young cities

Developing Urban Energy Efficiency

Tehrān-Karaj

Young Cities Research Briefs | 02

Guidelines for the Sustainable and Energy Efficient Architecture of the LIFEcenter

Design, Planning and Realization of a Vocational Training and Information Center in Tehran Region

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1 Introduction

The aim of the Young Cities Research Project is sustainable and energy efficient urban and architectural planning in the region of northern Iran. These guidelines are an attempt to inform architects and building planners, based on the findings of this project.

The goal is to disseminate the possibilities of up-to-date adapted design and to show practicable tools for the development of architectures. The method is not based on a purely technical view. It is based on spatial thinking, which considers the knowledge and abilities of the architects on the one hand, and the potentiality of an aware and sensitive architectural design on the other hand.

In this context the basis of these guidelines is the development of a New Generation Pilot Project as part of the Young Cities Project. This architectural pilot contains the development, design and planning of a vocational training center for Hashtgerd New Town, including additional facilities, which formulate the hybrid typology LIFEcenter.

The Young Cities research project is embedded in the Research Project Future MegaCities—MegaCities for Tomorrow, funded by the German Ministry of Education and Research.

1.1 Status Quo in the Tehran Region—The Influences of the Initial Position of the Location on an Architectural Planning

Periodic climatic variation is not new in the history of the earth. But at the moment there is a lot of discussion about climate change due to human and technological development. The results of climate change seem to grow dramatically, and various effects of it are expected. But this discussion is well

Visualization of the main entrance zone of the head building for information and seminar, LIFEcenter documented elsewhere, suffice to say that due to the natural limitation of the worlds resources and the impact of their use and/or abuse creates a critical situation for the world today and in the future.

In this respect it should be considered, that a large extent of energy demands worldwide are based on buildings and their whole life cycle, e.g. construction, operation, demolition and disposal. The building sector has a comparatively big part of the economy worldwide.

That this situation must be dealt with in an active and sustainable way, the careful use and re-use of resources and the control of their environmental impact should be foremost in the design, planning and implication of the building sector.

In times of negative economical change where subsidies are reduced and revoked worldwide new strategies must be employed. In addition the acquisition of resources becomes more and more difficult. The prices for natural gas, crude oil and electrical energy in general increase strongly. These developments take place in different countries at different speeds. In Iran, the region of interest of the research project Young Cities “Developing Urban Energy Efficiency, Tehran—Karaj” the prices for energy are increasing drastically. Ways to deal effectively with this situation would be the use of renewable energies and resource saving methods for building construction, operation and deconstruction of buildings as well as other methods and technologies. Concepts therefore have to be developed and integrated in the process of designing cities and buildings. Balanced concepts can only be developed on the basis of a sensitive and detailed view of the requirements of the surrounding environment of a building project, regarding technical and ecological aspects. The climatical and geographical parameters of a site are as important as the analysis of cultural life styles and social aspects in general. Only in this way it is possible to design adapted integrated concepts for buildings or city structures. The result of such relevant planning is a very energy efficient building in the best case, economically and ecologically balanced and with the lowest possible emissions, i.e. optimized in all aspects of sustainability.

Round table with planners

Climatic Conditions
Observed meteorological data from the year 1985—2006 of the Iran weather service 'IRIMO' were analyzed to interpret the climate for Hashtgerd New Town. Therefore, the meteorological data, the temperature, the maximum and minimum temperature, the relative humidity, wind direction and wind speed were interpolated by the help of the Cressman—interpolation scheme (Cressman, G. P., 1959), with a temporal resolution up from three to one hour.

The yearly precipitation sum during the time period from 1985 to 2006 of Hashtgerd New Town amounts by 283.3 mm/year, while the summer months from July to September show less precipitation with only 3% (8.9 mm) of the yearly sum. The wind during the years 1985 to 2006 is meanly coming from the south/southwest direction, only during the months of October to December the wind direction changes to the southeast direction.

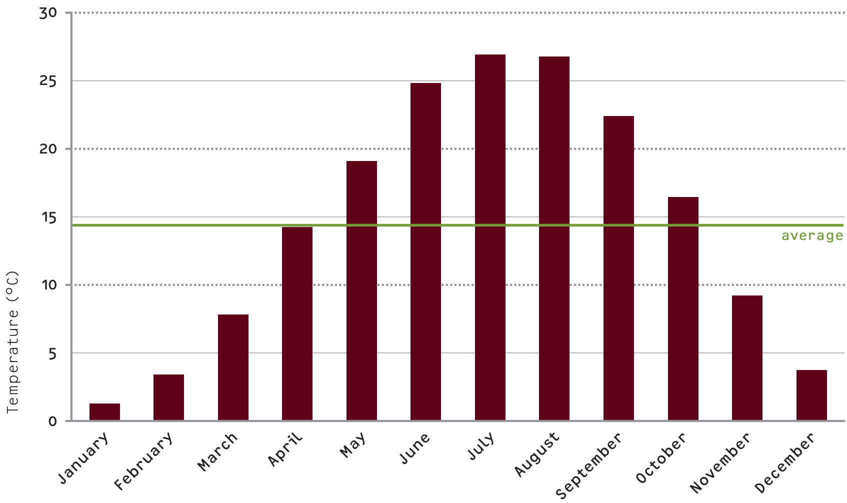
The mean temperature of the whole years lies by 14.7°C, with the maximum temperature of 19.2°C and a minimum of 9.5°C. During the summer months between March and August the mean temperature amounts to 19.9°C with the maximum of 26.0°C and the minimum temperature of 13.7°C, and for the winter period from September to February the mean temperature lies by 7.6°C, the maximum temperature by 12.0°C and the minimum temperature by 3.6°C. The maximum temperature in the course of the day is reached at 12 UTC with 39.6°C and the minimum temperature at 3 UTC with -15.5°C. The relative humidity lies during the whole year at about 50%, during the summer months only at 40% and during the winter months the relative humidity lies at about 60%. As in comparison to Tehran Hashtgerd New Town is by 10% more humid.

Conclusion: Through the calculation of the climate classification based on Köppen (Köppen W., in 1900) for the period of 1985 to 2006 the climate is defined for Tehran and Hashtgerd:

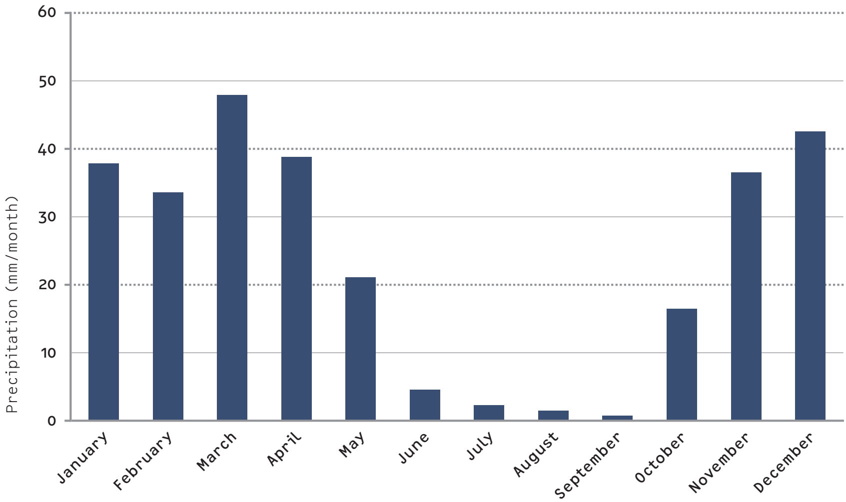
Tehran (BSh) points an arid climate (B) with semiarid character (S) and with an annual mean temperature of over 18°C it is hot (h); Hashtgerd (BSk) points an arid climate (B) with semiarid character (S) and with an annual mean temperature of less than 18°C it is cold (k).
(Text by Ines Langer, FU Berlin, Institute of Meteorology)

For architectural design in the region of Hashtgerd this means at first the necessity of protection against too much sun and therefore heat gain in the summer months, and it means the need of an even higher protection of indoor spaces against the cold in the winter months.

Traditional Iranian architecture directly reacts on these different climate conditions. In this sense, for example, the architectures in regions with a semi arid character try to catch the sun in wintertime with openings to the certain directions of sunlight. At the same time the grown architecture there deals with the heat losses in the winter months for example by thick walls made of clay. Traditional architectures in arid climate regions react on the certain conditions of especially very hot summers by the shading of some



Temperature diagram for Hashtgerd



Precipitation diagram for Hashtgerd

building parts with others or with bigger plants. These architectures work with design tools such as patios with water pools and greenery. In this way an energetic optimized microclimate can be created, which also influences the adjacent rooms positively.

Energy Situation

The energy supply in Iran worked in the last decades with high subsidies. This reduced the prices for gas and especially for electrical energy massively for private households as well as for commercial uses. But latest these subsidies go back, which happens with regard to the political and economical situation of the country at the moment. In the result the energy prices increase dramatically.

If there was only a very little awareness of the inhabitants of larger cities and towns in modern Iran to save energy in all days life, these changes in the costs create now a new raising awareness for an ecology-minded lifestyle and especially a sustainable building operation with low energy demands on e.g. climatisation and the use of household appliances.

In this connection also the possibilities of architecture for energy savings become more and more interesting. On the background of international discussions also the consideration of the necessity of an ecology-minded living on any level besides the aimed cost savings gets a growing chance in the peoples minds.

Within this framework also the use of regenerative energies becomes more and more interesting for Iran. The installation of adequate technologies can already play a role on the building level.

Cables outside the buildings at the bazaar in Tehran, typical in Iran

Architecture

The used planning methods in Iran are often almost incomplete in comparison with the systems in Europe. Planning drawings by engineers mostly go up to a scale of 1:200 or 1:100, a detailed planning is often not available. Autodidacts are bind in the processes on different levels. The builders are seldom qualified. Skilled workers only work in larger construction companies an large public building sites. In total there is a lack of awareness for high qualities in planning and building. This is caused by economical structures in the country. Building owners invest without a view on longer durations. The ownership structures in Iran are completely different to the structures, e.g., in Germany. The awareness for the building quality and as well the maintenance of the owned buildings with apartments is low.

It is important to consider whole life cycles of buildings in future planning and realization processes in Iran, to create an optimized setting as basis for an adequate high quality planning and building.

The traditional way of building houses—nowadays mostly private buildings, and apart from the urban infrastructure—works differently. Here the basis is not a common modern way of planning. However vernacular building methods are used and, if necessary, adapted to “modern” requirements on site. Local materials, which are available, are used, and the local knowledge becomes part of the design, planning and construction of such buildings.

Such traditional vernacular building methods and the knowledge of their use are in danger of becoming lost due to the wide spread use of unskilled workers, who often do not speak the language of the country and hence have a difficulty in understanding and learning the techniques necessary to fulfill their construction job. The often unbeneficial situation of these employees does not lend itself towards high quality construction. The normal training methods between construction workers in Iran are the partial transference of knowledge from experienced workers to those with less experience.

A product of this building method can be seen in the mass housing projects in the metropolitan region of Tehran, being towns or cities with a huge mass of low quality buildings with little adaptation to the social and climatic conditions. The homogeneity of these buildings is evidence also of these building methods. The urban design structures are mostly ruled by national design regulations, which offer a little potential of individual urban development. Building orientation mainly plays a small role in building design as well as the use of colors of finishing for adaptation.

The employed building methods fail to adapt to the existing earthquake danger. This is evident in elements of the construction quality, e.g. when infill masonry is not adequately adapted to the structure, stairs do not have a calculated structural quality and joints in the masonry are not staggered.

Usually communal residential buildings in new towns show the same typological shapes. They have a forecourt with shading and bordering walls. The apartments are piled up. The machines for the adiabatic cooling are often installed on the roof terrace. Also the back patios have mostly high bor-

Typical façades of residential buildings in Hashtgerd New Town

Typical façade of a mixed structure building in Hashtgerd New Town dering walls. These points do not completely support spatial quality.

The architecture of public buildings is sometimes more diverse. There are some designs of normal apartment housing buildings with shops on the ground floor and invisible office spaces in upper floors, and designs of representative commercial or administrative or cultural buildings. The cultural buildings with high-level architecture work with traditional tools such as ornaments and shapes, shading elements etc. Other architectures work with louder modern elements such as flashy colors, huge mirror glazing and striking shapes. This does not answer energetic requirements or produces spatial qualities.

1.2 Design Objectives

In the framework of climate adaptive and general local adapted building different approaches exist regarding the development of structures of living space respectively habitat. On the one hand they handle the situation in a sensitive way, on the other hand they adapt to the need of an aware dealing with the environmental conditions. Then again the active use of artificial structures for the improvement of the existing environmental qualities characterizes the modern architecture as well as up-to-date techniques and general methods in all days life.

The architecture for itself has an exceedingly large influence on the development of the direct surrounding environment and also of the larger ambience, first of all by micro-climatical changes, which means for instance constructional thermal mass or artificial shading, and second also by CO_2 emissions and high energy consumptions at production, construction, operation and deconstruction. In this sense common buildings are catalysts of the climate change. The possibility of energy savings and the reduction of greenhouse gas emissions in the area of the building sector where already analyzed in the past and also have to be picked out as a central theme in future. But also based on the background of the development of prices for energy architectural concepts have again and again to be thought in a new way. In Germany, for example, exists the several redefined "Energieeinsparverordnung", a regulation to dictate a certain level of energy efficiency for the different building types, since 2002, based on the older version "Wärmeschutzverordnung", which existed from 1977 to 2002 and was amended two times. The basis for these rules was the energy saving standard (Energieeinspargesetz) from 1977. Worldwide a couple of different certification systems for evaluation and representation of the level of energy efficiency but also sustainability in a more integrative way where developed recently. Especially in the semi-arid climate of northern Iran—but also of different places of the MENA region, which means Middle East—North Africa, it is very important to develop certain architectural structures to deal with the high heating and cooling demands at the same time while the costs for operation, and in this sense mainly for heating and cooling are aimed to be as low as possible. It is a goal to use the afforded reduced technical building equipment in a low extent by the development of an optimized architectural design and the implementation of efficient heating and cooling and lightning etc. concepts.

In this sense these guidelines shall show architects and building planners how a building can function in an economical and ecological manner with the help of concepts of three different architectural pilot project buildings in the satellite town Hashtgerd New Town in the north of Iran, on the footsteps of the Elburz Mountains and 60 km western on Tehran. A team of architects and planners and certain specialists developed these efficient urban and architectural structures within the research project Young Cities, which are projected now implementable in these design-guidelines.

Designing the LIFEcenter

The design process includes discussions with specialists

1.3 Energy Efficiency

To design and plan an energy efficient building a few parameters of the location have to be considered and design tools on a couple of different levels have to be used. The design process can only be an interdisciplinary process, which also includes modern planning strategies such as the use of computer simulating tools. Every building typologies belongs to its certain functions and functional connections. These have to be basis of design as well as the optimum methods for the energetic optimization of the building or building complex. Only in the conclusion of these facts an integrated adapted architecture can be created. In this sense it is difficult to give general advices in detail for energy efficient planning and building. The most important template is the aware consideration of conditions and requirements of both the location and the design task.

The topics, which have to be considered to optimize an architectural project in energetic senses, are differentiated. The exact setting of the building orientation in combination with the exact analysis of the opening ratio for each side of the building with regard to an aimed energetic optimization gives main advices for design. Additional shading devices in different shapes or as different types can even optimize the resulting solution. It has to be evaluated exactly, if these devices have to be flexible or oriented to a certain direction.

The micro climate in the direct environment of the building or in between a complex of buildings has a great impact to the comfort in and around the building. In this sense it is very important to possibly evaluate and optimize it. A big influence on the microclimate has the installation of greenery in any shape. Also open water pools can influence the microclimate positively. Neighbor buildings or other larger natural or artificial shapes can shade zones, lead or stop the wind or reflect sunlight.

Special façades can offer high thermal insulations or even ventilation functions or thermal gains and storage. The type, functions and exact orientation of certain systems have to be analyzed and evaluated for the building project.

In total the goals of an energy efficient design are to save energy for heating and cooling as well as for lighting and, if possible, also for other issues of building operation with regard to the possibilities of the architectural shapes or constructional ideas.

But to create sustainable buildings the whole life cycle of a building has to be considered, which means the planning and construction phase, the phase of operation including maintenances and renovations and, in the end, the phase of deconstruction.

1.4 Goals and Applicability of the Guideline

The public building owners have the task to take a cutting-edge position in the topic of climate-adapted building. The imperative of an aware use of efficient building methods and technologies for an active constructional adaptation to the local climatical conditions and their application against the progression of the climate change in the range of the influences of the building sector has to be reflected and projected in this context. In this way especially the multiplication of sensitive views on the issue of climate change as well as of adequate innovative ideas for handling the problem is getting more and more important nowadays for the development of living environment. The body of a city needs public buildings as a kind of organs, they develop pure sleeping towns to usable, readable, lively city spaces and create in this way centers for organization, communication, consume etc. Public buildings are socio-cultural centers and are able in this regard to transport images, knowledge, and capabilities. They can be an active, almost living part of the city and should use their example role to project the need of adapted acting—in this sense adapted planning and building. In this context especially the public buildings for educational facilities play a main role. Educational centers have a special example role and they have the function of knowledge transfer to any interested people. By this means the LIFEcenter in Hashtgerd New Town, vocational training center for construction workers and information center for contemporary building gets the task to teach knowledge and train abilities of high quality building and planning in particular. In this regard the most important requirements for the architectural shell are of course the sustainability, resource-efficiency, and reduction of greenhouse gas emissions. The building complex of the LIFEcenter has both the mission to give space to the doctrine of aware building in a functional way but also to support it as show-and-tell object regarding the didactical content.

Various factors play a role for the architectural design of the LIFEcenter. All of these factors will be reflected in these guidelines. A basis of designing a vocational training center for an almost new occupation in Iran and of designing an information center about in Iran yet almost not discussed topics is the awareness of social and cultural adaptation of the building complex of the LIFEcenter and in this way representatively for future building construction in the country. The social integration of both the building and its functions gives the scale of acceptability in the general public. The aim of the LIFEcenter is to offer possibilities, to show innovative ideas including available knowledge and material, to tell about modern methods for sustainable architecture and the necessity of higher construction quality. The design of the LIFEcenter therefore uses images of ecology- and economy-minded planning, supported by different partial concepts like the construction including recycling materials or recyclable elements, green roofs etc., which create the integral concept of the LIFEcenter. Passive and active methods for energy efficient architecture include the optimization of the building shape, its orientation and opening ratio, the building materials, the constructions and building quality, but also optimum techniques, installations, the use of regenerative energies, the careful use of resources. Goal is to create a reduction of the energy demand for heating and cooling and lightening etc. of the whole building in comparison with adequate common Iranian buildings and on an international up-to-date level. In this way it is also aimed to create the lowest possible operation costs but at the same time possibly low or common building costs to develop a functioning amortization process. A sustainable building means efficiency in all regards such as economical, ecological, social and cultural efficiency over the whole life cycle. And the adaptation to the directly surrounding environment is the basis for an aware design.

Project dissemination via presentations and symposia

Project dissemination via direct communication with interested people in certain regions

2 Guidelines

On the Basis of the Development and Planning of the Educational Building Vocational Training Center with Additional Facilities in Hashtgerd New Town

2.1 Introduction—Design Objectives

The design objectives of the new generation typology LIFEcenter in the following chapter support the design and planning of a modern, sustainable and energy efficient vocational training center, public building with administration facilities, school facilities, space for exhibitions, a congress center, gastronomy facilities, shop floors, residential buildings respectively accommodations etc in form of design principles. In this variety of the functional typology of the center, with a clear focus on functions, which support each other and the surrounding city, it is possible to present a wide range of possibilities in architectural optimization. The mainly points of optimization are focusing on the architectural design. It is aimed to include the whole life cycle of the building in the analysis and design results, and in this sense a lower cost implementation and an efficient operation create an expected efficient amortization time.

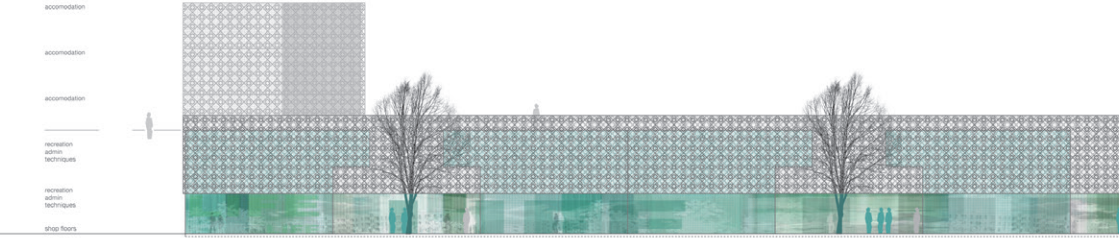
Various tools and methods exist to optimize a building regarding its sustainability and energy efficiency. There are tools to optimize the microclimate around the building and the thermal comfort in a building, to increase the level of cultural acceptance of modern building typologies and to increase the social adaptability to the building users, the work motivation in an administration building or a school, but also to reduce the negative impacts on the environment or the climate. Building technologies can be optimized to a very energy efficient level, and they might not have to be used over the whole year because of the energetic optimization of the building's architectural speech. In this way it is possible to install mostly "low tech" solutions.

The LIFEcenter is a building complex for the teaching and training of, and information service about modern, innovative architectural methods, energy efficient architecture methods, sustainable materials and technologies and—one very important point—the needed high quality of building construction. In this sense the LIFEcenter plays a multiplication role for transferring knowledge and abilities of sustainable planning and building. This is the framework for the architectural design of the center's building complex. The goals of its architecture reflect all the named points of the vocational training and information service arranged in the LIFEcenter. The LIFEcenter is shell for its functions and it is part of the lessons and informative exhibitions about up-to-date building. The building is a part of the

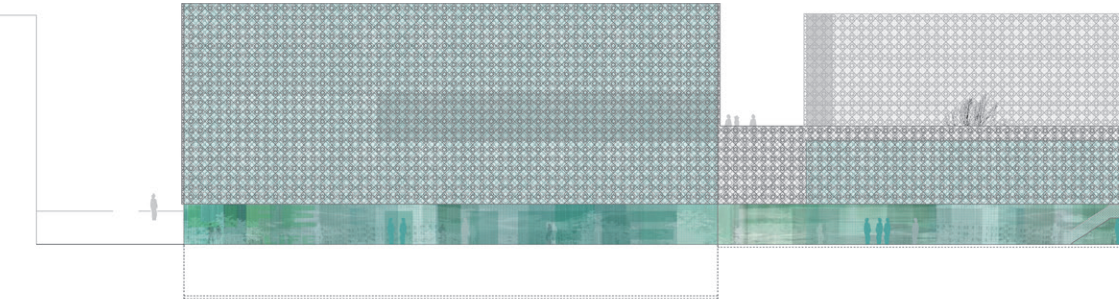
The LIFEcenter, a perspective drawing with view on a head building with the main entrance zone

didactical concept and it is an image for sustainable and energy efficient planning and building.

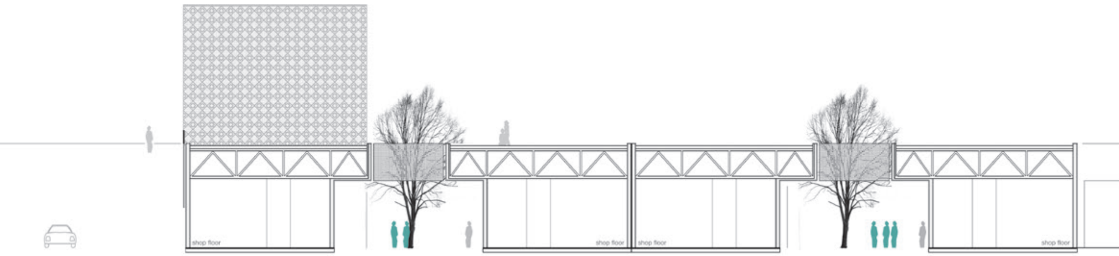
The LIFEcenter is a hybrid building complex for education. It directly addresses people of the building sector as well as building owners and interested investors. Mainly construction workers shall become qualified in the LIFEcenter but also academics of the building sector have here the chance of experiences in practice for an adequate qualification for supervision on site. The different facilities in the complex mirror this situation. The functions of information and theoretical education, including the library and media center, the administration of the center, a cafeteria with kitchen and a parking garage are allocated in the first head building. An accommodation for the students of the center and public hostel rooms including the adequate administration and some recreation spaces are allocated in the second head building. These buildings have 5 floors above the soil. In the 1 storey, 7 meters high hall buildings the shop floors are located for the training in practice. The certain building parts work modular. In Hashtgerd New Town they are planned in the following number and arrangement.



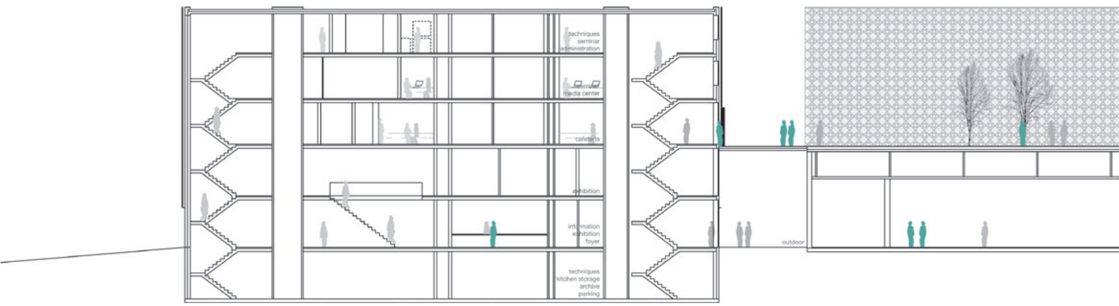
South-southwest elevation of the LIFEcenter



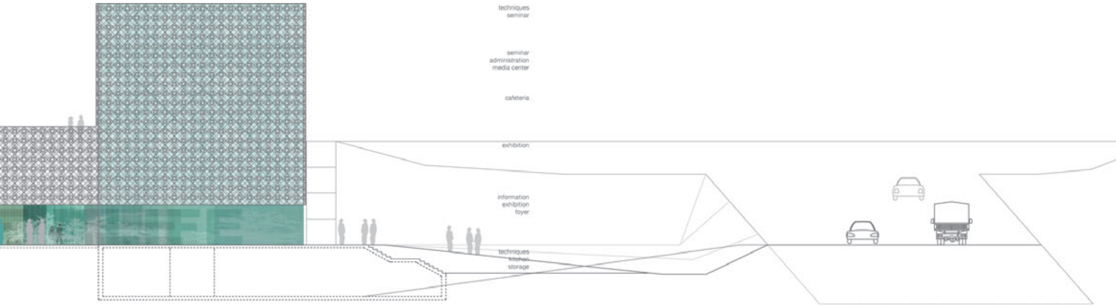
East-southeast elevation of the LIFEcenter



Cross section of the LIFEcenter



Longitudinal section of the LIFEcenter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kitchen
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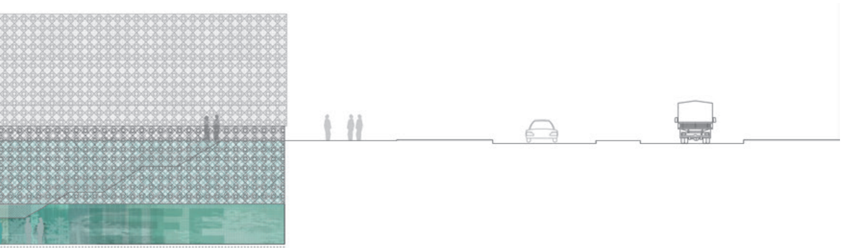

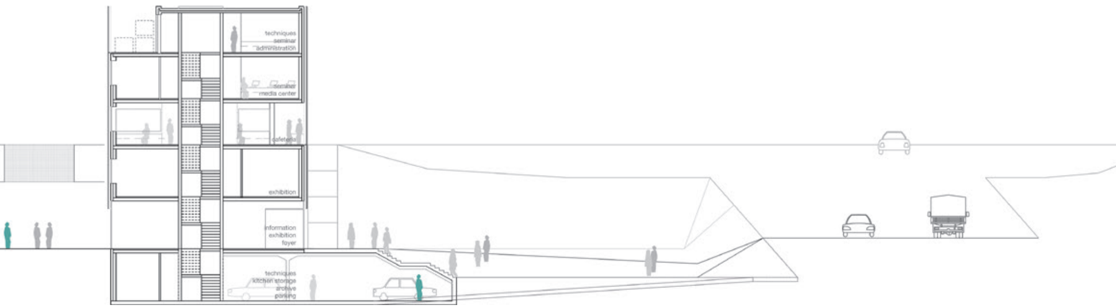
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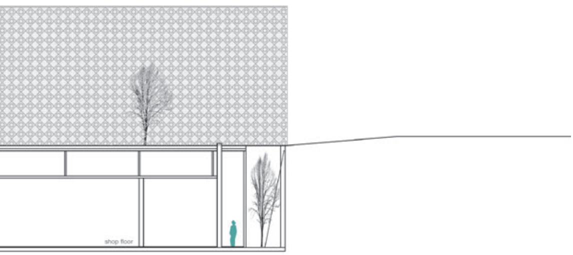
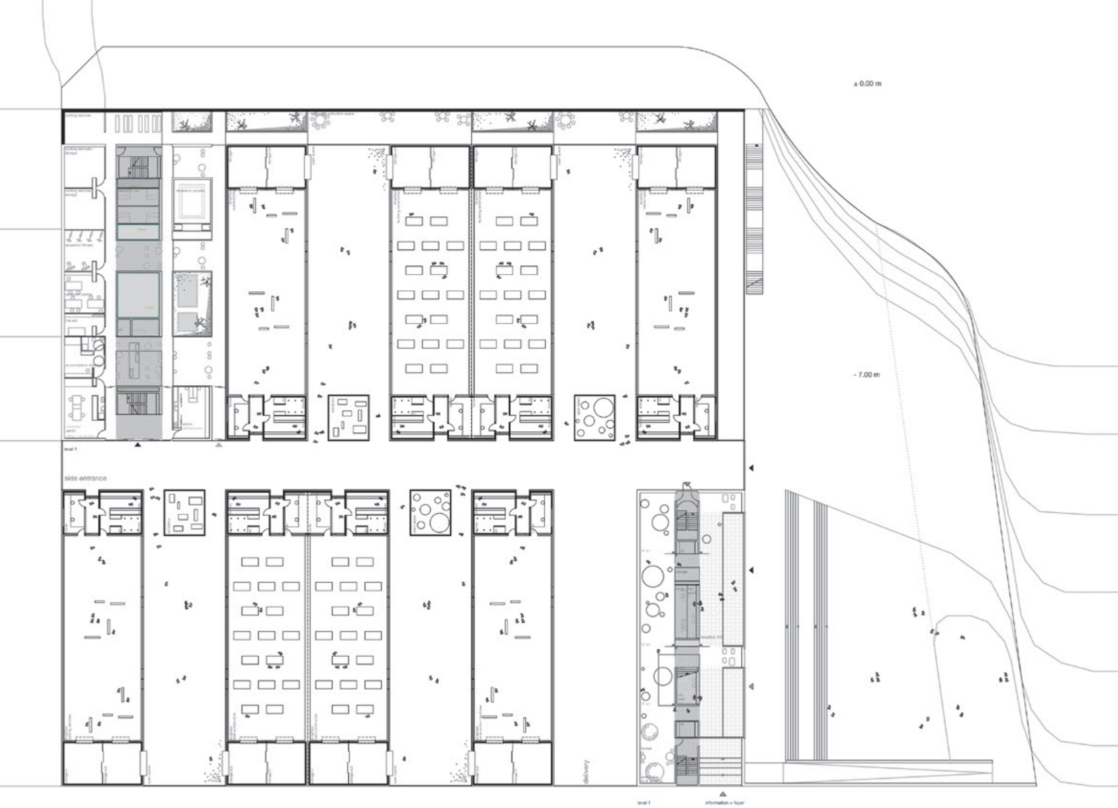

shop floor



Ground floor plan of the LIFEcenter

2.2.Energy Efficiency Measures

Architecture

The total goal is to develop efficient architectures. Besides others by this means the building needs as little as possible energy for climatisation while the phase of operation.

Therefore the building shape should be as compact as possible, in this sense as the function allows. The LIFEcenter design uses the simple shape of rectangular cubes. The certain compact building parts are bind together by a circulating grid as shading device, a curtain wall faced belt. Finally the whole complex of buildings has a compact shape.

The orientation of a building in a certain climate plays a main role to adapt the building to the regional climatical conditions. In hot summers it is absolutely important to reduce the heat gains by the sun to a minimum. In this way it is possible to avoid a natural heating, which would cause an adequately higher demand of cooling energy. At the same time it is important to increase the solar heat gains in winter. In this way the artificial heating would be supported by natural existing heating energy. The different orientations of façades cause different solar gains. It is a basis of climate adapted building planning to analyze and evaluate these and to set up the most efficient strategy for the orientation of a building regarding its shape and openings. For the region of Hashtgerd this means certain “rules”. The highest energy demand for climatisation of buildings in this region is not on cooling in summer but on heating in wintertime. In this sense the main orientation of a hybrid building should be to the southeast. This belongs to the values of both summer and winter months. In the winter the building has as much as possible heat gains while the heat gains at summer are still as low as possible to reach the gains in winter. With around half opened outer walls in total, the energy demands for heating and cooling will be as low as possible for the hybrid building. But these energy demands can be even optimized by the use of well oriented shading devices in front the openings or even in front the outer walls. Also here the most possible solar heat gains are aspired in winter and the lowest heat entrance is aspired in summer. By using external shading devices it has to be considered, that the opening ratio in total has to be increased by a bit. It is important not to forget the daylight entrance besides the solar gains. By considering all these facts the openings should face mainly the south or southeast. These windows should cover a little more than half of the southern oriented outer wall. Some openings can be arranged on the northern oriented façade. The smallest window ratio should be oriented to east and west. Here the low angle of the sun supports too high heat transmissions in the summer time. This would increase the energy demands for cooling dramatically.

The LIFEcenter building complex shows its larger and open façades to the southeastern direction. In this way also the large entrance zone with big doors and a representation façade is oriented.

The building parts of the shop floors are designed different from the head buildings, which consists of various smaller functions such as seminar rooms, administration offices, the rooms of an accommodation, a library, cafeteria but also an exhibition zone with larger spaces. These two types of building parts, the hall buildings and the head buildings, have different shapes, bearing structures, construction materials and different façade types. But their designs are also based on equal rules. The shapes of both types are compact to reduce the building envelope but are complex enough to increase the natural lighting. The orientation of the building parts is the same.

The basic idea of formulating the openings is as well the same in both building types. On this background the openings can be arranged very flexible. An additional façade grid in front the outer walls and openings of all building parts works as shading device. With parametric design tool it is designed to support the largest possible heat transmission in winter on every façade while the smallest solar gains in the summer months on each façade of the building complex. In this way the windows behind this shading grid can be arranged a bit more free.

The difference between the two building types hall building and head building is the necessary amount of daylight transmission. Because the big and deep shop floor hall buildings need as much as possible transparent or translucent area within their shell, a special translucent material is used for all façades of the halls. To avoid too high solar gains in the summer, the shading grid can be installed on each side of the façade, where it is needed. Additional bearing roofs are shading the façades partially.

The openings of all building parts are arranged in a way, which allows the necessary cross-ventilation for an effective natural fresh-air-supply. The hall buildings can get additional roof openings to optimize this cross-ventilation system.

Also the space allocation, which means the allocation of certain functions in the centers building complex, works as compact as possible to avoid long distances. This would reduce the effectiveness of the buildings operation. The access ways are allocated as central as possible to save space for access ways. Entrance zones are allocated differentiated to improve the effective usability of the different hybrid functions of the center. All functions are arranged in the center on the base of their needed connection the certain outside environment. This optimizes the accesses as well as the opening of the center in each direction in an aesthetical and representative sense as well as in a functional sense.

All open spaces are allocated in a way, which allows short ways to reach them. They are spatially directly connected to the indoor facilities, which belong to them functionally. The outside patios and alleys are used for the creation of optimum microclimate by an optimized shape, size and orientation. Also for sun protection certain shading devices are planned above these functional outside zones. The building parts and neighbor buildings shade the outside spaces and outside accesses partly in summer. The hall buildings have bearing out roofs above a part of the patios. In addition here are shading devices arranged, which are also possibly designed with the help of parametric design computer programs. They have a geometry, which allows a very high level of shading in summer, while the most possible sun can come through over the whole winter day. For that they are arranged in the main angle of the winter sun. In the end the in that way optimized microclimate of these outdoor zones influences the adjacent indoor spaces positively. It helps to cool them down in summer and to heat them up in winter only in a natural way.

Shading devices are also planned in front the openings and outer walls, wherever they are needed, especially in north and west direction.

Some greenery on certain roofs supports the microclimate in and around the LIFEcenter. Rainwater can go into the soil or the green. Based on the fact of a lack of natural water resources in the region it can store a certain amount of water. Afterwards the air becomes more humid in summer by a slow, organized evaporation. At the same time the evaporation process reduces the surrounding air temperature be the system of adiabatic cooling. The construction of a green roof in this way supports the microclimate. But it also provides a thermal insulation of the roof. As well it works as noise insulation layer. A longer durability of the roof construction is supported by the construction layers of the greenery because of the insulation of the roof construction underneath and therefore the reduction of strains and stresses of the materials by high temperature differences and it protects the construction from direct weather influences or mechanical influences. Therefore it is absolutely important, that the green roof is installed with high quality. The greenery can also be installed on façades, in patios or near the building. All this green works against soil sealing, for shading the building and the surrounding outer spaces also for preconditioning the fresh air supply.

The front yard is oriented to the southeastern side. This allows a larger and more open entrance zone and a widely opened entrance façade. The energetic losses are possibly low while the heat gains outside and inside are higher in winter.

The use of wind for cooling the building and its surrounding outer spaces in summer for creating an optimum outdoor microclimate and indoor climate is an effective design tool and also used in the urban and architectural design of the LIFEcenter. Therefore the shape and orientation of the building and the patios is oriented form southwest to north west, which answers the main wind direction in the region in summer. The wind flows through the patios delivering fresh air and influences the microclimate there.

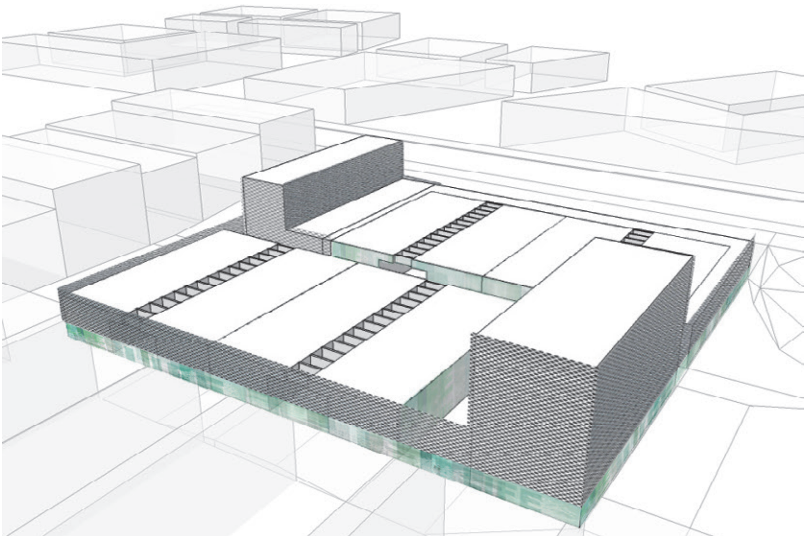
Also wind towers can be used. Those can be quite effective in the region of Hashtgerd New Town for the months in the summer, to cool down the indoor areas and deliver fresh air. They need certain expenditure in planning to calculate the most effective height, orientation and diameter. A wind tower usually needs some own footprint-space on every delivered story, and a certain own structure. Also its financing and maintenance have to be considered.

Another efficient issue is, that the LIFEcenter uses the topography of the site. The northern walls and partly the walls to the east and west shall be constructed against the soil. This works well for the thermal insulation on these sides. In this sense it makes the use of direct geothermal storage possible or even supports the indirectly use of geothermal energy by an installation of earth channels.

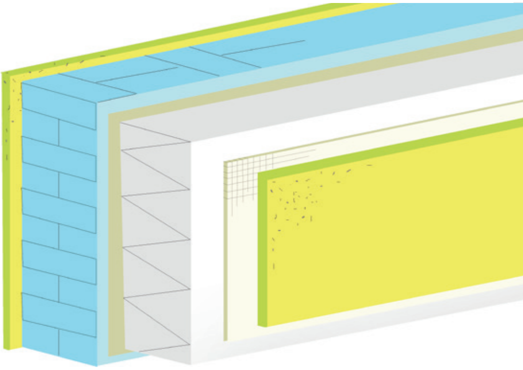
Besides all these point even the colors and finishing have a certain influence on the energetic efficiency of an architectural design. They can work as tool for sun protection in summer creating brighter and plain outer surfaces, because the solar radiation becomes reflected in a high amount. If they are darker and maybe a bit more rough, the solar radiation becomes absorbed in a greater amount and the solar gains in winter will be higher. The latter setting provides the possibility of storing the solar heat in the wall material behind the dark finishing. An “organized” slow transport of the heat into the rooms helps to condition them in a natural way. In this way color and finishing can even be used in an optimum and adapted way differently on the different sides of a building.

A high construction quality is needed on any point of building construction. Therefore it can be very important to choose building methods, which are known in the region and maybe commonly used. An adequate parallel qualifying of the workers while the construction process can help to improve the quality massively. Also for maintenance adequate abilities and experiences have to exist on the side of adequately skilled workers. Last but not least the quality of the installed products and building elements has to be adequate. To make sure, that these points are basis of the LIFEcenter project, the availability of the chosen materials was proved and a training of the workers in parallel to the construction on site is planned. The materials are whether common in Iran, such as bricks or reinforced concrete or insulation windows, or they are just getting researched and newly developed together with Iranian experts, such as aerated concrete blocks, or they are already used in Iran in other branches, such as the polycarbonate multiwall sheets and their profile systems for the façades of the hall buildings.

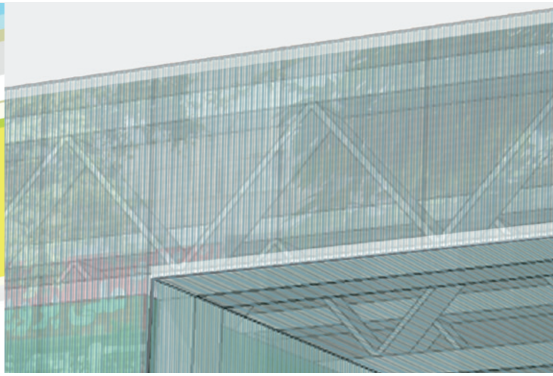
The LIFEcenter mirrors energy efficient architectural solutions with a great image factor, as landmark, especially in its function as information center for the information about modern energy efficient and sustainable design. And it works as show-and-tell object with its optimized architectural speech and building technologies as support for the vocational training function.



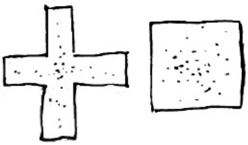
Isometric drawing of the LIFEcenter building complex



Adapted façade material for the head buildings

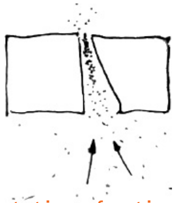


Adapted façade material for the shop floor halls



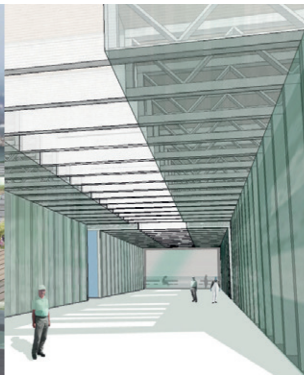
Compact building shape for an optimized energetic quality and earthquake resistance

Energetically optimized building shape and orientation



Orientation of patios and alleys regarding the wind direction

Partially greenery on roof tops for an optimized energetic quality, sustainability, activation of space and construction durability



Shading devices and cantilever roofs above the patios for outdoor training

Shading devices as curtain wall façade for the whole LIFE-center building complex

Structure and Building Materials

The façade constructions of the halls of the LIFE center project are different to the one of the head buildings. The hall buildings have a double-layered façade made of polycarbonate multiwall sheets with very good heat insulation values and an active air layer in between. The air layer works active as preconditioning layer. This means, that the air between the PC sheets becomes heated by solar gains through the translucent PC in winter an summer. In winter these gains are used. The outer walls work as heat storage and heating surface, which conditions the indoor air by heating it up. The outer PC layer has openings on the bottom and the top of the walls, which become opened in summer, to create a chimney effect in the air layer in the façade, by which an air change gets created. The air in the layer between the PC sheets becomes cooled by fresh air and does not influence the indoor air negatively. To optimize these effects a shading device is arranged in front the façade on east, south and west side. This device is part of the grid, which envelops the whole building where it is necessary. This grid became optimized in a parametric design process with computer programs and allows the most possible shading in summer and the most possible heat gains in winter.

The head buildings have outer walls made of aerated concrete blocks. Because they are just an infill in between concrete pillars, an additional ETICS is installed in front the blocks. In this way a highly insulated façade protects the rooms from too high natural heating in summer and heating losses in winter.

The materials, which are used for the building complex, are available local materials. They become produced in the region or in the country. In this way the transport ways are as short as possible. Depending on the material the CO_2 emissions are as low as possible in the production process. The gray energy of the materials should be low regarding the whole life cycle.

Also for the structure of the halls and the head buildings materials and elements shall be used, which have a long durability, low CO_2 emissions and energy demands in production, a high earthquake resistance, and which are available.

The possibility to use recycled materials or/and materials, which are recyclable, optimizes the results. This chance is used in the LIFEcenter especially in the façade grid for shading. It shall be made of recycled plastics or metal. It is designed to match the construction with both materials. Each grid-cluster is 50 by 50 cm big.

The following materials are used in the design of the centers building complex:

For the halls:

Façade (PC multiwall sheets), construction (steel frames), floor (concrete, insulated concrete), roof (green roof, simple flat roof).

The materials have certain qualities:
Green roof, extensive; capacity to withstand stresses: highest quality, ecology: highest quality, durability: high quality (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*); increases durability of roof, positive influences on room and microclimate.

Trapezoidal sheet: easy installation, experiences for construction, reduction of roof construction, available.

Shading devices, made of plastic; capacity to withstand stresses: middle quality, ecology: middle—low quality, durability: middle—low quality (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*); made of metal: capacity to withstand stresses: highest quality, ecology: middle quality, durability: high quality (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*).

Steel construction; available, commonly used, experiences in construction, modular, reusable, durable.

Multiwall sheets; capacity to withstand stresses: high quality, ecology: middle quality, durability: different (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*); acryl $d = 16\,mm$, $u = 2.7\,W/m^2K$; polycarbonate $d = 16mm$, $u = 2.4\,W/m^2K$ (from $u = 0.41\,W/m^2K$); Plexiglas $d = 16\,mm$, $u = 2.5\,W/m^2K$; lightweight, easy installation with profile system and easy transport; fire protection classification: B2 (normally inflammable) to B1 (hardly inflammable) (*GER, Din 4102*), Class 1 (*GB, BS476, Part 7*), M2 (*F, NFP 92501/505*), firmness: ball-impact-resistant (including Hockey ball) to shock- or impact-resistant, workability: can be bend cold, installation systems with profile systems, thermal insulation potential: middle to high insulation potential, can be combined with different coatings or kinds of infill for optimization respectively thermal transfer (Nanogel), light transmittance, transmission of sound, weather resistance etc.

For the head buildings:
Outer walls (bricks, insulated bricks, ETICS), construction (reinforced concrete frames), floor (concrete, floor construction), roof (flat roof)

The materials have certain qualities:
Concrete flat roof; capacity to withstand stresses: high quality, ecology: middle quality (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*), installation in combination with reinforced concrete framework, adaptation on site, available.

Shading devices, made of plastic; capacity to withstand stresses: middle quality, ecology: middle—low quality, durability: middle—low durability (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*); made of metal: capacity to withstand stresses: highest quality, ecology: middle quality, durability: high quality (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*).

Reinforced concrete, framework construction; capacity to withstand

Examples of AAC blocks

Examples of PC multiwall sheets

stresses: highest quality, ecology: middle quality (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*), availability, commonly used, experiences with installation, modular, reusable, durable.

AAC blocks; capacity to withstand stresses: highest quality, ecology: middle quality, (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*).

ETICS, stone wool; durability up to more than 50 years, up to 40% energy savings for heating and cooling, positive for indoor climate, noise insulation and fire protection, natural resources, recyclable (*www.hasit.de*).

Windows, aluminum; capacity to withstand stresses: highest quality, ecology: low—middle quality (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*), gray energy (MJ/m^2) frames: 2,600 (*based on catalogue from Büro für Umweltchemie, CH and econum GmbH, CH*).

Windows, PVC; gray energy (MJ/m^2): frames: 900 (*based on catalogue from Büro für Umweltchemie, CH and econum GmbH, CH*).

Windows, steel; capacity to withstand stresses: highest quality, ecology: middle quality (*Wirtschaftliche Standards des öffentlichen Bauens, Berlin, 2002*).

Windows, insulating-glass; gray energy (MJ/m²): 380…640 (*based on catalogue from Büro für Umweltchemie, CH and econum GmbH, CH*).

ETICS, insulation; construction: wall background massive, insulation material, reinforcement mortars, reinforcement fabric, exterior plaster, paint coat (fungicidal), insulation material: polystyrene or mineral wool

Polystyrene; fire protection classification: B1 (hardly inflammable), thermal conductivity: 0.035…0.045 W/mK, primary energy demand EPS 200…760 kWh/m³/XPS 450…1000 kWh/m³.

Mineral wool; fire protection classification: A (not inflammable), thermal conductivity: 0.035…0.045 W/mK, primary energy demand: stone wool 150…400/glass wool 250…500 kWh/m³, resistance against fungi, rottenness and vermin.

A high quality installation of the building elements of course reduces the energy demands for heating and cooling. Thermal bridges should be avoided in planning and construction.

As result the LIFEcenter reflects a high quality construction with adequate materials, recycling materials and structures as show-and-tell object. The integrative concept formulates a landmark with high image factor.

Building Methods

The use of traditional building methods in combination with traditional materials in the region of Hashtgerd is interesting for energy efficient building. The masonry of inner and outer walls of the LIFEcenter for example offers this chance.

Commonly used modern building methods as well support the implementation and effectiveness of a ready building. In the LIFEcenter this is, for example, the steel work of the structure of the hall buildings, the reinforced concrete framework of the head buildings and the polycarbonate sheets as façade material of the hall buildings.

Tidy construction site, example: site near Berlin

Certificated, secure scaffolding, example: construction site in Germany

large building site in Iran, photo J. Grunwald

Typical construction method in Iran, photo J. Grunwald

To use these opportunities in a way, which is adequate to the energetically optimized building design, it is very important to consider the construction quality as one of the biggest aims of the project. Without a certain building quality the effectiveness of any used tools for energy efficiency will be down rated. The training of workers therefore can possibly be the necessary basis of implementation. Skilled workers support an architectural project in a large amount.

Technical Building Equipment

For the additional heating of the halls and the head buildings a block heating station is planned, which delivers the whole building complex. Particular adiabatic cooling systems serve the indoor air conditioning especially in summer. They are planned as particular systems for each space or hall. The use of heat recovery systems in aeration and ventilation is planned adequately.

For the additional artificial lightening of the halls and of the head buildings and for any machines and household appliances the use of solar energy is foreseen in the greatest possible amount.

As well the use of solar heat for the hot water supply can optimize the energy concept of the center.

For adequate water savings special water-saving installations in the sanitary field are planned. Rainwater should be collected.

Besides the usual function of the techniques for the technical supply, the technical building equipment is part of lessons and seminars by being a show-and-tell object for the education.

Geothermal energy can be used for the aeration and heating of the building parts by the installation of earth channels for a preconditioning of the fresh air.

Regenerative energies, such as the energy from sun and wind, should be used in an efficient amount for the building operation. The LIFEcenter has on top the southern situated hall buildings photovoltaic panels installed. They can be arranged there in the optimum orientation on a large area.

Exemplary photovoltaic modules on the roof of a one-family house in Germany

2.3 Socio-Cultural and Economic Aspects

Architecture

The building shape supports a more introverted design. Patios structure the complex inside and offer openings to the inside situated outside.

The urban design benefits the adaptation of the centers building complex to environment. Building parts are arranged in a way, that each part is spatially or visually connected to the surrounding city.

Also the size of the building parts is designed adequately to the certain neighbors. The residential building is allocated to residential environment; the main head building is allocated on the side of main traffic streets and the main entrance zone as well. The front yard gives space in the access zone and formulates an address with character.

In this way also the different heights of the buildings work adapted. The high head buildings work as landmarks, while the low hall buildings with their roof tops, being plane with the northern passing soil, give a free view from the northern neighbors to south with Old Hashtgerd. This increases the increases the identification of the LIFEcenter users with the place and the location. The location or identification with the genius loci works in a social-aesthetical way.

By designing such a functional building, like the LIFEcenter is, in a very functional way, almost as a machine, the work motivation and generally the motivation of the users will be raised. To increase the functionality there are, for example, short ways arranged in the buildings, and central access ways simplify the movement. Also the optimum allocation of accesses or the differentiation of the certain entrances works well for the hybrid functions. The outdoor spaces and belonging indoor spaces are directly connected.

Perspective drawing of the LIFEcenter with the view from north to southern Old Hashtgerd above the roofs of the LIFEcenter

Also the modularity of the design of the LIFEcenter building complex offers a flexible planning tool to adapt the design concept easily to other locations with certain parameters, and as well as a flexible utilization concept to develop the longest possible life cycle of the building and the highest possible chance of adaptation to new requirements. The modularity is served by the design of particular building part modules and room modules, such as the halls and the inserted room boxes for office, lockers and storage.

The finishing on the outer sides of the complex, the colors and ornaments mirror the aim of creating a landmark with high image factor. Nevertheless the use of common or traditional colors and ornaments increases the identification potential of the future operators and users with their building. The use of traditional architectural elements in the architectural design such as ornamented shading devices in front the façades, with a look on mashrabeja and the playing with ornaments, benefit the identification as well as the creation of the patios including greenery, the introversion of the typology, the use of cooling wind in summer etc.

The greenery on the roofs of some of the hall buildings and the open air spaces such as the patios support the users in a functional way and work as place for recreation and communication, for outside works or training in the created, positive environment of flora and fauna.

Structure and Building Material

The use of common or traditional known or simple construction methods benefits a construction with Iranian workers, based on their existing experiences, knowledge and abilities. The steel frame construction of the hall buildings, which works with welding, or the construction of frame structures with reinforced concrete in the head buildings of the LIFEcenter and an infill with stone blocks as masonry trade are good examples.

In this way also the use of common or traditional and known materials and building elements, which are available and accepted in the region benefit the building quality on the one hand and the acceptance of a realized operating building on the other hand.

The optimization of known building constructions and methods as well as the introduction of modern technologies can be combined with training for the new methods. In this sense also, for example, the low but widely spread welding abilities can become optimized. Or also the quality of reinforced concrete in the LIFEcenter can be increased, which is especially needed for a longer and safer durability of building constructions. The commonly constructed infill with stone blocks can become optimized by the introduction or multiplication of new materials such as aerated concrete blocks. They are getting researched and optimized and produced already in Iran. Façade constructions in layers are usable for an energetic optimization in combination with the use of modern materials such as polycarbonate multiwall sheets, which are used already in Iran in another context for engineer constructions.

To increase the positive environmental influences of up-to-date building recycling material should be arranged in the construction. This also benefits an awareness raising regarding the aims of modern, energy efficient and sustainable building planning and can support the acceptance of the building.

Constructions and materials, which are foreseen in the LIFEcenter, are earthquake resistant or they support the earthquake resistance. Whether they are a proofed material for an adequate building structure, such as the reinforced concrete framework or the steel frames, or they are as light as possible, like the polycarbonate sheets of the shop floor halls are and the aerated concrete blocks as infill for the outer walls and the drywall constructions in the head buildings are as well.

The architectural materials, elements and the building techniques support the education and information in the center by being a show-and-tell object for the education.

The energetic efficiency increases the economical efficiency of a building massively.

Very important is a high construction quality for the earthquake resistance, for energetic efficiency, and in this way in the end for the identification of the users with their buildings.

Typical system building in Old Hashtgerd

System building in Old Hashtgerd with masonry infill

The typical construction of a multi storey residential building in Hashtgerd New Town with a steel frame structure

A typical construction is the framework made of reinforced concrete with an infill of masonry

High buildings in Iran nowadays are often made of concrete

Building Methods

The use of traditional building methods with traditional materials is common working method in regions such as northern Iran. The experiences of older construction workers help to create a higher level of building quality on the one hand but also to transport old knowledge and the abilities from experienced workers to younger workers. The LIFEcenter therefore uses the method of masonry, for example, in a quite big amount, to create the outer and inner walls of the head buildings. The masonry abilities of the construction workers just need to be improved to increase the building quality, but a basic knowledge exists.

The use of technologies, which are known and nowadays commonly used in Iran, or which are easy to understand, support the progression of the construction work and the quality. In this sense the hall buildings have a steel frame structure. Iranian workers are used to the welding trade. Here it is just necessary to improve their abilities because the common welding quality is not very high. Also the use of, e.g., polycarbonate sheets is common in Iran. It is just not directly used in architecture yet. There are workers, which have the ability to install them. This method can be strengthened.

Traditional materials, finishing and even ornaments in the public space (top)
Traditional methods for shading, here in public spaces in Tehran (bottom)

A high spatial comfort also depends on the quality of the indoor thermal comfort

Technical Building Equipment
The creation of a high thermal comfort indoor and as well of a high comfort by lighting can be reached by the installation of the adequate building equipment. This influences massively the work motivation of users of the LIFEcenter building complex.

2.4 Conclusion

Sustainable design is based on various architectural and technical parameters. The total balance of energy demands does create the basis of an aware design as well as a sensitive adaptation to the users needs and perceptions and social and cultural requirements. To bring a sensitive design down to a round figure, also the building methods have to be considered. The facts of availability of materials, the abilities of construction workers, the possibilities of future maintenance influence the quality of architectures extremely. The idea of the LIFEcenter design works with these facts in all regards. Only by an integrative architectural concept the future of the vocational training center with its additional facilities of information and communication about up-to-date building can be ensured. And this again develops the basis for the transport of modern building ideas.

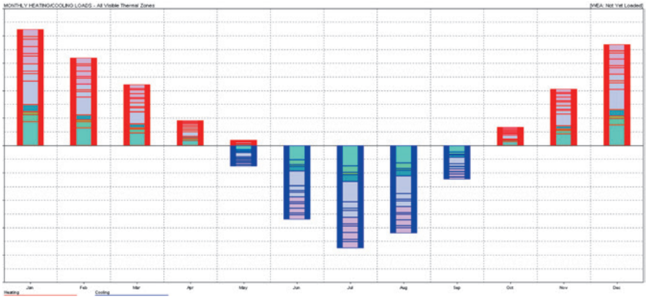
3 Transferability to other Regions

3.1 Different Approaches

Reduced energy demands in a building operation reduce the operation costs. The reduction of an air conditioning by technical equipment means a reduction of operation costs. As well a good natural lighting reduces the costs for building operation.

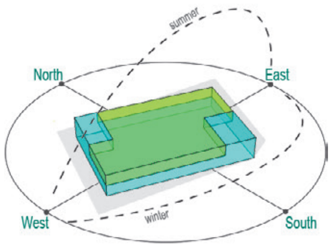
In the following some hints will be given for buildings for vocational training or education and any additional facilities such as exhibition spaces, a media center, gastronomic facilities, the accommodation, and administration space in the semi-arid climate of the region of Hashtgerd. Some interesting hints for differences to the arid climate will be marked.

•• Heating loads in winter create the largest energy demands of a building in the semi-arid climate.



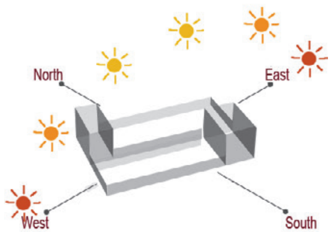
Heating and cooling loads of the LIFEcenter over a year, diagram by J. Huber/UdK

•• The building should be mainly oriented to south/southeast for higher solar gains in winter. This is different in arid climate.



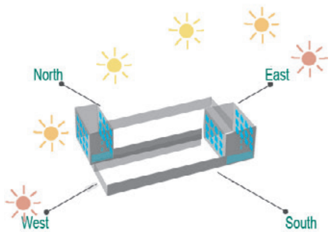
Sun path diagram for the LIFEcenter

•• The east and the west side of a building should be shaded partly to avoid to high thermal gains in summer.



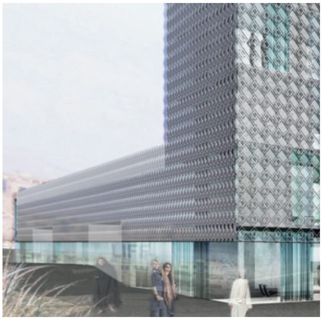
Different requirements on shading to the different directions of the LIFEcenter

•• The northern side should be more closed in the semi-arid climate. In the arid climate it can have a higher opening ratio for better cooling conditions in summer.

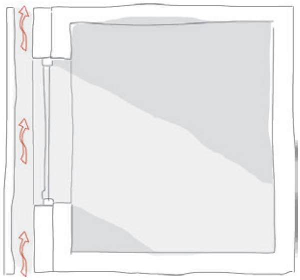


Different opening ratios to the different directions of the LIFEcenter

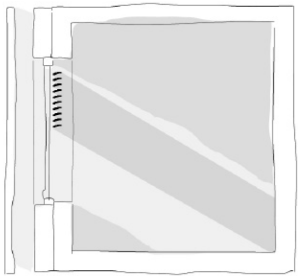
- Shading devices should be installed as fixed elements or constructed shading to avoid high maintenance needs and to create a longer durability. Therefore the shading devices should be optimized for shading in summer and less or no shading in winter, because of the mixed temperature situation in the semi-arid regions. This is easier in arid regions. The pure shading is more important there.


Elements for shading

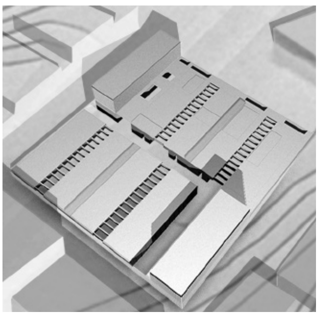
- Behind the possibly external installed shading devices enough space should be left for a good air circulation.


Air circulation behind shading devices

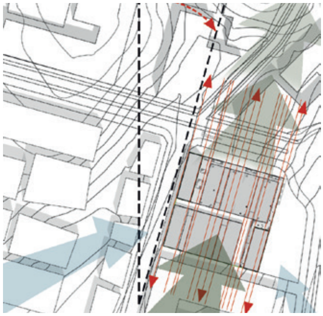
- Additional moveable shading devices are beneficial, but they also need more maintenance.


Additional flexible shading devices

- Shading by other building parts or neighbors avoids a strong heating in summer. But also the plus of natural heating in wintertime should be considered.

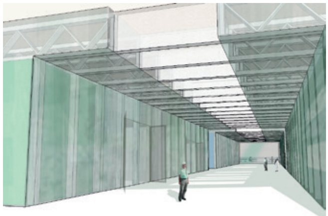

Shading by buildings or building parts

- Patios, alleys, gaps and building shapes should be oriented in the main wind direction in summer, but possibly not in the wind direction of wintertime, for a fresh air supply and therefore the support of the micro-climate.



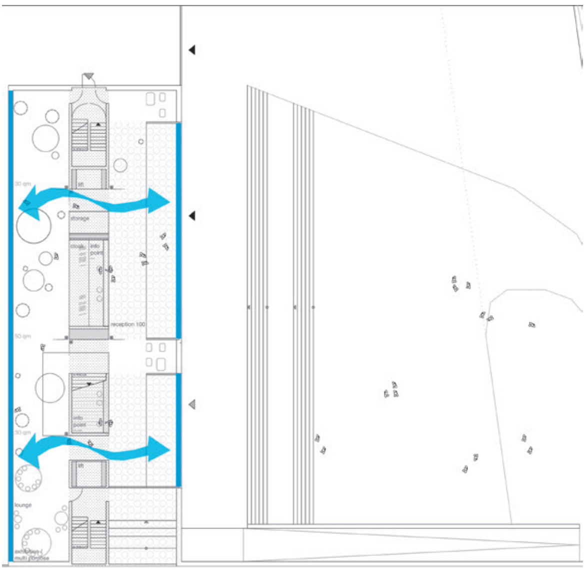
Patios and alleys oriented in the main wind direction in summer

- Outdoor zones in front the openings or techniques for ventilation and cooling should be shaded in summer.



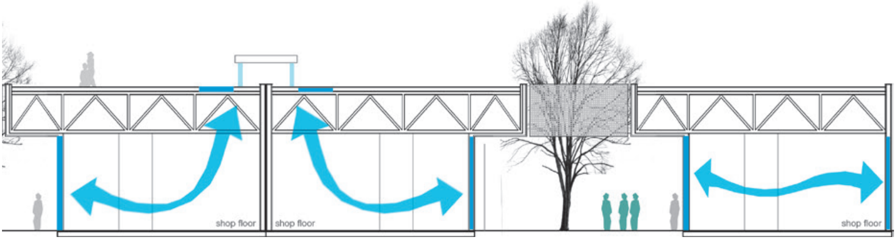
Shaded outdoor area in front of openings

- Openings in the buildings outer shell have to be arranged in a way to work for cross ventilation.



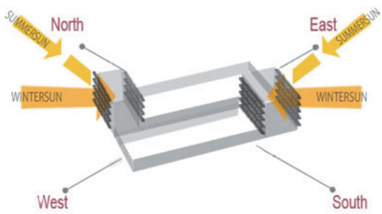
Exhibition space in head building with cross ventilation

- Doors to open air working or training spaces, which are anyway often opened in summer, can be used for natural ventilation in combination with openings on the other side of the rooms.



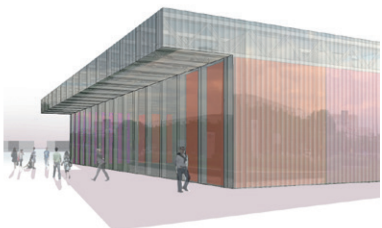
Doors of hall buildings for ventilation

- The adequate opening ratio in the semi-arid climate means a main orientation of windows to the south and south east. In the northern oriented façades as little as possible windows should be arranged to avoid too much cooling in winter. The openings to east and west are difficult but interesting. The can provide solar gains in winter but in summer the solar gains are too high. If adequate shading avoids that heat transmittance in the summer months, those openings can be beneficial.



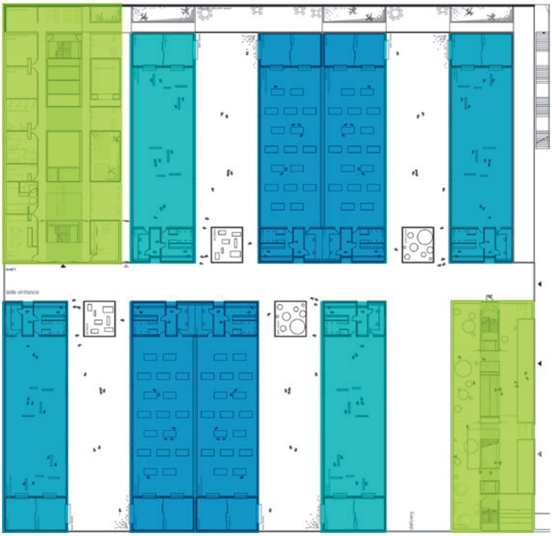
Optimized shading devices with regard to the orientation

- Enough openings or transparent or translucent façades for natural lighting have to be designed.



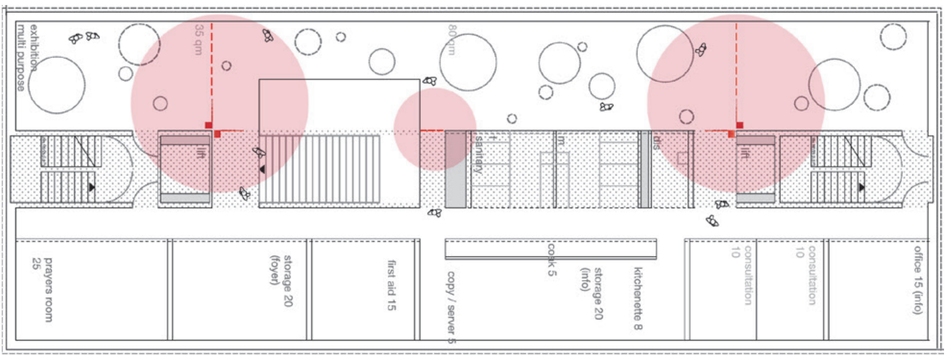
Hall building with PC-multiwall-sheets as facade system

•• Rooms with extra thermal loads or noise contamination from building equipment or machines, e.g. in shop floors, should be allocated separately, respectively should be closed by walls and doors.



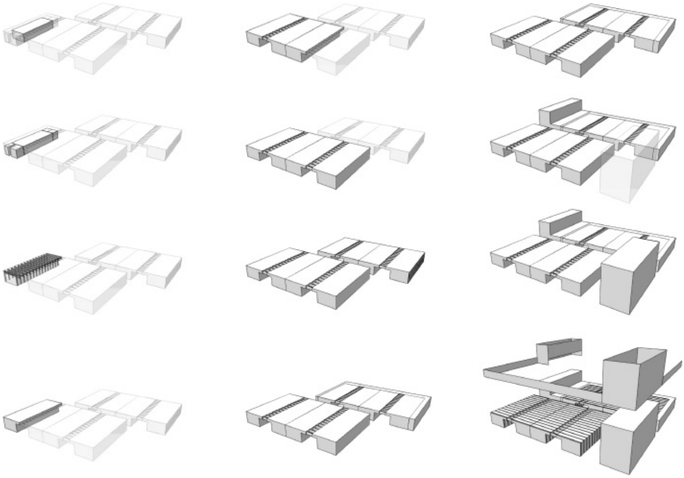
Optimized allocation of functions

•• Large multi purpose rooms can be designed flexible regarding their size and proportions by installing flexible walls. In this way smaller rooms have to be air conditioned, when only smaller spaces are needed.



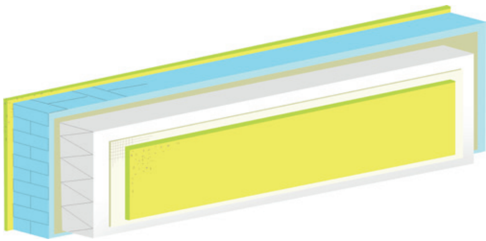
Flexible usable spaces by wall systems on the example of the upper exhibition level in the information and seminar building

•• To work with building modules in planning and design means to work more flexible and efficient.



Modularity of the LIFEcenter is created by modules on the level of construction and rooms and building parts

•• The use of adequate outer wall constructions and materials with low heat transmission and in this way a high thermal insulation is important.



Exemplary ETICS as facade construction of head buildings

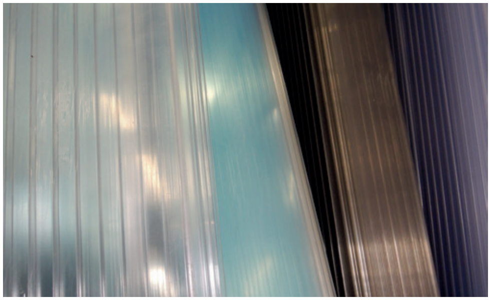
•• Good insulating materials are AAC-blocks, insulation materials such as polystyrene, mineral wool, modern insulation windows with double glazing, PC multiwall sheets in the adequate quality etc.

Exemplary polystyrene, insulating bricks, mineral wool, AAC-blocks, insulation windows and polycarbonate sheets as well insulating materials

- In this way opening systems for doors and windows should also close tight and be sealing.

The installation of any kinds of windows have to answer the needs of an adequate insulation

- Transparent or translucent glazing or polycarbonate shells or others should be chosen on their qualities regarding reflection or absorption of sunlight, insulation with regards to their use and allocation.

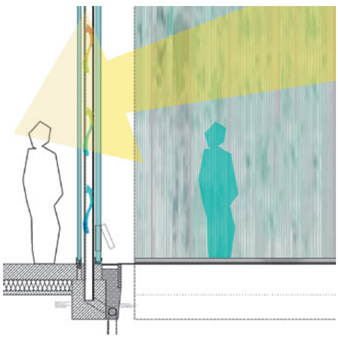


Different kinds of polycarbonate multiwall sheets with certain characteristics

- Window frame profiles should be insulation profiles; the glass should be insulating double-glazing.

Well insulated windows with adequate glazing and profiles

- Alternative façade constructions can be used to increase the light transmittance, for example for the deep shop floors or industry halls. This can be the double-layered polycarbonate multiwall sheet system with air layer, which can be activated for condition the indoor air.



Façade of halls with optimum daylight transmittance

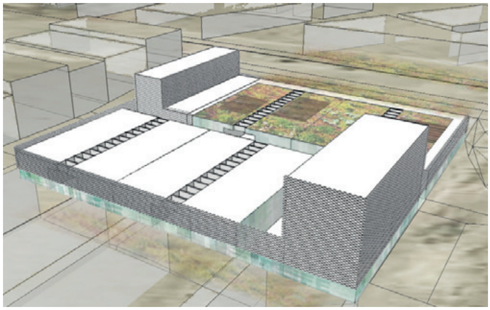
- Where solar gains are allowed or aimed, materials in the interior can be used, which store the heat and give it slowly to the inside space.

Solar gains optimized by storage materials

- A high building quality with well-planned details works against thermal bridges. This enables natural air conditioning systems and technical building equipment to work highly efficient. In this way energy demands will be reduced.

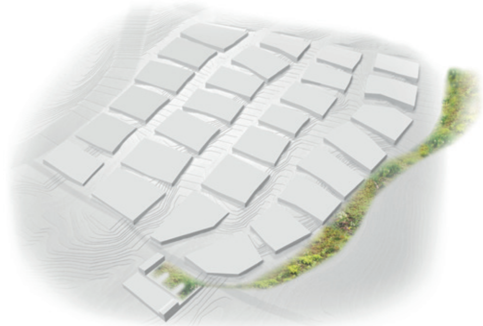
Adequately planned construction details

- Greenery on roofs supports the thermal insulation and also the microclimate by its cooling effect of evaporation. It also works as rainwater storage, which supports the cooling effect and the humidity in the environment. Green roofs also last longer.



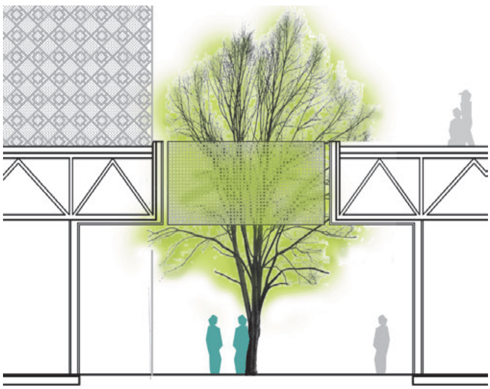
Extensive greenery on some hall building roofs

- Greenery anywhere around buildings reduces greenhouse gas emissions, improves the air quality and produces oxygen.



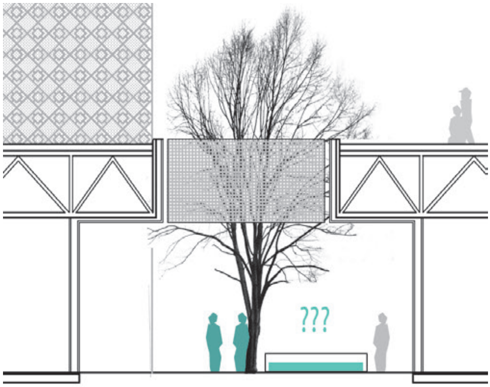
Natural green near the LIFEcenter increases the microclimate quality

- Green in patios benefits a high comfort by the effect of evaporation in and around the building parts of a complex.



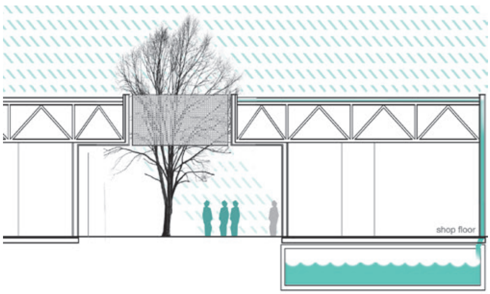
An adapted greenery in the patios supports their microclimate positively

•• Water basins can help to cool down the open air in patios and alleys, but have to be used rarely because of the lack of ground and rainwater in the region.



Water basins in patios can support the microclimate but also need a certain amount of water, which is difficult in the case of the LIFEcenter

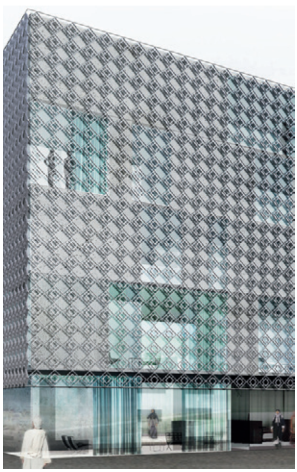
•• Extra rainwater storage in tanks or cisterns under the soil can be used for watering and others.



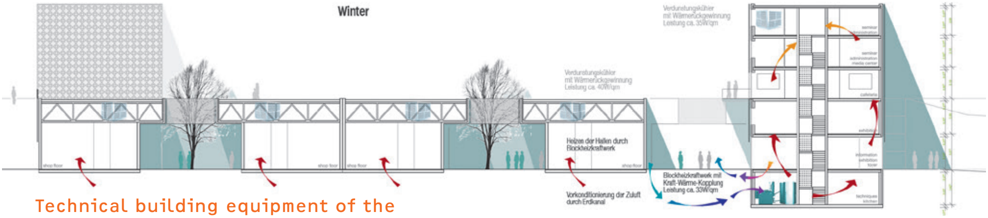
Cisterns can collect rain water for usage in the LIFEcenter building complex

•• Bright colors and finishing reflects the sunlight in summer, to avoid too large solar gains. If façades are shaded with parametrical optimized external devices, they can have darker colors to increase solar gains in winter.

The finishing of outer wall surfaces influences the absorption or reflection of sunlight

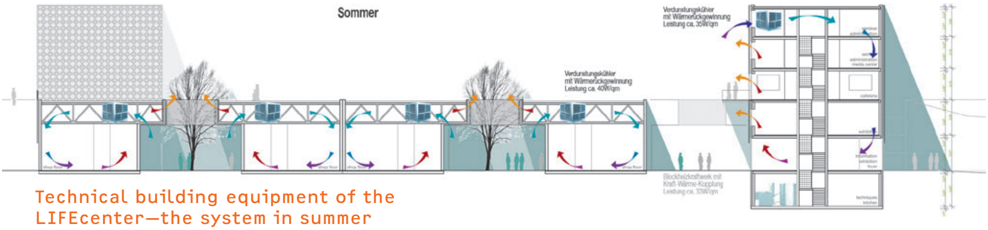


- The building techniques for air conditioning should work flexible adjustable to adapt their energy demands to the utilization needs.



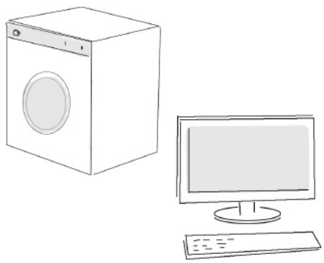
Technical building equipment of the LIFEcenter—the system in winter

- Adjustable air conditioning techniques can also react exactly on seasons and daily weather conditions.



Technical building equipment of the LIFEcenter—the system in summer

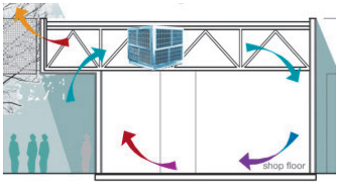
- Also energy saving household appliances etc. should be used.


The quality of other techniques for building operation and household appliances has to be considered

- Water saving sanitary installations help to save both water and energy. For instance low-flow shower heads and low-flow toilet flushes can be used.

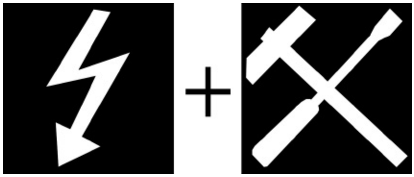

Exemplary water saving toilet flush and flow restrictor and backflow preventer for tubs and shower heads, easy to install

- The machines for adiabatic cooling systems and, especially in a region with arid climate also the place where fresh air comes into the system, should be possibly shaded to use pre-conditioned air for cooling in summer.



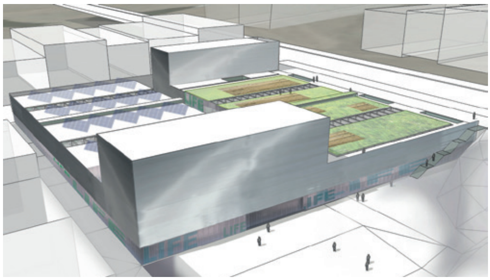
Shaded zones for fresh air supply

- A general regularly maintenance of technical equipment, installations and household appliances is important to ensure the efficiency to avoid losses of heat, water and energy.



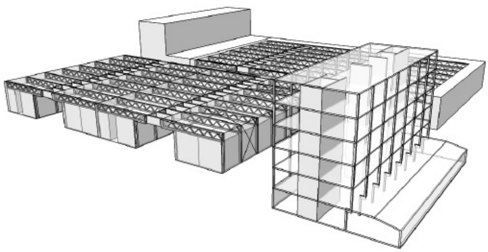
The regularly maintenance of technical equipment is basically

- The installation of photovoltaic modules or solar water heaters on roof tops where the sunlight reaches benefits in integrated concept. They should be arranged in the optimum angle of about 30° in south direction.



Activation of roof space, partly photovoltaic modules on roofs of the LIFEcenter

- Earthquake resistant building is reflected by a mostly compact, symmetrical building shape in combination with adequate construction details—e.g. considering horizontal loads—and adequate building materials or elements—e.g. light weight materials.



Earthquake resistant building construction

3.2 The Aims and Possibilities of Adaptation

The Iran is one particular interesting spot to talk about climate adapted sustainable and energy efficient planning. The climate in the reference region of the LIFEcenter project is a semi-arid climate. There are also regions in Iran with hotter climate. Here the design objectives differ sometimes. The conditions and requirements in the direct reference region mark intensely the maximum or minimum frame a building designer or architect can move in.

Some general objectives can be set in this guideline. They are based on the research pilot project of a hybrid educational building complex and in this way they are adaptable to similar building typologies in adequate climate regions.

As well the whole LIFEcenter design is adaptable because of its flexibility and modularity. For more information see the publication series of the Young Cities research project, respectively the series "competencies and facilities" of the team of the LIFEcenter planning and research, publishers U. Frank and A. Böhm, TU Berlin.

3.3 A Small Instruction Manual

For climatic adaptation use the different planning tools, including simulations and optimization by adaptation. Set priorities and aims, change parameters. Use different basic architectural passive elements. Optimize the architectural concept. Evaluate the planning by simulations, physical models etc. Analyze and adapt the concept. Optimize the results in a next step to get a closer approach to optimum architecture.

For economic adaptation analyze the local market, regarding jobs, income, transit infrastructure, cultural infrastructure and others such as shopping, health, administration etc. Analyze the local social intermix. Analyze and adapt the building concept, its typology, regarding functions, additional facilities, the level of design quality, the level of furnishing, materials, sizes, proportions.

For social adaptations analyze the social intermix, regarding incomes, social groups, cultural interests, awareness for residential properties, religion, social habit etc. Adapt the level of building quality, visibility, furnishing, and as well the factor of tradition or modernity of shapes, ornaments, materials etc.

4 Conclusions

Nowadays architects and building designers are concentrating on issues of sustainability, energy and resource efficiency. These design parameters have become a main factor of building quality in recent years.

The research project Young Cities deals with this perspective for creating up-to-date projects of urban design and architecture in the semi-arid regions of Iran. The aim is to develop a functioning and lively city on the outskirts of Tehran, which provides both residential space with the necessary infrastructure and public facilities for a fast increasing population.

Within this integrative project a group of architects designed different architectural pilot projects each with a different basic function: residential buildings, an office building and a building for vocational training, education and various supporting functions. The building for vocational training and information is a pilot project for demonstrating the sustainability and energy efficiency on the building level on the one hand and social and cultural designing on the other hand. The energy efficiency arrangements, which are applied in the project, are, however, diverse, and cover architectural as well as constructional aspects.

Intended as a direct and applicable handbook for the design, planning and operation of a building for vocational training and information in the building sector by reflecting the project as reference, this guidebook shows a way to create a high quality and sensitively adapted building with an effective, cost-neutral and economically efficient planning concept to focus on the energy efficiency, especially through architectural design, as well as on social and cultural aspects of building design. The optimized architectural concept can be developed on basis of this guideline for semi-arid regions by not increasing building costs. Therefore it contains:

- The issues of the necessity of energy efficient architecture and the objectives of modern and adapted design in combination with economical efficiency
- Relevant facts for building planning, especially "passive" aspects of sustainable architectural design
- Planning methods and approaches for evaluation
- A list of common and innovative building materials from sustainable aspects
- The planning documentation in an overview of the exemplary architectural pilot

This guidebook operates as an essential reference for climate adapted and sensitive architecture for architects and building designers and as a source of ideas for the creation of the integrative hybrid building complex of a LIFEcenter for vocational training of construction workers, seminars for academics and information and exhibitions for other building interested.

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