls will be placed on the concrete roofs, but these won't be affect the architectural design.
With the breakthroughs in the ceiling we can introduce air into the rooms.


south facade m=1:200

On the facade we wanted to picture nice, simple, linear motives. We think so, that the nearby buildings with their simplicity suggest awareness, that's why we also pursued a kind of softness and simplicity during the shaping of the facades. It is built from the rhythmic alternation of three main motives: these are the plain, plastered wall, the brick fence with gaps in it and the shades, called mashrabya-s. The mashrabya is a type of shade in traditional Arabic architecture made from carved wood latticework. Only pale colours appear on the facades and on the roofs too, so they absorb less from the Egyptian heat.


east facade m=1:200


section m=1:200

>NEW WAY< / >BIELIK JUDIT, FERES HAMROUNI, PÉNZES LAURA< / >BOKOR BALÁZS, VERES LAURA, DR. HABIL VASÁROS ZSOLT DLA<

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