Accomplishments and Objectives

Young Cities Research Paper Series, Volume 02

Edited by Rudolf Schäfer, Farshad Nasrollahi,
Holger Ohlenburg, Florian Stellmacher

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Editors: Rudolf Schäfer, Farshad Nasrollahi, Holger Ohlenburg, Cornelia Saalmann, and Florian Stellmacher

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Abstract

This is the second volume of the Young Cities Research Paper series presenting the scientific results from the mutual Iranian-German research Project "Young Cities: Urban Energy Efficiency. Developing Energy-Efficient Urban Fabric in the Tehran-Karaj Region". The German partners of the project are funded by the German Federal Ministry of Education and Research (BMBF). From the Iranian side, the Building and Housing Research Center (BHRC) and the New Towns Development Corporation (NTDC) as the main project partners are both affiliated to the Ministry of Housing and Urban Development (MHUD).

The Young Cities Research Paper shall disseminate the scientific results gained from the Young Cities project and the related PhD, post doctoral and senior expert research. The first two volumes are published following the completion of the first of the Young Cities pilot projects, i.e. the New Quality pilot project buildings in Hashtgerd New Town. Hashtgerd New Town, 65 km to the west of Tehran and 30 km to the west of Karaj in the Alborz Province in Iran, forms the spatial focus of the Young Cities project. It is the place of intervention and for testing the solutions and concepts developed for energy-efficient and sustainable urban design and planning, infrastructure provision, and object planning by the Iranian and German project partners. The solutions and concepts shall, however, be applicable and transferable to other places in the Tehran-Karaj region as well as in Iran and in the Middle East North Africa region (MENA).

The New Quality buildings as the first of the pilot projects to be completed are residential buildings. It was planned jointly by the Iranian and German partners from a typical Iranian residential building scheme widely to be found in the region's new settlements and New Towns and adapted by small scale interventions for economical improvements regarding building quality, construction layout, and energy-efficiency. The pilot project has been erected by the Housing Investment Company (HIC), Tehran, under supervision of BHRC and TU Berlin including an on-site vocational training workshop for construction site staff aiming at improved building quality and use of the new materials and construction technologies introduced.

The erection of the New Quality pilot project, now, is completed. The pilot project, however, goes on by the seamless start of monitoring of the buildings performance during use regarding energy consumption, water

consumption and building quality. The results from the monitoring will be fed into the development of the other pilot projects, into the tested concepts and solutions to be presented and disseminated as the project's output and into the project evaluation assessing the effects from the project.

The present second volume is to introduce the overall Young Cities project with its accomplishments until 2010. It is divided into four main parts on the background of the project, its objectives and methodological approach, the results and accomplishments reached so far and an outlook on the future progress of the project. Thus the focus is laid on the presentation of results from (selected) pilot projects and additionally accomplishments of all single research disciplines. The accomplishments of the main part and the focus of the volume since the series is devoted primarily to the results from the project. However, as the first volume in English language, the Young Cities project is also introduced with respect to some background information and to its objectives and methodology forming the introduction into the series.

سری مقالات پژوهشی پروژه شهرهای‌جوان در نظر دارد، نتایج علمی این پروژه تحقیقاتی را ارائه نماید، درحالیکه محصولات مشاوره‌ای همچون دستورالعمل‌ها، نرم‌افزارها و ابزارهای مدیریتی نیز پس از بکارگیری در یک پروژه واقعی در شهر جدید هشتگرد و ارزیابی در یک دستورالعمل دائما درحال توسعه، گردآوری و منتشر خواهند شد. بنابراین پس از انتشار جلد نخست به زبان فارسی در سال ۲۰۱۰، دومین جلد از سری مقالات پژوهشی پروژه تحقیقاتی شهرهای‌جوان، به عنوان اولین جلد به زبان انگلیسی، کلیت پروژه را معرفی خواهد نمود و تمرکز این مجموعه تنها بصورت بخشی بر نتایج بوده، بلکه بیشتر طرح کلی و اهداف پروژه در آن ارائه شده و نگاهی اجمالی نیز بر پیشرفت و نتایج پروژه دارد.

دومین جلد از سری مقالات پژوهشی پروژه تحقیقاتی شهرهای‌جوان در نظر دارد کلیت این پروژه و نتایج و پیشرفت آنرا تا انتهای ماه آگوست سال ۲۰۱۰ ارائه نماید. این مجموعه دارای چهار فصل اصلی شامل پس زمینه‌های پروژه، اهداف و رویکرد روش شناختی پروژه، نتایج و پیشرفت پروژه تا زمان انتشار این مجموعه و نگاهی به روند توسعه آتی پروژه، می‌باشد. پیشرفت و نتایج پروژه بخش عمده و محل تمرکز این جلد را تشکیل می‌دهند، هرچند این مجموعه به عنوان جلد دوم، پروژه شهرهای‌جوان را با توجه به برخی اطلاعات پس زمینه‌ای و بویژه با اهداف و روش انجام آن معرفی کرده و مقدمه‌ای برای مجموعه کامل سری مقالات پژوهشی این پروژه را تشکیل می‌دهد.

خلاصه فارسی

مجموعه حاضر به عنوان دومین جلد از سری مقالات پژوهشی پروژه تحقیقاتی شهرهای‌جوان، نتایج علمی پروژه تحقیقاتی مشترک ایران و آلمان با عنوان «شهرهای‌جوان- بهینه سازی شهری مصرف انرژی: توسعه بافت شهری انرژی‌کارا در منطقه تهران- کرج» را ارائه می‌دهد. این پروژه در آلمان از سوی وزارت آموزش و تحقیقات دولت فدرال آلمان تامین مالی می‌گردد. در ایران، مرکز تحقیقات ساختمان و مسکن و شرکت عمران شهرهای جدید شرکای اصلی پروژه هستند که هر دو زیر مجموعه وزارت مسکن و شهرسازی می‌باشند.

هدف سری مقالات پژوهشی شهرهای‌جوان ارائـه نتایج و دستاوردهای علمی حاصل از این پروژه می‌باشد. مجموعه حاضر و نیز اولین جلد از سری مقالات پژوهشی پروژه شهرهای‌جوان، به مناسبت تکمیل اولین پروژه پایلوت یعنی ساختمان پروژه پایلوت «کیفیت نوین» در شهر جدید هشتگرد انتشار یافته‌اند. شهر جدید هشتگرد که در ۶۵ کیلومتری غرب تهران و ۳۰ کیلومتری غرب کرج و در استان سابق تهران و استان فعلی البرز قرار دارد، نقطه تمرکز فضایی پروژه شهرهای‌جوان است. این منطقه محل مداخله و بکارگیری و آزمودن راه‌حل‌ها و مفاهیمی است که توسط طرفین ایرانی و آلمانی پروژه برای برنامه‌ریزی و طراحی‌شهری پایدار و انرژی‌کارا، توسعه زیرساخت‌ها و طراحی ساختمان‌ها، ارائه و توسعه یافته‌اند. هرچند راه‌حل‌های بدست آمده بایستی تاحد امکان قابلیت انتقال و به‌کارگیری در دیگر نقاط منطقه تهران- کرج، ایران و نیز منطقه خاورمیانه و شمال آفریقا را دارا باشند.

پروژه شهرهای‌جوان به خانواده‌ای بین‌المللی مشتمل بر ده پروژه تحقیقاتی تعلق دارد که با حمایت مالی وزارت آموزش و تحقیقات دولت فدرال آلمان انجام می‌شوند و با مسأله توسعه شهری انرژی‌کارا در ابرشهرهای آینده سروکار دارند. دیگر پروژه‌های متعلق به این خانواده در کشورهای هند، چین، ویتنام، اتیوپی، مراکش، آفریقای جنوبی و پرو قرار دارند. ایده و

تعهد اصلی برنامه تحقیقاتی مزبور، ارایه نتایج تحقیقاتی مناسب و موثر برای کلان‌شهرهای درحال رشد است. این تحقیق بایستی نه بر روی کلان‌شهرهای درحال رشد، بلکه برای این کلان‌شهرها و به همراه شرکایی در این مناطق انجام گیرد. در رابطه با پروژه شهرهای‌جوان، این مسأله منجر به همکاری تنگاتنگ و سازنده‌ای میان دانشگاه فنی برلین و طرفین ایرانی به سرپرستی مرکز تحقیقات ساختمان و مسکن گردید.

Introduction

Rudolf Schäfer | Farshad Nasrollahi | Holger Ohlenburg | Florian Stellmacher

This is the second volume of the Young Cities Research Papers Series presenting the scientific results from the mutual Iranian-German research project "Young Cities: Developing Energy-Efficient Urban Fabric in the Tehran-Karaj Region".

The Young Cities Research Papers shall disseminate the scientific results gained from the Young Cities projects and related PhD, postdoctoral and senior expert research. The first two volumes are produced related to the completion of the first of the Young Cities pilot projects, i.e. the New Quality pilot project buildings in Hashtgerd New Tow. Hashtgerd New Town, 65 km to the west of Tehran and 30 km to the west of Karaj in the Alborz Province in Iran, forms the spatial focus of the Young Cities project. It is the place of intervention and for testing the solutions and concepts developed for energy-efficient and sustainable urban design and planning, infrastructure provision, and object planning by the Iranian and German project partners. The solutions and concepts shall, however, be applicable and transferable to other places in the Tehran-Karaj region as well as in Iran and in the Middle East North Africa region (MENA).

The New Quality building as the first of the pilot projects to be completed is a residential building. It was planned jointly by the Iranian and German partners from a typical Iranian residential building scheme widely to be found in the region's new settlements and New Towns and adapted by small scale interventions for economical improvements regarding building quality, construction layout, and energy-efficiency. The pilot project has been erected by the Housing Investment Company (HIC), Tehran, under supervision of BHRC and TU Berlin including an on-site vocational training workshop for construction site staff aiming at improved building quality and use of the new materials and construction technologies introduced.

The erection of the New Quality pilot project, now, is completed. The pilot project, however, goes on by the monitoring of the buildings performance during use regarding energy consumption, water consumption and building quality.

Construction and completion of the New Quality pilot project fell into a period of special political tensions related to Iran. The continuation of the project was strongly supported not only by the Iranian project Partners but also from the various Iranians known to the project in Germany and not the

least by the German embassy in Tehran representing the German Foreign Ministry due to the importance of the project's issue and of keeping the long established contacts and cooperation between Iran and Germany.

The present second volume is to introduce the overall Young Cities project with its accomplishments until 2010. It is divided into four main parts on the background of the project, its objectives and methodological approach, the results and accomplishments reached so far, and an outlook on the future progress of the project. The accomplishments form the main part and the focus of the volume. However, as the first English volume, the Young Cities project is also introduced with respect to some background information and primarily to its objectives and methodology forming the introduction into the series.

In the first chapter the main lines of the cooperation between the three main project partners BHRC, TU Berlin and NTDC and additional partners on the Iranian and German side are drawn. The second article depicts the current situation regarding energy-efficiency and energy consumption in building and construction related fields in Iran. The third article displays Hashtgerd New Town's importance to the project as the main place of investigation and intervention of the Young Cities project. The chapter is concluded by introducing the Future Megacities research program by the German Federal Ministry of Education and Research BMBF being the major framework and main funding organization of the project.

The second chapter introduces the project's objectives and approach. A first article presents the main aim of the project: Urban Energy Efficiency. The Young Cities project employs two major methodological approaches in following up its objectives, i.e. the action research concept and pilot projects. These research approaches are described in the second article. As the transfer and applicability of the project's results are of major importance from the outset, the third article provides an insight in the strategy adopted by the project for dissemination of results and solutions gained throughout the project. The forth article introduces the concept of evaluation of the project's effects and impacts and its development.

The third chapter on the project's accomplishments until 2010 is divided into one part on the selected pilot projects and another part on the accomplishments of the so called project dimensions, i.e. the various disciplines involved in the project usually represented by one partner on the German side. The project dimensions are only briefly introduced due to the wide variety covered by the overall Young Cities project.

The forth chapter covers a glance at some major aspects of the overall project's future development. Thus, a glimpse is given on some of the forthcoming milestones of relevance to the overall project. One idea is to arrange a planning and building exhibition in Hashtgerd New Town with the 35 ha Area pilot project as central demonstration ground.

Foreword

Dr. Tayebeh Parhizkar,
Building and Housing Research Center
Iranian Project Director

The great need for providing the housing necessary for the Iranian population in the recent years, especially in mega cities, has lead to the need to apply master plans in this regard. According to the statistics in the last few years, considering the young age average of Iran's population, 1.5 million housing units or even more are needed each year. These statistics along with the concentration of the population in mega cities require basic solutions to solve this issue. Among some of the possible considered determinations for providing the necessary housing for the community and decentralization from large cities is to develop New Towns and satellite towns around the cities. Development of New Towns around the mega cities has been followed in the country with the following three main goals:

- Implementation of the national framework design and proportional distribution of the population and employment throughout the country in relation to the strategic goals and limitation of the water, soil and energy resources.
- Development of residential areas for the workers of newly established economic activities.
- Helping the implementation of the housing development plans qualitatively and quantitatively and balancing the housing market.

Tehran is one of the most important mega cities, for which the development of New Towns has been centered around. In recent years, the western region of Tehran has had the highest rate of population growth and the city of Karaj is considered the center of growth in this region. Therefore, the development of the New Town of Hashtgerd in the Karaj-Qazvin region and next to the old town of Hashtgerd was considered as one of the largest New Towns projects for achieving the goals of housing development around Tehran and Karaj. Hashtgerd is located approximately 30 km from Karaj and 65 km from Tehran. The city stretches over an area of 4,600 ha of which 4,000 ha is located on the north side of the Tehran-Qazvin freeway and the rest is on the south of it. The urban growth of this town follows the topography of the Alborz mountain side region, in which it is located, that is from north to south. 25 neighboring units, each with 20,000 occupants, are to be separated by green areas and to have regional facilities such as shopping centers and a university.

New Towns provide valuable capabilities and facilities for designers. Appropriate use of such opportunities can lead to forming proper patterns for the urban development in the country from different dimensions. Meanwhile, due to uniform planning and lack of procedure, growth and low participation of the public in urban development, these Towns often face problems of presenting urban identity and the feeling of belonging and meaningful qualities for the occupants. Also, other problems such as management can lead to the inhomogeneous development of New Towns.

The German-Iranian Research project "Young Cities: Developing Energy-Efficient Urban Fabric in the Tehran-Karaj Region" has been developed to face these problems, setting a focus on the development of procedures, methods, models and designs for energy efficient and sustainable urban fabric in line with traditional Islamic principles in order to provide a sustainable environment for the future inhabitants and to be able to implement it throughout Iran and even within other countries of the Middle East North Africa (MENA) region .

This volume of the Young Cities Research Paper series presents a broad overview about the overall German-Iranian Young Cities project with its goals and results reached so far as well as expected ones.

Foreword

Prof. Dr. Rudolf Schäfer, TU Berlin
German Project Director

This second volume of the Young Cities Research Paper series presents an overview of the research work of the mutual Iranian-German project "Young Cities: Urban Energy Efficiency. Developing Energy-Efficient Urban Fabric in the Tehran-Karaj Region".

In the future, the Young Cities Research Paper will present detailed results to specific topics addressed by the Young Cities project. By this, the Research Paper series of the Young Cities project will contribute to the world wide discussion of designing and creating habitat structures that are facing the challenges of climate change by means of mitigation and adaption.

The Young Cities project is funded for the German side by the German Federal Ministry of Education and Research (BMBF). On the German side, the project is conducted by the Technische Universität Berlin together with a number of German research institutions and other partners. From the Iranian side, the Building and Housing Research Center (BHRC) and the New Towns Development Corporation (NTDC) as the main project partners are both affiliated to the Ministry of Housing and Urban Development (MHUD).

The Young Cities project belongs to a worldwide program of nine research projects that are funded by the German BMBF and is dedicated to the question of energy efficiency. The other projects of this program are located e.g. in India, China, Vietnam, Tanzania, Morocco, or Peru.

The basic idea and commitment of this German research program is to generate research results useful for growing megacity regions. This research has to be done not *on* but *for* the growing megacity regions concerned and together with partners in these regions. In the case of the Young Cities project, this led to an intensive and constructive cooperation between TU Berlin and the Iranian partners lead by BHRC. We have to thank our Iranian partners for this stimulating cooperation.

Although, in the last two years, the focus of the program had to be concentrated on questions of energy efficiency and climate change, the comprehensive design and approach of the Young Cities project could be maintained. This project design is characterized by interdisciplinarity, a multi-level approach and a focus on pilot projects and action research. This orientation on application gives the Young Cities project a very specific profile.

On this background, it is of particular importance that three of the pilot projects are already realized today:

- The New Quality pilot project building has been constructed;
- The innovative obligatory building plan (Tarh-e Tafsili) for an area of 35 ha in the New Town of Hashtgerd has been finished;
- First courses in the field of vocational training have taken place in the context of the New Quality pilot project.

We are sure that this fruitful cooperation between Iranian and German research institutions will continue and form the basis of the next steps of our mutual project. And we would appreciate if the practical results of this cooperation could be presented in a planning and building exhibition in Hashtgerd New Town.

Chapter I
The Background

This chapter will provide basic information about the context of the Young Cities project. Firstly a brief overview about the history of the German-Iranian Cooperation is presented, secondly Hashtgerd New Town as main Project area is introduced, followed by an introduction of the topic of energy efficiency in Iranian construction and urban development. The fourth chapter will give information about the German Megacities Research Program as funding program of the German side.

Cooperation between TU Berlin, BHRC and NTDC

Rudolf Schäfer | Florian Stellmacher, TU Berlin

The mutual Iranian-German research project Young Cities has been established resulting from a number of bilateral workshops held in Iran and in Germany by the project partners of the Iranian Building and Housing Research Center, Technische Universiät Berlin, and the Iranian New Towns Development Corporation. The first workshops arranged by TU Berlin and BHRC took place in 2003 and 2004 on different issues of building and housing focusing on the "Sustainable Restructuring of the Building and Housing Sector in Iran". These workshops and the cooperation were mainly facilitated by then BHRC Research Vice-President Dr. T. Parhizkar and by then TU Berlin Dean of now School VI Planning Building Environment Prof. Dr. R. Schäfer. Both have contributed massively since to the sustained and tightened cooperation between both institutions. BHRC and TU Berlin, in 2004, concluded a five-year Memorandum of Understanding on the cooperation between both scientific institutions signed by BHRC President Prof. Dr. G. Heidarinejad and TU Berlin President Prof. Dr. K. Kutzler.

This has been part of the strategy of TU Berlin and especially its School VI Planning Building Environment to set one regional focus in international cooperation and scientific expertise in the Middle East North Africa (MENA) region due to the tremendous challenges following massive population growth, urbanization, desertification, climate change etc. Scientific cooperation with Iran is embedded in a wider regional focus and, thus, intended to result in exemplary solutions transferable or applicable in other countries of the MENA region.

During the bilateral workshops, the development of New Towns as part of the national Iranian New Town program throughout Iran has become one of the core issues suffering considerably from partly slow development both, regarding investment and inhabitants despite fast development growth in and around the major conurbations in Iran. The New Towns, however, were mainly designed to ease population and development pressure for the major cities and urban centers, especially the Tehran-Karaj region, the Isfahan region, or the Mashad region.

Consequently, from 2004, one of the New Towns in the Tehran-Karaj region, namely Hashtgerd New Town, 65 km west of Tehran and 30 km west of Karaj in the fastest developing western growth corridor of the region, became the focus of the Iranian-German cooperation. Hashtgerd New Town,

designated to become the most populous of the Iranian New Towns with 500,000 inhabitants, was jointly selected due to its intended size and importance as well as its exemplary challenges in planning and managing the construction and community building of a completely new urban center (see chapter on Hashtgerd New Town). Hence, the NTDC was involved as the third main partner in the Iranian-German cooperation.

The partners jointly designed the development of three projects that have later become the New Quality, New Technology, and 35 ha Area pilot projects. The design was brought in into the joint application for a project in the research program "Research for Sustainable Development of the Megacities of Tomorrow" of the German Federal Ministry of Education and Research (BMBF) in late 2004. By mid-2005, the application bid was approved by the German Ministry funding the project "Young Cities: New Towns in Iran. New Towns as a Concept for the Sustainable Development of Mega City Regions" in a preparatory project phase from 2005 until 2007. Funding was mainly limited to travelling and fact finding costs. The Young Cities project partners, however, decided to start with the intended three pilot projects, New Quality, New Technology, and 35 ha Area, from the very beginning. TU Berlin involved a number of German partners in the Young Cities project, except for the more than twelve chairs from TU Berlin a number of non-university research institutions as well as the Construction Industry Association of Berlin-Brandenburg and its vocational training institute and private companies.

All partners along with a large number of outstanding international experts participated in the "International New Towns Conference" in Tehran in May 2005. The conference was held by NTDC following similar intentions as with regard to its entering in the cooperation with TU Berlin and BHRC. The then Managing Director and Chairman of the Board of Directors of the NTDC, Eng. M. Mirian, contributed intensively to the mentioned conference as well as to the Young Cities project, not the least by approving the three pilot projects to be partly financed by NTDC and by designating a plot of 35 ha in Hashtgerd New Town for development according to the plans elaborated under the auspices of sustainable urban development by the scientific Young Cities project partners. The project partners also participated in the International Symposium organized by TU Berlin on "New Towns as a concept for the sustainable development of Megacity regions?" held in Berlin in September 2006.

During the elaboration of the three pilot projects, it became obvious that a stronger focus was needed with regard to the energetic performance and, hence, the carbon emissions of the buildings erected in the New Towns in Iran. Additional expertise has been integrated in the Young Cities project in this respect to perform energy checks and develop energy-efficient concepts on the urban and on the building level adapted to local and national conditions in the Tehran-Karaj region. Therefore, in 2007, the project

partners jointly decided to submit an application also for the main phase of the BMBF research program "Research for Sustainable Development of the Megacities of Tomorrow". The focus for the main phase of the research program was changed from a general sustainability approach towards "Energy- and climate-efficient structures in urban growth centers" (www.future-megacities.org).

Accordingly, the focus of the project was shifted to "Young Cities: Urban Energy Efficiency. Developing Energy-Efficient Urban Fabric in the Tehran-Karaj Region". The newly developed urban structures in the New Town of Hashtgerd have become an exemplary object of investigation for the development of energy efficient and sustainable urban settlements under the conditions of the region. Following this shift in focus, also the project consortium was amended by energy related partners and associated partners on the German side, e.g. the "Innovation Centre Energy" at TU Berlin. The Ministry of Housing and Urban Development, to which both, BHRC and NTDC, are affiliated, became the third main partner on the Iranian side. The bid to BMBF was approved and the Young Cities project is funded for the German side by BMBF from mid-2008 until mid-2013.

On the German side, the set of partners and associated partners, now, also includes other Berlin universities or the Königin-Luise-Foundation, a school in Berlin with strong ties to Iranian schools, or the Association of Iranian Natural Scientists and Engineers in Germany (VINI). On the Iranian side, associated project partners include Tehran based universities or the planning consultancy in charge of the Hashtgerd New Town master plan. BHRC, however, forms the main partner for TU Berlin activities in Iran. Therefore, the Memorandum of Understanding between TU Berlin and BHRC was renewed for another five years by TU Berlin President Prof. Dr. K. Kutzler and BHRC President Prof. Dr. S.M. Fatemi Aghda in 2009.

Exchange on doctoral and post-doctoral research has already been established widely between the Iranian and German partners. This is also supported by BMBF and the German Academic Exchange Service (DAAD) and other institutions funding more than fifteen researchers from Iran conducting research under the supervision of German project partners. Except for that, a number of researchers and practitioners prepare PhD theses contributing considerably to the Young Cities project supervised by TU Berlin project partners.

Hashtgerd New Town

Holger Ohlenburg | Sebastian Seelig | Florian Stellmacher,
TU Berlin

Iran is characterized by a huge need for residential buildings due to the population growth rate as well as massive rural-urban migration. The Iranian population has doubled during the last 30 years to 74 million inhabitants in 2010. According to the Iranian government policy, there is a need of about 1.5 million new housing units per year for at least ten years. In addition to the demographic factor, the prevalent short life-span of the residential buildings contributes to this number. The changes in family planning let the size of existing flats become unsuitable. As older flats have 150 to 300 m², the need is now for 80 to 120 m² and such resizing is questionable due to the construction of the existing stock.

An area of symbolic evidence regarding these tremendous challenges is the western growth corridor from the city of Tehran beyond the city of Karaj. In the last decades, the city of Karaj has experienced the highest pop-

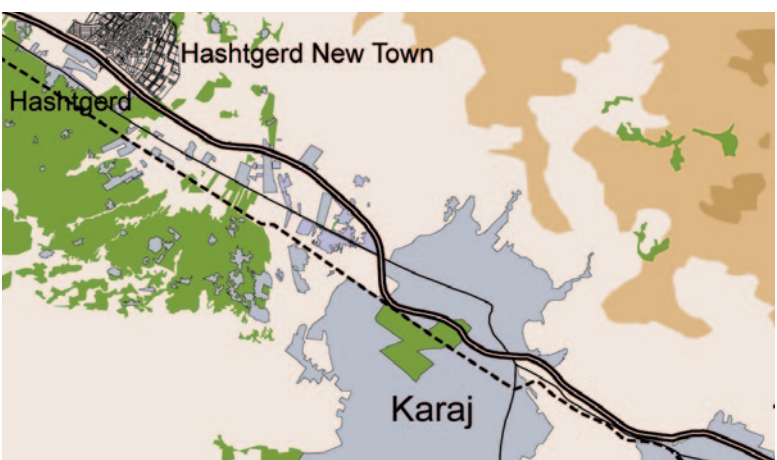

Fig. 1: The western growth corridor (TU Berlin)

ulation growth rate of all cities in Iran (from 10,000 inhabitants in 1950 to 1.23 million in 2005). Situated about 35 km off the capital, Karaj forms part of a coalescing growth axis reaching from Tehran to Qazvin, the country's most densely populated and fastest growing urban area. The Tehran-Karaj Megacity region is approximately covering the Provinces of Tehran and Alborz (Karaj). In 2006, their combined population counted 12.3 Mio. inhabitants, of which about 7.3 Mio. lived in the city of Tehran.

Facing the enormous urban growth in the country, in 1985, the Iranian government decided to introduce a nation-wide New Towns program. It encompasses about 25 New Towns throughout the country mainly close to the major urban centers like Mashhad, Isfahan, Shiraz etc. and is assigned to contribute considerably to the production of the residential units needed. The focal point of this program forms the Tehran-Karaj region, particularly the western growth corridor. The central actor in managing the program is the government owned New Towns Development Corporation (NTDC) established in 1989. NTDC identifies sites, finances site preparation and construction of infrastructure and supplies the land to private developers. Each New Town is managed by a local NTDC branch.

By 2007, 22 New Towns have been under construction aimed at an overall target population of over 4.65 Mio. inhabitants ranging from 12,000 to 500,000 inhabitants respectively. The New Town of Hashtgerd is intended as the largest Iranian New Town with a target population of about 500,000 inhabitants, though, only approximately 45,000 inhabitants by 2006.

Hashtgerd New Town as well as the old City of Hashtgerd are situated app. 30 km west of Karaj and 65 km west of Tehran. The region is located at the southern slopes of the Alborz mountains (ranging from 900 to 1700 m above sea level). The region is exposed to a constant threat of seismic hazards due to its location between the central Alborz and the Iranian plateau. The rupture between the Alborz and the Iranian plateau, which is one of the largest of its kind in the world, is characterized by a series of faults. These

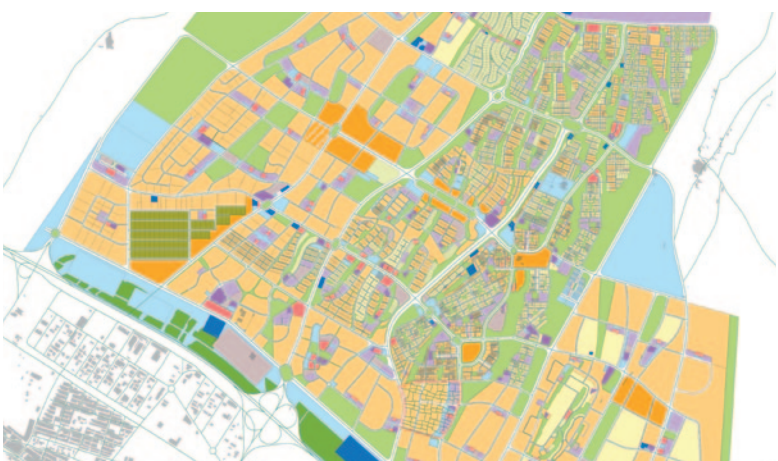

Fig. 2: New Town's master plan (NTDC; graphics TU Berlin)

are constantly active and create slight tremors.

The region is characterized by a semi-arid climate. It receives low annual precipitation (250–500 mm). A high share of precipitation falls as snow during the winter months, which provides a reliable source of water supply for the region's residents. This will be changing when the effects of climate change will increasingly be felt in the region. Regional climate forecasts predict unchanged or slightly increased precipitation during winter,

but even an increasing runoff during winter and a shortening of the snow melt during spring caused by rising mean and maximum temperatures. Especially problematical in this respect will be a further decrease of summer precipitation by 20 to 30 % as is predicted (IPCC 2008, 884).

The air in the wider Tehran region is heavily affected by pollution and the soil is characterized by a reduction in the content of organic matter, an increased salinity and alkalinity, changes in the region's land use and increasing volumes of industrial pollutants.

Hashtgerd New Town's urban area is planned to cover some 4,600 ha, of which 4,000 ha are dedicated to the New Town located north of the Tehran-Qazvin highway, and 600 ha to the industrial zone south of it. Hashtgerd New Town is organized within a north-south grid pattern following the topography at the foot of the Alborz mountains. 25 neighborhood units for 20,000 residents each separated by green spaces shall be developed, amending residential units by public and service facilities and supplemented with large-scale facilities like shopping centers or a university.

Fig. 3: Overlooking Hashtgerd New Town (TU Berlin)

The urban design is clearly influenced by western New Town concepts, aiming to create a multi-nucleus town. The neighborhood units should offer small-scale public and service facilities. The industrial area provides space for light industries such as machine manufacturing, instrumentation production and large-scale facilities such as a film studio and a hydroponic farming complex. Hashtgerd New Town's urban form is dominated by free standing 3- to 5-storey buildings and vast open spaces (see Fig. 3). With

an average density of 150 inhabitants per hectare, urban density is compact compared to the average density of contemporary Iranian towns.

It seems unlikely, that Hashtgerd New Town will reach its targeted population of 500,000 inhabitants by 2016. The development speed is lower than expected and caused by complex reasons. Firstly, the prices of housing units are high due to high costs of site development in such a semi-arid region, the long-term development process of New Towns and the high inflation rate. Furthermore, there is a lack of local services. Large scale infrastructures, such as the university, which could act as urban catalysts, are not being built yet, and it is unclear when construction will start. The integration of Hashtgerd New Town into the regional public transport system is lacking, the metro link to Tehran is still under construction. Moreover, the monotonous urban design based on widespread building types, creates no distinctive identity of the place. Like in most New Towns, it was not possible to create sufficient employment opportunities, yet. This is of specific impact since New Towns are often specifically laid-out as self-sufficient towns and, therefore, located remote to the metropolises. Thus, their success highly depends on creating an economic base and on integration into regional transport networks. The necessary cooperation of responsible ministries and agencies concerning the Towns' location, the allocation of industries and the integration into transport networks has not been sufficient, yet. Considering the overall aim of decongesting the urban agglomerations by absorbing population and creating economic growth poles, the New Town policy widely failed so far. Observing Iran's rapid urbanization figures and comparing them to the development stage of the New Towns, the high expectations could not be met, at this stage (Atash 2000; Ghalehnoee & Diba 2005).

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Energy Efficiency in Construction & Urban Development in Iran

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Iran's energy consumption, while already comparably high, is increasing at a rate of 7 % per annum (Based on data from: Iran Ministry of Energy 2006). Because of the country's oil resources, fossil fuels are used with little regard to their long-term availability. 97 % of Iran's primary energy consumption is covered by oil and natural gas, while only about 3 % is covered by to other energy sources such as hydro power, coal, etc. (see fig. 1).

Approximately 99 % of the energy consumption of buildings in Iran is supplied from oil products and natural gas (Nasrollahi 2009). Alternative energy resources such as renewable energies are only marginally used in Iran, in fact just experimentally in different fields. The administration is,

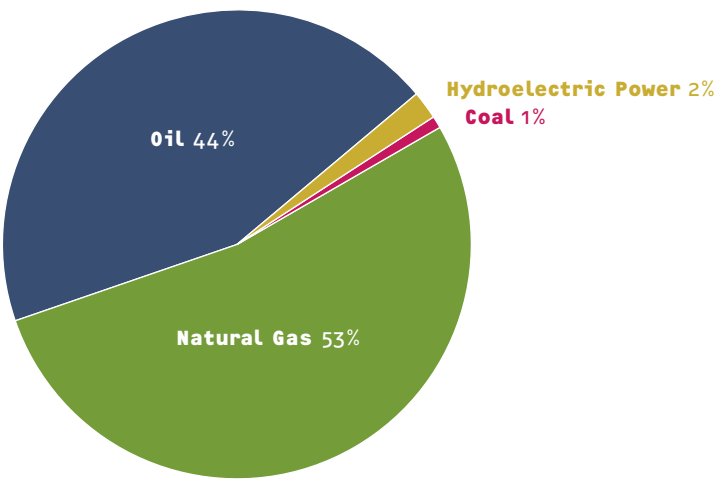

Fig. 1: Total energy consumption by type of fuel (Energy Information Administration 2008)

however, promoting the use of such renewable energies as wind and especially solar energy as well as that of nuclear energy.

On the other hand, Iran's large urban centers, particularly Tehran, suffer from high levels of air pollution widely caused by fossil energy use, far exceeding the standards set by the World Health Organization (WHO) and posing serious health problems (Sarbib 2001). Therefore the preservation of energy and reduction of energy consumption are very important for Iran.

Energy Consumption in the Building Sector

The building related sector is the biggest energy consumer in Iran. Despite recent fluctuations, the percentage of energy consumption of the residential and commercial sector has increased from about 30 % in 1990–91 to about 40 % in the year 2004–05.

A reduction of energy consumption of buildings is, therefore, crucial for Iran and the introduction and construction of energy efficient buildings, especially in a spread scale, would have a significant impact on the country's overall energy consumption and thus also on the carbon dioxide emissions.

The following graph (fig. 2) shows the final residential and commercial energy consumption by fuel type. It shows a yearly increase in the total energy consumption for the residential and commercial sector as well as a significant increase in natural gas consumption (which coincides with a recent reduction in the consumption of petroleum products). The ratio of electricity consumption has also increased slightly and the ratio of non-commercial fuels has steadily decreased in recent years.

The subsequent graph (fig. 3) shows shows the percentage of energy consumption for the various fuel types in the residential and commercial sector for 2004–05. The majority of residential and commercial energy consumption (about 62 %) was supplied by natural gas. Although petroleum

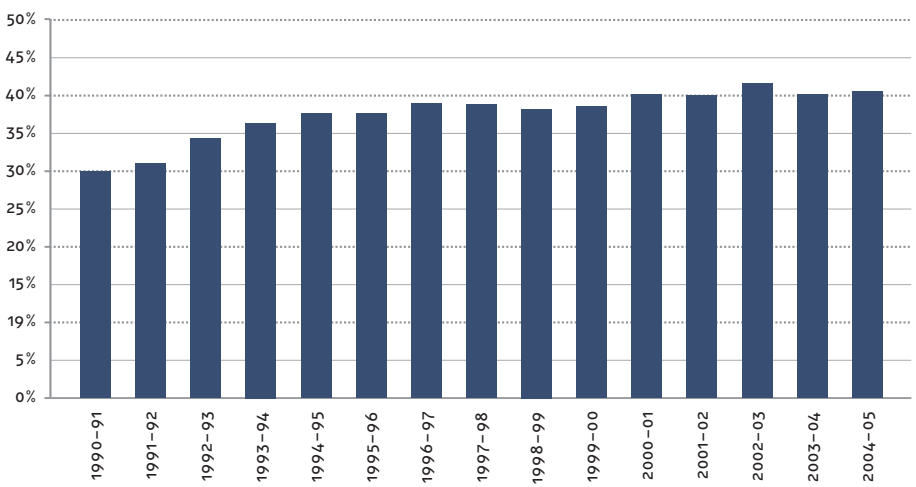

Fig. 2: Percentage of energy consumption of Residential & Commercial sector (Based on data from Iran Ministry of Energy 2006)

products were the most commonly used fuel type before 1980, they only accounted for approximately 26 % of the energy consumption in 2004–05.

Not only the share of buildings of the overall energy consumption is very high, but also the buildings' energy consumption in Iran is very high at 582 kWh/m² a for cold regions and an average of 310k Wh/m²a (Iranian fuel conservation company 2005). The main reason for that is the low, i.e. highly subsidized, energy price in Iran.

Iran has paid large amounts of subsidies on oil production, especially for energy used in building heating and cooling. In 2002, approximately 13 billion US$ were apportioned for energy subsidies (Massarrat 2004). However, the abolition of energy subsidies has been approved by the national parliament in 2009. Up to the year 2010, the energy prices in Iran were very low in comparison with international standards. Mainly for this reason, up to now, only little attention was paid to energy saving, especially when increasing the building costs, because the amortization time was very long and the population widely preferred to build and buy cheap, high energy buildings, instead of costly, energy efficient buildings. The energy consumption of buildings in Iran is, therefore, very high in comparison to other countries, in particular to Western European countries. But reduction of energy subsidies in the last year and high increase of energy costs will make energy saving economically viable and will increase the interest on saving energy in buildings.

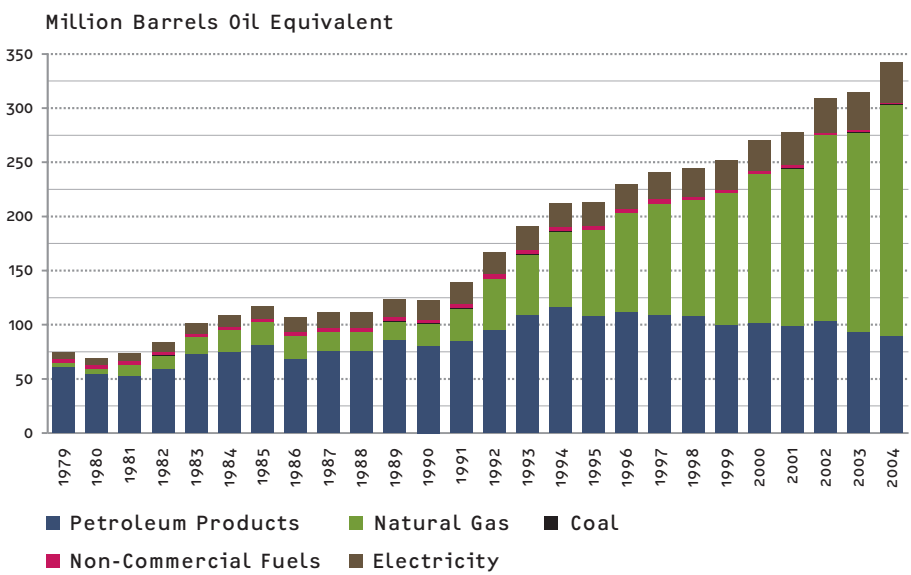

Fig. 3: Final consumption of residential & commercial sector by type of fuel (Based on data from Iran Ministry of Energy 2006)

Related Research and Knowledge in Iran

Recognizing the importance of reducing worldwide primary energy consumption, in 1995, Iran founded various governmental organizations to research energy conservation and renewable energies, the most notable of which being the “Iranian Fuel Conservation Company” (IFCO), the “Iran Energy Efficiency Organization” (IEEO), and the “Renewable Energy Organization of Iran” (SUNA).

Recently, higher priority has been given to saving energy, though mainly with a focus on industry rather than on energy conservation in buildings. For saving energy in buildings, often only heating and cooling systems and household appliances are studied, as well as the construction elements in buildings. For construction elements, one concentrates mainly on windows, insulation materials and air change, all of which is supported by IFCO and BHRC. There is extensive research about climate, natural cooling, heating and cooling systems, and building elements. What is yet seeking is a focus on studies and analyses surveying all of these factors in relation to each other. Such studies and researches can lead to practical and usable results or energy-efficient buildings or even settlement systems.

These days, almost none of the traditional Iranian climatic rules and architectural heating and cooling techniques are used in new buildings. Not only the buildings are designed with little concern for climatic conditions, but the urban characteristics, and orientation, width, and height of streets etc. are neither designed according to climatic conditions.

There are no rules or standards for the amount of energy consumption (per m²) of a building in Iran and there are only few for the degree of thermal resistance and thermal transmittance of components comprising the thermal envelope (Code 19—National Building Regulation). However,

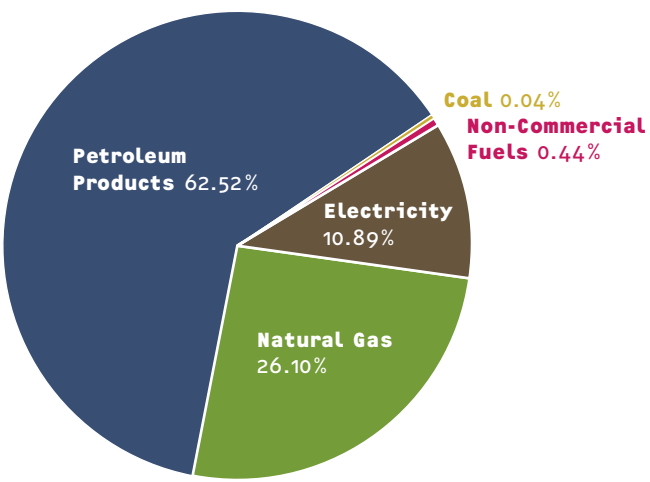

Fig. 4: Consumption of residential and commericial sector by type of fuel (2004–05) (Based on data from: Iran Ministry of Energy 2006)

they are ineffectively used, especially in privately built buildings. One of the main reasons for this are the low energy prices. Today, although some architectural rules vary between the climates within Iran, the main rules apply throughout the entire country. Therefore, the buildings of different climates are almost the same with little attention to climatic conditions. Due to the mentioned activities, energy consumption of the building sector in Iran has not been reduced during recent years.

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German Megacities Research Program

Rudolf Schäfer | Florian Stellmacher, TU Berlin

In 2004, the German Federal Ministry of Education and Research (BMBF) announced the research program "Research for Sustainable Development of the Megacities of Tomorrow" as part of the Framework Program "Research for Sustainability" (www.fona.de) of the Ministry. This was driven by the fact that the global trend to urbanization and to the further expansion of megacities is unbroken especially in emerging markets and newly industrializing countries. In particular, future megacities, i.e. urban centers growing at fast degrees to the population size of megacities (10,000,000 inhabitants plus) within the next years and decades, face fundamental decisions on the direction to take. They may still have a choice between different pathways of development. Decisions of planning and investment of today will determine the energy efficiency, the economic productivity, the social quality of live and the ecological capacity of the expanding megacities for many years.

A large number of applications for bilateral German-international research projects was handed in to BMBF for the so called preparatory project phase of two years and a main phase of up to another nine years. BMBF on advice of an international expert panel granted funding in the preparatory phase from 2005 to 2007 for 16 projects on future megacities in Latin America (3), Africa (4) and Asia (9). These projects focused on the sustainable development of certain areas of need in urban development such as water supply, waste disposal and treatment or urban agriculture. BMBF provided also for cooperation with the German Gesellschaft für Technische Zusammenarbeit (GTZ) building on the experiences of GTZ in developing projects in the respective countries.

The Program's Focus in the Main Phase

For the main phase of the Future Megacities research program, the program contributes to BMBF's "High-Tech Strategy for Climate Protection". The focus was, hence, shifted towards "energy- and climate efficient structures in urban growth centers". Efficient energy supply and economical energy consumption are set to become central questions of the 21st century. Mankind's energy consumption rises continuously and presents enormous challenges for climate protection and energy supply. Urban agglomerations and megacities in developing and newly industrializing countries are important arenas for energy consumption. Although cities cover only 2 % of the earth's land

surface, they are responsible for three quarter of global energy consumption as well as approximately 85 % of the global greenhouse gas emissions.

Against this background, megacities and future megacities offer strategic approaches for efficient energy use and climate protection. On the one hand, the agglomeration of people, material flows and residential districts in megacities allows to reduce the consumption of resources and energy, because more people can be supplied using the same amount of transport, energy and space by the use of modern planning and service concepts. Material cycles can be partly closed. On the other hand, the complexity of infrastructures and urban industries enables an accelerated dissemination of innovations.

The elaboration and implementation of solution-oriented, innovative and integrated planning and management concepts for sustainable urban development forms the focus of the projects funded in the program. The emphasis of the research lies on "prevention and therapy" instead of just "diagnosis". The concepts should as far as possible be transferable to other urban centers being commendable (good practice) and transferable (best practice). Therefore, the bilateral project teams shall:

- Research, plan, develop and realize technical and non-technical innovations for the establishment of energy- and climate-efficient structures in an exemplary way;
- Enable the city in focus of the respective project, along with its decision makers and inhabitants, to bring about increased performance and efficiency gains in energy production, distribution and use;
- Demonstrate that the resource consumption and greenhouse gas emissions by the energy using sectors can be reduced in a sustainable way in the future.

The concepts are to be developed in close cooperation with decision makers and stakeholders in the particular urban growth centers and elaborated in the context of joint projects based on partnership and the division of work. Capacity building and international networking figure prominently in this program. Scientists and companies are required to develop their projects in a user-oriented and participative manner, i.e. in close cooperation with local institutions responsible for urban development in the respective countries. From the outset, stakeholders from politics, economy and society have been included to ensure that the research questions are suited to pressing, local needs. Relevant groups of interest from politics, economics and society are to be involved to adjust the questions treated to real needs.

Outcome of the projects will be strategies and pilot projects that show new ways for the introduction of energy- and climate-efficient structures in urban growth centers through:

- Technical innovations in urban infrastructure adapted to local conditions and accepted by the citizens,

- New ways in political decision processes, new forms of political decision-making and governance,
- New management instruments in urban decision-making,
- Tools to evaluate the effectiveness of urban planning measures,
- Capacity building and vocational training,
- New partnerships combating climate change.

The Projects in the Program's Main Phase

Ten projects are funded by BMBF in the program's main phase from 2008 till 2013 subject to a mid-term evaluation in late 2010. The main phase has, thus, been reduced from an intended nine to five years. The projects strike a geographic as well as thematic balance. They deal with urban agglomerations in China, Ethiopia, India, Iran, Morocco, Peru, South Africa and Vietnam (see fig. 1). The projects are dedicated towards specific energy- and climate-efficient structures in areas like housing and construction, nutrition and urban agriculture, public health and quality of life, urban planning and governance, direct energy supply and consumption, mobility and transport, water supply, waste treatment and environmental management (www.future-megacties.org).

Fig. 1: The urban centers addressed by the BMBF Future Megacities projects in the main phase (2008–13) (BMBF/DLR)

Cooperation between the Megacities Projects

On top of the results elaborated by the single projects, BMBF aims at developing joint results from the overall program by assembling results and, in particular, by networking between thematically neighboring projects. The first is e.g. to be approached by a common database to be developed jointly by the sixteen Future Megacities projects. Networking has e.g. been established between the projects addressing urban planning and design or be-

tween those dealing with transport and mobility issues. Close cooperation is accomplished with two other major megacities research programs of the German Research Foundation (DFG), Priority Program 1233 "Megacities-Megachallenge: Informal Dynamics of Global Change", and the Helmholtz Association of German Research Centers, Helmholtz Research Initiative "Risk Habitat Megacity". The three programs form a joint German megacities research initiative.

Study- and Research Scholarships of Today for Megacities of Tomorrow

According to the thematic focus of the BMBF Future Megacities research projects, especially qualified students, PhD students, post-docs and senior scientists from the partner countries (Vietnam, India, China, Iran, Peru, South Africa, Ethiopia, and Morocco) are supported by BMBF. By fall 2010, these are 59 scholarships, administered by the German Academic Exchange Service (DAAD). Main aim of the accompanying measure is to give the Megacities projects the possibility to gain additional foreign research capacities by granting study and research scholarships. In parallel, this should contribute to the development of new scientific expertise and the creation of sustainable megacity networks (capacity building). A second wave of scholarships will start in 2011 has been initiated by DAAD within the same program.

This article is partly based on the background information about the BMBF Megacities Research Program by the BMBF and the DLR available at www.future-megacities.org.

Chapter II
Objectives and Approach

Based on the background on energy efficiency in the construction and urban development sector in Iran as well as the housing policies and the related New Town program in the country, this chapter is to introduce the objectives and the approach of the research Project "Young Cities: Developing Energy Efficient Urban Fabric in the Tehran-Karaj Region". Starting from the Project's main objectives, the methodological approach on Urban Energy Efficiency is outlined in detail as well as the resulting Project's organization. The action research context of special importance to the Project with its strong application orientation already from the very beginning is described subsequently. The chapter is concluded by the transfer of the Project's results and products by dissemination activities as well as to the approaches to the evaluation of the Project's impacts.

Urban Energy Efficiency

Sebastian Seelig | Farshad Nasrollahi | Florian Stellmacher, TU Berlin | Christoph Nytsch-Geusen, Berlin University of the Arts

Link between Urban Structures, Climate Change and Energy Efficiency

A considerable amount of research in the field of architecture, urban planning, transport planning, and energy studies in recent decades has empirically proven the link between individual energy-using devices such as buildings and vehicles and energy consumption and greenhouse gas (GHG) emissions (e.g. Brown & Southworth 2008, or Grazi & Berg 2008). A much less researched field has been the influence of complex urban structures on the level of neighborhoods or entire towns on energy consumption and GHG emissions. Despite the fact that there is considerable research on the general effects of urban structures on the environment (for a comprehensive overview see e.g. Alberti 1999), the (quantitative) contribution of urban structures to the total GHG emissions remains heavily debated. A number, which has been frequently stated, is that cities contribute up to 80 % of all CO_2 emissions while housing only 50 % of the world's population; recently, this number—mainly related to the question of allocation of emissions—has been doubted by a number of scholars (e.g. Satterthwaite 2009). Apart from the quantitative contribution, there is no doubt that urban agglomerations contribute to GHG emissions, however, cities also offer large possibilities to mitigate GHG emissions by reducing individual energy consumption.

Firstly (physical/object dimension), this can be related to institutional factors: Cities are places of intellectual and financial concentration, which suggests an increased disposition for political action. In addition, the city level is an effective scale for political intervention, often with fewer barriers than on the national and international level. Beyond that, local governments are able to effectively steer policy fields that are highly relevant for adaption and mitigation strategies, such as energy management and supply, transport planning, urban planning and design, and even architecture (Bulkeley & Betsill 2005:2f). These disciplines can have remarkable influence on climate change mitigation and adaption since they determine spatial/physical structures, thereby directly (or indirectly) influencing energy consumption and, thus, GHG emissions: urban planning and design, landscape planning, and architecture can define urban morphology, including building configuration, typologies or street systems, and, thus, directly affect energy-consumption through influencing heating and cooling demands.

Secondly (structural dimension), urban planning and transport plan-

ning take structural decisions on densities, land use patterns and infrastructure systems, and, thus, influence the distribution of goods and users. This indirectly affects the energy consumption required for transportation since spatial structures heavily influence behavior and consumption patterns of individual energy consumers. Energy supply and distribution networks also largely influence the exhaust of GHG emissions through the energy supply infrastructure and the respective distribution networks.

Thirdly (procedural dimension), urban planning/urban management supports the procedure of plan-making and implementation. This is of particular importance since plan-making and implementation increasingly becomes complex when addressing interactions and interdependencies between climate change and adaption and mitigation measures in urban agglomerations (Tyndall Centre for Climate Change Research 2009:4f). Thus, effective solutions require the integration of all climate factors into plan-making in order to solve conflicts between mitigation and adaption and to foster the synergies between the measures on different spatial and temporal scales. Holistic urban planning and design are key factors to balance these conflicts and to create synergetic spatial and functional approaches.

Young Cities Project Approach

These three basic assumptions form the basis of the Young Cities project's approach to develop, implement and evaluate strategies for energy efficiency in the three dimensions of physical, structural and procedural arrangements on the scale of neighborhoods. As such, the term "energy efficiency" as used in the project is broadly defined and encompasses sufficient, efficient and consistent development strategies following the logic of a physical, structural and procedural approach.

The main arena, in which these questions are being tested, is formed by the project's case study, the New Town of Hashtgerd (see section on Hashtgerd New Town for details). One area, a 35 ha large area in the southern part of Hashtgerd New Town, has been chosen by the research consortium as the central demonstration ground to be developed as en energy efficient neighborhood for app. 8,000 inhabitants including technical, social and green infrastructure.

Regarding the physical and structural dimensions, the project explores the following aspects:

- Definition of criteria and objectives for energy-efficiency in semi-arid (and potentially in arid) regions on quarter scale,
- Development and implementation of adequate planning and design strategies in the form of the 35 ha Area pilot project, including evaluation according to the project goals, and
- Derivation of methodologies in terms of manuals and guidelines for energy-efficient and resilient planning and design in Iran, eventually resulting in adapted or new codes and policies on the local, regional and even national level.

The technical-scientific and procedural innovations for Iran are expected to be realized through the highly integrative approach of the project into one coherent scheme, which takes effects on several scales/aspects:

1. A major aim of integrative approaches must be to combine adaption and mitigation measures in order to handle the potential conflicts between the measures such as cooling of buildings through higher temperatures. Integrated approaches aim at balancing these conflicts already at the planning stage.

2. In order to minimize the energy demand on the city and neighborhood level, all climate change drivers need to be considered alongside other processes of long term change, associated with demography, the economy, technology, and behavioral change (Tyndall Centre for Climate Chamce Research 2009:5). Integration is a process, in which these aspects and interactions of design are interlinked in a manner that permits synergistic benefits. In the context of the Young Cities project, the urban scale approach integrated with the building level solutions and the infrastructures offers large possibilities to reduce energy consumption and, hence, carbon and other GHG emissions at low financial expenses. The project, therefore, tries to foster energy efficiency by a trans-disciplinary approach that ties together strategies of urban planning, urban design, architecture, landscape planning, transport planning and mobility management, urban climatology, water, waste water- and energy management, public participation, and environmental assessment and monitoring. This integrated analysis and design covering the scale from the entire city to the single object level including infrastructure networks is an innovative approach for energy efficiency strategies not only in the context of Iran.

3. A third innovative aspect of the project stems from the integration of solutions, which are sustainable from ecological, economic, social, as well as cultural angels. This implies particularly the wide applicability of resulting solutions with respect to e.g. cost-efficiency. The traditional Iranian building design and settlement structures in various climatic regions offer these potentials since they are well adapted to the climate as well as social and cultural conditions of Iran. Traditional architectural elements in the warm, semi-arid (and arid) climate include e.g. narrow and high passages for making enough shade as well as for providing natural ventilation, courtyards with vegetation and water pools for evaporative cooling, natural ventilation elements, natural shading, thick walls for low heat loss and for night cooling etc. The main characteristics of Iranian architecture go beyond special techniques, furthermore, the Iranian architectural designs have always been changed during times according to needs and necessities of each place. In this project, it is tried to keep the values of these dynamics and design. However, while such features have widely been lost during the last century of construction practice in Iran, technological and design solutions for efficient energetic behavior of buildings have only marginally been introduced to Iran and been adapted to Iranian conditions, socially, culturally, or economically, yet. Thus,

the project partly aims at (re-)introducing these solutions of the urban heritage but by combining them with modern technologies, system and planning methods, not least referring to infrastructure systems

This complex, interdisciplinary, multi-scale approach requires an exploration of procedural aspects as an integrative part of the approach as well. This will lead to the development also of innovative planning methodologies and instruments resulting from the project as an important objective.

Therefore, the partners involved in the Young Cities project approach urban development comprehensively and interdisciplinary at three different levels:

- Urban structures (space),
- Urban infrastructures (networks), and
- Buildings (objects).

The social, ecological and economic framing conditions complement the levels as the forth reference. At these four levels, a number of pilot projects reflecting the strong application orientation of the project's approach have been initiated (see next section for details).

Fig. 1: Project Organization Chart

Accordingly, the Young Cities project is structured in three so called Strategic Dimensions. The different disciplines involved in the project collaborate strongly within these Strategic Dimensions as well as beyond this structure. The social-economic dimensions in addition function as four so called Supporting Dimensions in cooperation with the Strategic Dimensions and the single disciplines.

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Action Research Approach and Pilot Projects

Rudolf Schäfer, TU Berlin | Hans-Liudger Dienel, nexus Institute

Mix of Methodological Approaches

The complex approach of the Young Cities project is dealing with

- Urban structures (space),
- Urban infrastructure (networks),
- Buildings (objects), and
- Social and economic framing conditions

has to be reflected on the level of methodology. Consequently, the project is characterized by interdisciplinarity and a mix of methodological approaches. The spectrum of this mix goes from classical approaches like literature review and empirical studies via elaboration of plans and urban and architectural design to model calculations and simulation models.

The basic structure of this mix of methodological approaches is defined by two elements:

- The project belongs to the field of planning sciences
- and it is strongly orientated on application.

The main scientific project partners BHRC and TU Berlin have clearly decided to follow this approach. It is realized with the methodological tools of pilot projects and action research. Typical examples for this approach so far are the elaboration of the Tar-e Tafsili for the 35 ha Area pilot project and the architectural design and the construction of the New Quality pilot project building. The same way will be gone in the elaboration and implementation of the New Generation pilot projects buildings for residential, office and educational uses. Pilot projects and action research are not limited to the field of planning and building but also used to develop innovations in the fields of vocational education and training, project management and awareness raising.

On the other hand, there are complementing and experts' studies concerning environmental, social, economic, organizational, and legal framing conditions focusing on:

- Model calculations and simulation models in the field of vegetation and climate,
- The qualification and vocational training of construction workers in order to achieve a.o. a higher construction quality and, hence, a lower energy demand and an improved life cycle quality of the buildings,

- The awareness raising among multipliers and inhabitants in order to promote sustainable lifestyles,
- The development of efficient management structures and tools,
- The development of local and regional energy concepts, as well as
- Legal conditions and instruments of urban development.

Validity of Pilot Projects and Action Research

Using pilot projects and action research as central methodological approaches, one has to reflect the concept and validity of these tools. Pilot projects usually are defined as small scale preliminary studies conducted before the main research in order to check the feasibility or to improve the design of the research. In this project, the term is used differently: Pilot projects are case studies (Yin 2009), which to a certain degree at the same time have the quality of experiments. As such, they are testing methods in empirical research. Additionally, pilot projects can have elements of action research. Action research (Zuber-Skerritt 1996) is defined as an interactive inquiry process that balances problem solving actions implemented in a collaborative context. Such collaborative contexts are for example given in the case of the feasibility study for the 35 ha Area pilot project or with the elaboration of the New Generation Office Building pilot project in Hashtgerd New Town. As generally known, case studies and action research have their particular problems concerning the generalization and validity of the results gained. But based on solid theoretical research questions and a clear program for observation and analysis, such approaches are useful not only for testing and creating theories but also for the exploration of so far unknown structures and relationships.

Types of Products

As the Young Cities project has a clear orientation on application, it does not produce only the typical results of a research projects like discussion papers, studies, conferences, scientific workshops, models and simulations. It aims very intensively at other types of formats and products, too. Most important are implemented products like technological solutions, applied technology and—as mentioned above—pilot project buildings. The results of the research work should also be used for consulting products: manuals, guidelines, standards/norms, management tools and instruments, software tools. As an example, the extensive and complex interdisciplinary work that has been invested in the urban design concept for the 35 ha Area pilot project will be transformed into a manual for energy efficient and climate change oriented urban planning presenting the experiences with innovative tools. Last but not least, the project is expected to develop dissemination and transfer products. By these products the results are to be transferred not only to other cities in Iran but also to interested practitioners in neighboring countries with similar conditions and problems. Transferability studies, curricula and teaching materials, short and study courses and exhibition concepts are possible products of this type.

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Dissemination

Daniel Karsch, TU Berlin | Seied Nasseri, Association of Iranian Engineers and Natural Scientists in Germany

Dissemination of the results and also the project's methodological concept form an important aspect of the Young Cities project ensuring that a wider scientific and practitioners' public will benefit from the developed solutions, strategies and methods and the scientific results. Accordingly, the German Federal Ministry of Education and Research (BMBF), which is partly funding the project, stresses the importance of the transferability as well as the actual transfer of results and products. The Young Cities project has elaborated an overall dissemination strategy in order to assure that the accomplishments are communicated to research scholars, policy-makers and other national and international parties in Iran and the Middle East North Africa (MENA) region alike.

Two institutions involved in the Young Cities project are primarily assigned with different aspects of dissemination including the Association of Iranian Engineers and Natural Scientists in Germany (VINI) and the West Asia North Africa Cooperation Unit (WANACU) at School VI (Planning Building Environment) of TU Berlin.

Bilateral Iranian-German Dissemination: Scientific Community, Practitioners and Enterprises

VINI has been involved from early stages of the Young Cities project as an associate project partner in order to capitalize on the vast network of scientists, engineers, practitioners and entrepreneurs affiliated to VINI being active in or maintaining strong ties with Iran not the least in planning and building related fields. VINI in turn has placed the Young Cities project at a high priority in its activities and covers all the project's steps for its members and vice versa. At several occasions, VINI has been promoting and campaigning for the project and has a track record in accomplishing certain deeds and actions at its potentials, such as arranging and facilitating meetings and even conferences. VINI introduces the Young Cities project to professionals and relevant parties, especially German-Iranian companies or the Iran Renewable Energy Organization (SUNA) as well as institutions in Germany.

In addition, VINI provides professional consultation to different partners within the project. With the advancement of the pilot projects approaching the phase of implementation, developing the collaboration basis

with German and Iranian enterprises to be involved in the demonstrative realization of solutions is gaining importance with VINI playing a crucial role. Apart from the above mentioned activities, VINI also employs its range of communication means such as its Bulletin, internet website and so on in order to inform and reflect the events and showing the different aspect of the project to its network.

Dissemination within the MENA Region

WANACU is the Young Cities project partner in charge of coordinating and advancing the transfer and dissemination in the wider MENA region, of course also encompassing Iran (http://www.wanacu.tu-berlin.de). WANACU was set up in 2006 in order to ensure a systematic approach to international activities of TU Berlin's School VI Planning Building Environment in the MENA region, a region facing widely similar conditions and similar challenges for (sustainable) development. Over the past years, this region has become a major focus in international activities of TU Berlin, particularly regarding sustainable urban and rural development and the built environment. WANACU coordinates and connects different activities and, furthermore, establishes new activities with the region.

School VI Planning Building Environment of TU Berlin now sustains intensive and intensifying cooperative relations with a growing number of partners from the MENA region including universities, research institutions, NGOs, public administrations and private companies alike. In order to offer a structure for these partners to give them the chance to get in touch bi- or multi-laterally and to create joint activities, a network structure has been created, the Middle Eastern North African Sustainable Habitat Development Association (MENASHDA) (http://menashda.tu-berlin.de), managed by WANACU. Being one of the best-known, most promising and also biggest international research projects at TU Berlin, the Young Cities project is an important asset for WANACU and the MENASHDA network and vice versa. WANACU actively provides the MENASHDA network to Young Cities as a comprehensive approach for communicating and transferring the Young Cities project as well as its results and products within the MENA region. The promotion through MENASHDA implies a huge potential for publicity and recognition for the Young Cities project. The dissemination strategy is understood as a two-way strategy: the Young Cities project also benefits from ideas, activities or projects by the partner institutions based in the wider MENA region.

The dissemination strategy is based upon five fields of activity and in constant advancement:

- Activities with focus on individuals (multipliers, researchers, practitioners, etc.),
- Editing and publication of scientific results,
- Transfer of results into teaching and advanced training,

- Transfer of methodological approaches and experiences into new activities, as well as
- Spin-off projects or activities.

Besides elaborating the dissemination strategy, activities so far have focused on promoting the Young Cities project and its approach as well as bringing together the project and TU Berlin's partners based in the MENA region. Young Cities has played an important role in a number of activities focusing on the overall subject of sustainable development in the MENA region.

Project Evaluation

Peter-Diedrich Hansen, TU Berlin

The assessment and evaluation as well as the communication of the results generated within the Young Cities project will demonstrate clearly the predicted effects of the proposed measures. A respective project-wide evaluation concept has been under development as an ongoing process from the outset of the project. A project evaluation working group has been set up involving all project teams from the highly varying disciplines involved in the Young Cities project in 2008 and has developed detailed working strategies in an ongoing progress during 2009. The working strategies and the project-wide progress is documented for communication and decision support.

A pertinent and scientific monitoring strategy for the assessment and evaluation of the qualitative and/or quantitative effects to arise from the proposed measures has been elaborated from this basis. A matrix was developed as a tool to allow for lucidity and enabling all project partners to check the status of the project's work in relation to the intended impacts. In detail, an overview on the important aspects of the project is given in form of a horizontal flow along this matrix, providing information on the investigated aspects and exemplifying their causality. Main aspects are:

Objective, Strategy, Measure, Output, Indicator, Target Value, Measuring Methods and the project-wide comparable endpoints and qualitative/quantitative scaling (see exemplary table 1).

During the ongoing project, the matrices are constantly adapted, optimized and updated to the current status. This process includes a great deal of discussion potential and feedback among the project teams and partners. This process provides a constant flow of information, permanent optimization and feasibilty of the solutions and measures proposed. Focussing and condensing of the results generated project-wide is one of the main tasks in the coherent final communication with the scientific and non-scientific communities and target groups addressed by the project.

Tab. 1: Exemplary table of the project evaluation matrix

Field of Action	Strategic Dimension	Work Package	Objective	Target Values qualitative/quantitative	Contribution to Sustainability	Field of Sustainability
1	Evironmental Assessment	27. Environmental Assessment	development of sustainable methods for the consideration of climate change aspects in environmental assessments in urban development	manual/checklist (5)	fundamental as a first step towards sustainability	I, II, III, V
2			consideration of environmental/nature conservation aspects in Iranian urban planning	manual/checklist (5)	refers only indirectly to sustainability but would have low/no/difficult to be directly related effect in terms of the Agenda 21/ the Brundtland-Report	II, V
3			—	—	—	
1	Capacity Development	28. Case Studies on Energy-Efficiency and Building Quality	energy-efficient, high quality and sustainable construction execution	at least two documentations with valid information about needs for action (5) from (1)	technological system that follows new solutions as one out of many requirements for sustainability in terms of the Brundtland-Report	I, II, V
2			energy-efficient, high quality and sustainable construction	at least two documentations with valid information about needs for action (5) from (1)	creation of a self-contained, stable base as requirement for sustainability in terms of the Brundtland-Report	I, II, V
3			enabling professional work at construction sites to produce energy-efficient high quality buildings	at least two documentations with valid information about needs for action (5) from (1)	technological system that follows new solutions as one out of many requirements for sustainability in terms of the Brundtland-Report	I,II, III, V

Chapter III
Accomplishments

Pilot Projects

In the following the main accomplishments until 2010 of the overall Young Cities project are presented. In a first section selected pilot projects are introduced by the Project Dimensions in charge. Namely the pilot projects on which the focus is layed on are: 35 ha Area, New Generation Office and New Generation Educational Building "LIFE Center", New Quality and New Technology. The results concerning the work on the New Generation Residential Building pilot project, which has been started in 2011 will be presented in a separate volume of the Research Paper Series (see even chapter Outlook).

Pilot Projects

New Quality
New Generation Office Building
35 ha Area
New Technology

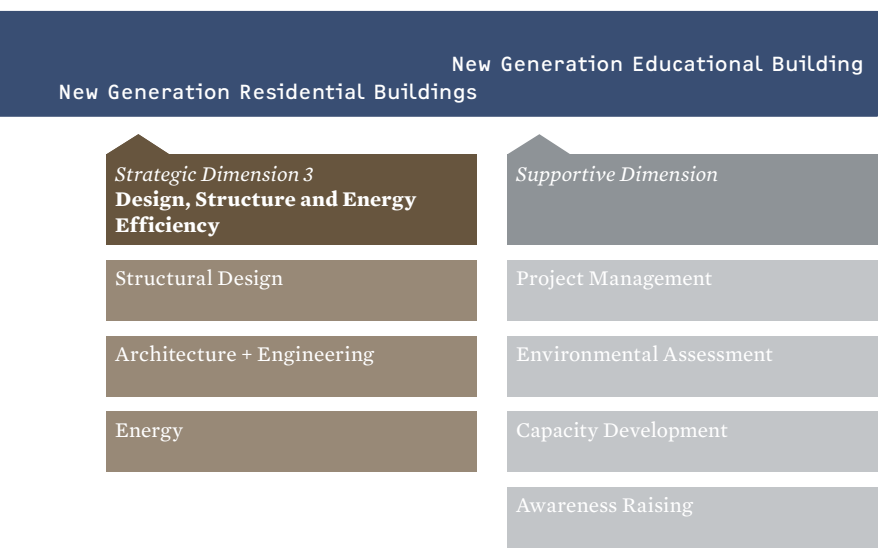
Strategic Dimension 1
Urban Development and Design

- Urban Planning + Urban Design
- Urban Design + Architecture
- Transport + Mobility
- Landscape Planning
- Climatology

Strategic Dimension 2
Urban Infrastructure Systems

- Energy Management
- Water + Wastewater Management
- Integrated Urban Technologies

A second section introduces the fourteen Project Dimensions regarding the respective objectives and accomplishments so far, to show the broad range of research issues within the overall project. The interdisciplinary aspects are mainly covered by the pilot project articles. The articles have been written by the responsible Project Dimensions from the German side as well. The authors are named at the respective article.



Pilot Project

35 ha Area

Elke Pahl-Weber | Sebastian Seelig | Holger Ohlenburg (ed.),
TU Berlin

Introduction and Aims

Located in the South of Hashtgerd New Town, the 35 ha Area has been defined by the NTDC to accommodate approximately 8,000 residents. The site is the central demonstration area of the Project for developing and implementing innovative urban infrastructure, object planning and design schemes for sustainable and energy-efficient housing in New Towns. The area will act as a laboratory to research and implement planning and design measures predominantly targeting on a reduction of greenhouse gas emissions, thus, concentrating on mitigation measures on the quarter scale. Among the large number of already well-known and well-proofed sectoral mitigation measures on the urban scale, such as sufficient density or efficient public transport (Breheny 1992, Jenks et al. 2000), the technical-scientific and procedural innovations for Iran are to be expected through strategic integration of the required disciplines. This will foster a multi-scale approach on various levels (from the entire city to the single object) in order to achieve an integration of sufficient, efficient and consistent development strategies (e.g. combination of efficiency in resource use and energy consumption as well as consistent life-cycles). Thus, the area is developed in a trans-disciplinary manner tying together the Project Dimensions of urban planning, urban design, architecture, landscape planning, transportation planning and mobility management, climatology, water/waste water and energy management. Accompanying measures are conducted through environmental assessment, participation, capacity development and accompanying monitoring.

The goals of the Project Dimensions involved in the 35 ha Area pilot project are threefold: Firstly, they aim at defining an adequate urban form for achieving energy-efficiency in hot climates while considering Iran's cultural context. This includes the definition of criteria for energy-efficiency and the adaptation of related goals and indicators in the respective Dimensions.

From these the adequate planning and design measures are researched and later implemented in the form of the 35 ha Area pilot project. At the outset the result shall be evaluated according to the project goals. Secondly, the involved Dimensions will derive methodologies from the planning process in the form of guidelines and manuals for sustainable and energy-efficient planning and design in Iran. Thirdly, the actions shall result in manuals or even policies and codes on local, regional and even national level.

In terms of its role for the entire research project, the pilot project has proofed to be of major importance since it combines a range of advantages:

- It is a model project, thus excluded from daily routine allowing for new innovative approaches;
- It follows a "research by design" method, fostering constant feedback loops between design and scientific evaluation, leading to applicable and concrete solutions;
- It raises awareness since the aims of the pilot project are adapted directly in the planning practice;
- It fosters communication within the project since it is elaborated in a conversational process encouraging exchange between the Project Partners;
- It is a laboratory to elaborate approaches for successive scaling up of the solutions.

Methodology

Methodologically, the design and evaluation process of 35 ha Area pilot project is complex, depending on the approach of each Dimension involved. In the following, the methodology of the 35 ha Area pilot project shall be presented by taking the tasks of "planning and design", and "simulation" as an example. Generally, the design and simulation approach of the 35 ha

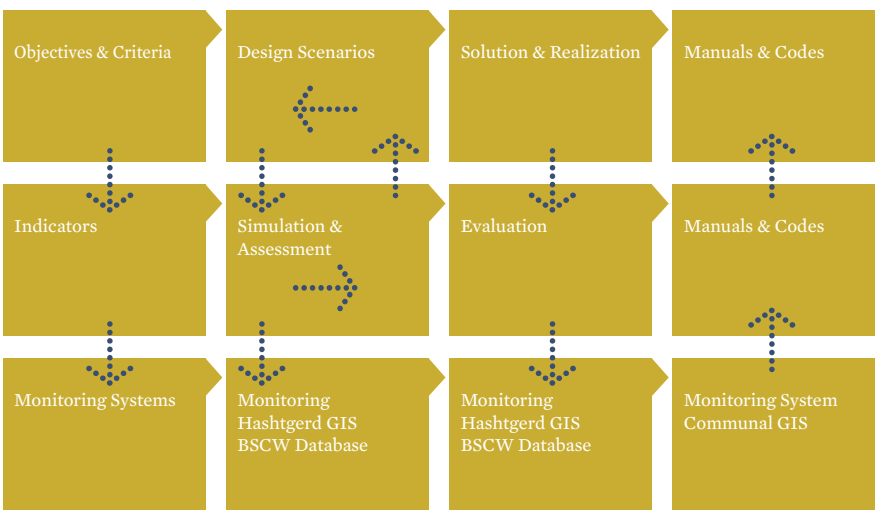


Fig. 1: Methodological approach of design, simulation and documentation of the 35 ha Area pilot project

Area pilot project encompasses three parallel tracks. These are "planning and design", "simulation and assessment", followed by "documentation and analysis". These fields are accomplished in parallel, though not all tasks are conducted in a linear process. The above (see fig. 1) diagram shows a simplified procedure of the process and its reciprocal interdependencies.

Accomplishments

In the following section, the major principles of the urban concept are explained since these form the current main results of the pilot project.

Climate-sensitive Design

Elke Pahl-Weber | Sebastian Seelig | Philipp Wehage | Eberhard Reimer | Ines Langer | Sahar Sodoudi | Holger Ohlenburg | Wulf-Holger Arndt

The guiding principle of the urban design scheme is to develop a sustainable and energy-efficient urban quarter for 8,000 inhabitants (approx. 2,000 residential units). The urban design approach is derived from the spatial and functional logic of the traditional Islamic city, aiming at a dense and clearly readable urban pattern with a clear hierarchy of public, semi-private spaces, private spaces and access systems. The chosen urban design approach can be described as “low rise, high density”, referencing the traditional regional urban form. This approach builds on previous design strategies of traditional cities, such as the reduction of direct impact of solar radiation; through minimizing the amount of exposure to the buildings surface. Moreover the approach should support climatic comfort of open spaces through shading, as simulated in shading analyses with the software

Fig. 2: 35 ha Area Urban Concept

tool ECOTECT. The building masses are organized in four rows stretching from north to south, located on the ridges. The 28 compact urban clusters partly block the main winds from the west and northwest, as well as the hot and dusty winds from the southeast which occure mainly in the summer months. The cooler north-south winds are channeled through the main access roads and a linear central open space. The detailed local climatic effects are being simulated with the simulation tool ENVI-met (http://www.

envi-met.com). The results show that the quarter's low skyline allows free movement of air, which is of high importance for fresh air supply. The increase of unbuilt areas in 35 ha reduces the heat island effect through cooling caused by vegetation and increase of air humidity which is caused by plants evaporation. To predict the mesoclimate a base run with ECMWF and CLM model will be prepared for the last 50 years. Therefore neuro-fuzzy models will be developed for downscaling.

Besides morphological advantages, the density of the design (floor area ratio of 1.6) is a precondition for energy-efficient housing from a transport perspective, since there is a direct link between density and the consumption of energy mainly related to mobility needs and demands. The traffic-reducing effect of the dense urban structures relates to the fact that public transport options can be provided more efficiently in dense urban structures, and thus, car use can be limited; this has been proven by traffic-related research (e.g. Ewing et al. 2007). Traffic simulations with VISUM show that the land use concept for the 35 ha Area has the potential to reduce individual car trips by 3 % as well as trips with public transportation by 7 % as compared to a functionally separated land use concept.

Each cluster (approximately 100 m by 60 m) is defined by a central

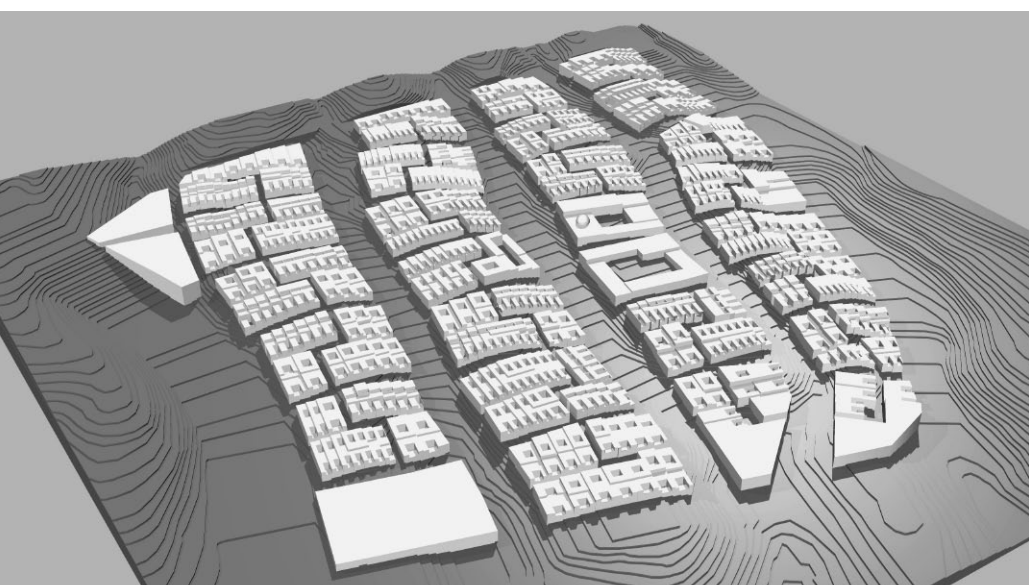


Fig. 3: 3D Rendering of 35 ha Area Urban Concept

courtyard (15 m by 30 m) and four building groups situated around the courtyard. The courtyard forms the inner centre of each sub-neighborhood and works as a semi-public space for the inhabitants. The clusters are accessible by foot and bike through a six meter wide path from the access streets of the quarter and by a north south connecting path, also allowing a good access by foot and bike. Cars are not intended to be present, only service and emergency mobility are to be provided for. This introverted ac-

cess system allows for a compact urban fabric and a reduction of the infrastructure areas. This is of major importance since a correlation of density and compact urban form is a major need for achieving energy-efficiency. Furthermore compact urban form leads to a comparatively lower amount of sealed ground per capita within the total settlement and traffic area (BBR 2001). By reducing soil sealing a number of environmental impacts (e.g. loss of habitat function, function of backing of precipitation water, filtering and chemical buffering) can be minimized (von Haaren 2004, Köppel et al. 1998:112f). The organization of each housing group and each building supports the compact form since the single plots are narrow, deep, and have a good average volume-surface ratio of 0.5.

Extensive Landscaping

Stefan Heiland | Bernd Demuth | Theresa Garske

Regarding a sustainable landscape planning of the 35 ha Area three important issues exist: Firstly a sufficient per capita provision with green and open spaces in the vicinity of residential areas should be guaranteed. According to Iranian and German standards 7 m² green and open space per resident have been fixed. However, a suitability assessment of the areas for

Fig. 4: Compact urban form

recreation purposes within 35 ha Area showed a significant conflict potential due to different qualitative and quantitative criteria. This results in a demand of further suitable areas adjacent to the 35 ha Area which can provide green and open spaces to the under-served residents within the 35 ha Area probably in addition to those from the other surrounding residential areas. Secondly, to contribute to the mitigation of climate change the unsuitable areas within 35 ha Area will be planted with suitable, low-maintenance (wa-

ter consumption, see below) plants, to bind and thereby decrease the freely disposable CO_2.

The third major aim of green and open space development is the reduction of water consumption for maintenance and preservation of green spaces: the selection of suitable vegetation (native or adapted) is based on the aspect of low water consumption. In contrast to the mainly 'dry landscape'-character of the 35 ha Area, some representative, small areas will be designed with more water-demanding, green plants. Furthermore, only treated greywater will be used for irrigation of the vegetation. Additionally, water saving irrigation systems are planned in the areas. Due to the reduced water demand and because of the decentralization of the constructed wetlands, the effort for pumping will be reduced. As a consequence and contribution to the mitigation of climate change, the energy consumption will decrease as well.

Eco-Mobility and Transportation

Wulf-Holger Arndt | Norman Döge

The transportation concept aims at a reduction of travel distances and, hence, saving of energy and minimizing of GHG emissions. The developed concept combines "push" and "pull" strategies, using hard and soft policies. The assignment of a choice of different measures to the mentioned policies and strategies is shown in Fig. 2 in article 'Integrated Transportation

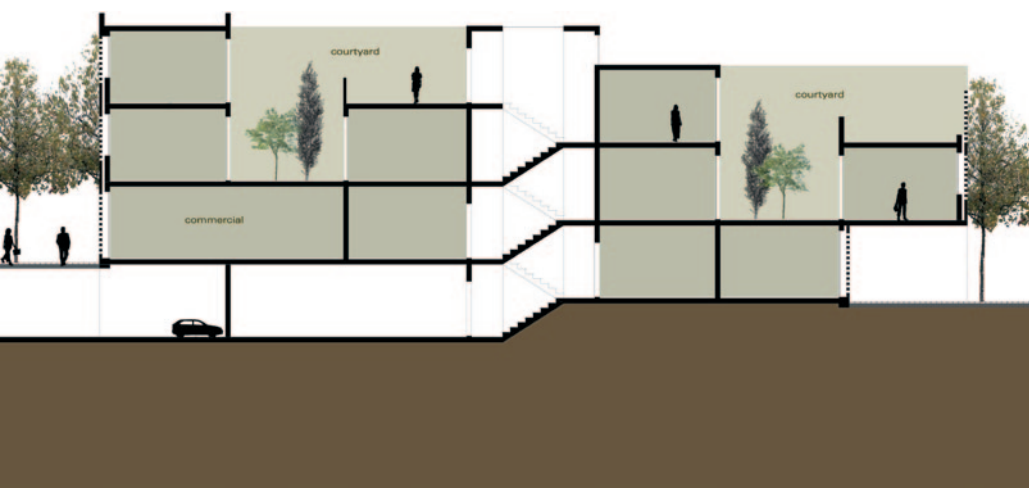


Fig. 5: Contemporary courtyard housing

Planning for Energy Reduced Traffic'. The "pull approach" primarily focuses on the change of mobility routines of the new residents. To reach this mind shift a mobility management will be established as a main element of the soft policies.

One core instrument of the soft policies is the mobility package, which includes information, services and incentives for inhabitants to force the modal shift towards eco-mobility. A special package aiming at citizens who

move to Hashtgerd New Town is important to assist them in the orientation phase in Hashtgerd New Town in order to influence their mobility routines. The instruments regarding the physical transport network are included in the hard policies. In close reconciliation with other project dimensions, the dimension transport and mobility elaborated plans for an attractive public transport, footpath, and bicycle system. Great emphasis laid on the consideration of shorter travel distances (supporting the Mixed Use approach), topographical as well as environmental prerequisites. Taking into account an implementation of the elaborated draft for a public transport system, the assignment results of the developed transport model for the whole region of Hashtgerd have shown that regarding future demands the planned network for motorized traffic is by far too over dimensioned. In the case of the 35 ha Area these cognitions allowed the elaboration of a proposal for an alternative route course and the downsizing of a road to the East of the area, preserving a worthy green belt. In order to guarantee the horizontal spatial integration into Hashtgerd, the 35 ha Area should be surrounded by higher capacity public transport systems such as citybus and bus rapid transit in advance of a later light rail transit. These systems will form the commuter connection to the planned Hashtgerd-Karaj-Tehran metro line and to the

Fig. 6: Transportation concept

City of (Old) Hashtgerd. The sub neighborhoods and the center of the 35 ha Area are planned to be served by a minibus line, reducing distances towards the next stop to 250 m. In order to reduce motorized traffic inside the area and to support the modal shift, it should be considered to allow street parking only on the area's surrounding roads. Parking inside the 35 ha Area should take place in underground garages. For optimal CO_2 mitigation results, the parking lot factor should not exceed 0.2 per household.

Mixed Land Use Schemes

Elke Pahl-Weber | Sebastian Seelig | Philipp Wehage

The described urban, landscape and transport concept is to be combined with a mixed land use concept. Besides the well-known qualities such as increasing vitality and urban quality, mixed land use in compact urban environments offers high potentials for the reduction of fossil energy use and, therefore, GHG emissions (BBR 2000). This is mainly related to efficient land use, to shorter travel distances and to increased use of public transport. This translates into a concept for the 35 ha Area that proposes a horizontal arrangement of the larger functions, and a finer vertical mix of smaller uses on the neighborhood level. The land use concept is connected with the city-wide public transport concept and to walking and cycling routes in order to minimize individual car traffic. This broad strategy results in the proposed detailed land use concept: Larger social amenities, located in the very center of the 35 ha Area create the social center of the quarter consisting of a mosque, attached cultural functions, a kindergarten and a primary school. The central location of the social amenities guarantees the accessibility for most of the inhabitants by foot (catchment area 300m) and is connection with the public transport system. The larger commercial functions with a

Fig. 7: Land Use Concept with small-scale mixed use areas (in orange)

local or regional catchment such as a regional shopping center, a larger office building and a secondary school are located at the quarter's edge. This keeps the motorized traffic out of the quarter, ensures efficient access with public transport and, moreover, creates a lively and visible address of the quarter. On the neighborhood level small commercial and social functions are catering for the everyday needs of the residents. Special zones dedicated on the ground floor of the residential buildings and concentrated around

the courtyards make the shaded courtyards the centers of each sub-neighborhood. A target corridor of up to 10 % of the building area for the commercial shares within the mixed use zones is recommended.

Regionally adapted Architecture

Elke Pahl-Weber | Philipp Wehage

The housing type also has a large influence on the energy consumption. A type very suitable for semi-arid and arid regions is the traditional courtyard house (Edwards et al. 2005). The courtyard building is the main typology of the regional Islamic cities since it offers privacy and is suitable to the hot climate. The inner courtyard allows for the principle of convection as a basic element for natural cooling (Fathy 1986). Another advantage is that the narrow courtyard is not exposed directly to the sunlight. By introducing a contemporary interpretation of the courtyard house with a predominant south orientation, the housing design for the 35 ha Area takes up these advantages. The modern two to three storey courtyard house starts with a 6 m axis, developing in steps of 1.5 m to a maximum width of 15 m. The plots are 20 to 35 m deep, predominantly orientated in north-south direction. The building volumes are elaborated with courtyards and niches in order to increase the amount of surfaces facing south for using the sun incidentally as energy input. The strong vertical organization of the volume provides sun

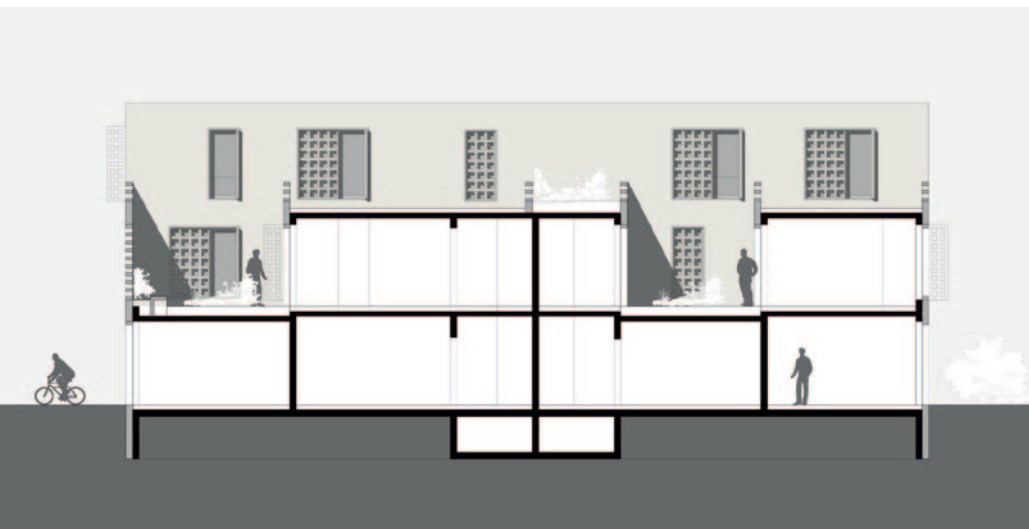


Fig. 8: Section 9m residential building

for every residential unit. A central staircase as a vertical element in larger buildings, offers access to at least two units on every level. The orientation of the living zones in the units around the courtyard combines the offer of privacy in Islamic tradition with the microclimatic advantages as described. Regarding to earthquake resistance and economic efficiency, the constructive structure will be made with concrete frames, columns or slabs.

Energy Supply Systems

Christoph Nytsch-Geusen | Jörg Huber | Steffen Unger

Another major factor for achieving energy efficiency is related to the chosen energy supply system and the respective technologies: The first step for the development and the design of centralized, semi-centralized and decentralized energy supply systems was a detailed simulation analysis, which considers the building physics of each type of the residential buildings in detail. The demand of the other (non-residential) building types is approximated with coarse mean values, because at present, detail planning fundamentals do not exist.

For this purpose, detailed 3D building models in Autodesk ECOTECT were developed and used for a detailed thermal simulation analysis with ENERGYPLUS.

Based on the results of the energy calculation of the several residential building types, the total energy demand for each sub-neighborhood and for the 35 ha Area in total were calculated. Secondly, the sun protection effects of more opened western style facades and more closed oriental ones have been simulated and quantified.

With these detailed information about energy demand and thermal behavior of the buildings under the influence of the local climate, several supply strategies were analyzed.

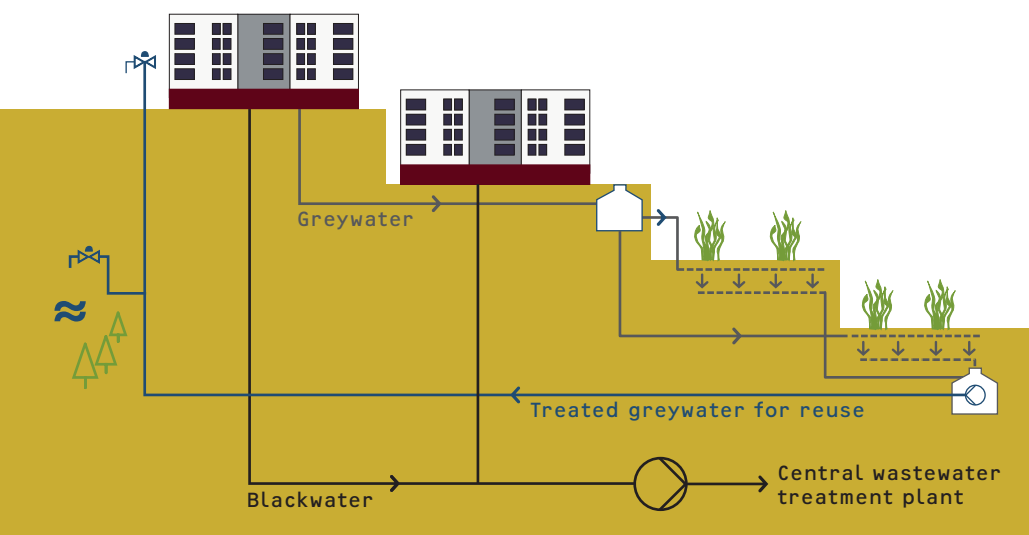


Fig. 9: Water and wastewater systems

The aim “energy efficiency” can be reached with several methods, for example by using common Iranian building technologies in different ways or by the improvement of these technologies. Another possibility consists in the use of available renewable energy sources, for example the very high potential of the solar irradiation with the help of solar thermal technologies for heating and cooling. Energy efficiency can be even increased with new imported building technologies, such as centralized, semi-centralized and

de-centralized energy supply systems, based on co- and tri-generation technologies and district heating networks.

The advantages and disadvantages of the different technologies for the energy transfer from the energy supply systems into the thermal zones of residential buildings (cooling ceilings, heating and cooling induction devices etc.) has been computed and compared.

Efficient Water and Waste Water Systems

Shahrooz Mohajeri | Tamara Nuñez von Voigt | Martin Vocks

The dense, mixed-use urban form is interconnected with an efficient waste water disposal concept. The guiding principle of the waste water disposal concept is to respect the local conditions such as climate, availability of water, earthquake threat and culture, and to reduce energy and fresh water demand without a loss of comfort. Moreover, to meet the special needs for New Towns, the concept has to be adaptive and flexible. The developed waste water concept includes a separate collection of two different waste water streams: grey water and black water. The grey water, which origins from bath tubes, showers, sinks and washing machines, will be collected separately and treated decentralized in constructed wetlands. The treated grey water should be reused for irrigation, as service water and other exhouse purposes. The non used grey water is given into the storm water system and hence infiltrated.. The black water, which origins from toilets and kitchens is collected in a separate system and should be treated in a central waste water treatment plant. Depending on the used technology and degree of treatment this water might also be ready for reuse. Another possibility would be a controlled infiltration of this water after treatment for groundwater recharge. This is important due to an assumed ongoing decrease of the groundwater level. For the same purpose, storm water harvested from roof-tops, sealed surfaces and streets are collected in a separate system and infiltrated into the ground.

Impact Mitigation through Environmental Assessment

Holger Ohlenburg | Johann Köppel

To avoid and minimize undesirable negative impacts on the environment urban development projects should undergo a (strategic) Environmental Impact Assessment. Knowledge of the likely adverse impacts on the natural goods and its ecosystem functions enable project planners to take precautionary steps to avoid or minimize undesired effects. The work of the Dimension

Environmental Assessment results in a brief inventory description of the environmental subjects of protection (flora, fauna, soil, groundwater/surface water, climate/air, landscape). Furthermore a simplified analysis of the likely impacts caused by the 35 ha Area pilot project has been conducted based on the urban planning concept, the available environmental data, analogies and assumptions. The survey area was adjusted for each subject of protection individually and had been widened in the eastern and northeastern direction

because of an existing first order water course combined with comparatively ample vegetation (woody structures, orchard, wetland and riparian vegetation) which would be strongly affected by the pilot project.

Based on this analysis, several measures have been proposed to minimize the environmental impacts on the 35 ha Area, such as the reduction of sealing and utilization of land for building purposes, backing and infiltration of precipitation water for groundwater recharge, enhancement and consideration of local climate issues (air quality, fresh/cool air supply, urban heat stress). These mitigation measures had been either integrated in the 35 ha Area pilot project during the project's runtime or are to be considered in the ongoing planning process for implementation and realization (legally binding comprehensive plans). A restructuring of the building lots and a relocation of the eastern collector road as well as environmental compensation measures have also been proposed.

Citizen Participation

Jenny Schmithals | Sabine Schröder

The Project Dimension Awareness Raising has developed a concept for an environmental awareness raising exhibition on the 35 ha Area pilot project. The concept envisions the exhibition of the plans for the 35 ha Area combined with environmental awareness raising and activating components. The presentation and texts shall be adapted for a public audience, focusing on the ecological concept and activating environmental awareness raising. The exhibition shall additionally be combined with participative methods and events to discuss open design questions related to the 35 ha Area with citizens, representatives and experts. The goals of the exhibition are raising awareness for energy-efficient and climate friendly consumption patterns as well as integrating the expert knowledge of Hashtgerd citizens into the planning process, in order to raise its acceptance and attractiveness.

Besides the conceptualization of the exhibition, a survey of Hashtgerd New Town citizens on consumption patterns and environmental awareness was accomplished. The survey was designed to get knowledge about the specific perceptions and framings of "climate friendly consumption patterns" in Hashtgerd New Town. To do so, it is necessary to analyze the role of climate change and energy consumption in the everyday life of Hashtgerd New Town's residents. An explorative and qualitative survey was carried out in March 2009 with 60 residents of Hashtgerd New Town using a semi-structured questionnaire. The main results of the survey showed that there is general knowledge about climate change as well as about the anthropogenic impact on climate mainly transported via media. Another major outcome was that there is the willingness to save energy, gas and water, but that constructional insufficiencies hamper the residents to do so. These and other outcomes clearly relate the proposed planning measures of the 35 ha Area and shall be deepened in further exchange with the Hashtgerd New Town's inhabitants.

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Pilot Project

New Generation Educational Building 'LIFE Center'

Andrea Böhm | Bernd Mahrin, TU Berlin

Description and Aims

Hashtgerd New Town is going to be expanded. It should be prevented, though, from becoming a dormitory town for people working in Tehran or Karaj. This requires both, to build up attractive high quality residential buildings and to develop a functional and pleasant urban atmosphere. Planners have to care for all facilities a prospering city needs, regarding infrastructure, medicine, services, public spaces, shopping, religion, culture, education etc. Furthermore an important precondition for a high quality of life is the availability of jobs and workplaces in the town. Only under these conditions, a New Town is able to emerge an individual character.

Higher general as well as vocational education has increasing importance for people's chances of employment (cf. Kordan, A. 2007). There is a direct interrelation between people's professional competencies and the region's economic development. An efficient education infrastructure is an important factor especially for New Towns, where industry and trade have to be settled.

In a growing town like Hashtgerd New Town, construction is one of the most important sectors for development and for the job market. Currently, there is a considerable lack of skilled workers and foremen. This contributes strongly also to a lack of quality and energy efficiency of the buildings.

Due to these requirements, the New Generation Educational Building pilot project is intended to become a multifunctional service center for sustainable construction, education and urban living called LIFE Center (Learning, Information, Forum, Exposition). It will provide vocational education and training for construction workers, foremen, technicians and practical training for engineers and architects.

The design and the implementation plan of the New Generation Educational Building pilot project are developed under the main aspects of energy efficiency, sustainability, quality, cost-effectiveness and industrialized construction. The Educational Building shall be realized as a prototype building.

The building site is located just outside the 35 ha Area in Hashtgerd New Town. This location is a central traffic junction for the people living in Hashtgerd New Town, but mainly for the prospective residents of the 35 ha Area. This place matches the requirements based on research results and infrastructural intents at this district.

Two guiding themes guide the spatial composition: The urban arrangement creates an infrastructural and communicative intersection and an entrance to the 35 ha Area and it formulates a perspective for the fragile environmental structures of residential and infrastructural spaces. The resulting social chances created by the urban arrangement are broadly diversified and support both, the objectives of the Young Cities project and the people living in Hashtgerd New Town and the 35 ha Area.

Fig. 1: Location of the Educational Building (A. Böhm)

The prospects and advantages of the pilot project are integrated and take effect on different levels: The pilot project is based on an analysis of Iranian vernacular architecture and converts the findings into the planning process. In conjunction with modern building methods and new technologies, an optimized architecture is being generated.

The focus of the design and planning is set on the mitigation of carbon dioxide emissions. Therefore, it is essential to develop an adequate archi-

tecture regarding the reduction of energy consumption over the whole life-cycle of the building. Thus, the Educational Building pilot project becomes coincidentally a show-and-tell-object for awareness raising and support of education and vocational training. Regarding the building's sustainable architecture and its high quality, the pilot project supports the awareness raising far beyond the duration of the research project.

The research activities aim at applicable results in design, planning and implementation. A main objective is the creation of an adaptable and shapeable building with a maximized flexibility of usage. The educational building is supposed to be multipliable. Besides this demand, the design of the building is clearly focussed on the function as an innovative vocational training center. The innovations of the planning and the implemented building are intended to be adaptable and exemplary. The pilot project affords a guideline regarding design, planning and implementation of an educational building for vocational training in Iran. This is addressed to students, trainers and teachers, skilled workers and foremen, prospective building owners, planners and investors. It will contain the research results regarding planning processes and building technologies with the background of the economic, ecologic and social context of the region. Development and transfer of knowledge are integrative intentions of the project's work. The implementation of the planning of the building complex is part of the active research work. The monitoring of the realized scientific results will complete the project.

Fig. 2: Building site–View from west (J. Grunwald)

Methodology and Organization

The work on the pilot project is executed on multiple levels, which are linked. The research work proceeds as an active design and planning process, which is fed back by scientific research in the form of direct evaluation of the particular results. The definition of an internal target catalogue concretized the different steps of work.

Broad research as first step and basis for planning, design and design

process as research work, permanent analysis of design regarding scientific results and backflow of research results into the design and planning occur. An alternating process specifies the project work.

Degree dissertations about lateral topics expand the spectrum of the project work and give the opportunity to deepen a multitude of issues. They encourage the design and planning and help optimizing the research results regarding the overall project goals of sustainability and energy efficiency.

The urban concept for the building complex is created in cooperation with urban planners. Building simulations are prepared in collaboration with energy planners. Specialized consultants are involved to check the management and the design regarding energy efficiency and earthquake resistant building structures. Cooperation with participation experts during the planning process shall assure to meet the requirements of the prospective building owners and users within the particular regional context. After realization of the buildings, this cooperation maybe continued as part of the monitoring and evaluation program.

Vocational training experts and architects develop in close collaboration the vocational training center regarding the didactical concept, the operating model, the facilities and functions, the space program, the architectural, functional and constructional typologies The training concept, the responsibilities for realization and operation, the financing of investment and operation costs as well as the architectural concept are modified in cooperation of the German and Iranian project partners and further experts.

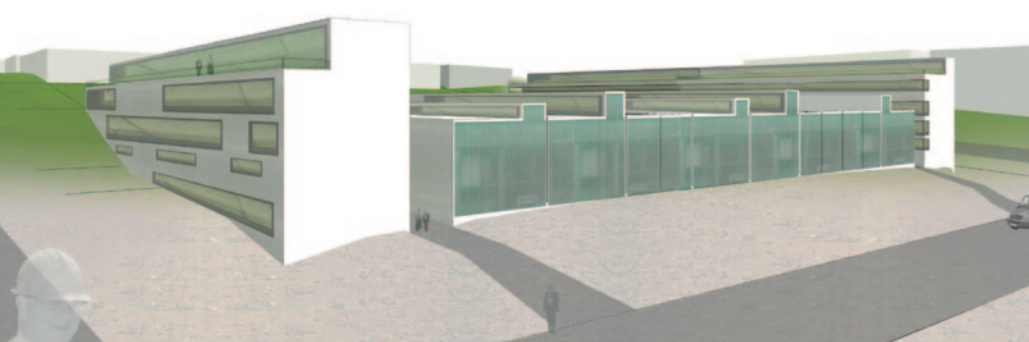

Fig. 3. Model 1—Perspective rendering (A. Böhm)

Adequate adaptations to Iranian building regulations, codes and specifications are done within this network of Iranian and German professionals.

The required service spectrum of the Hashtgerd New Town Service Center LIFE was defined based on expert talks, interviews and building site visits. It will be continuously updated.

Results and Accomplishments

The results of the project related research work are differentiated and closely bound to the design and functional contents of the Educational Building.

To point out the center's various functions and its flexible, multifunctional concept, it is called LIFE Center: center for Learning Information Forum Exposition. It shall combine different sectors of professional and public life.

The New Generation Educational Building shall join educational, communicative and informative tasks and responsibilities according to the model of regional training and competence centers in Germany (BFW Berlin-Brandenburg 2001; Freie und Hansestadt Hamburg 2008; HBZ Münster 2007). An information center is to be integrated providing space for varying and permanent expositions, for consultation, for fairs, and other events. Regularly, modern and sustainable construction methods will be present-

Fig. 4. Vocational training center in Tehran—Excursion in May 2009 (A. Böhm)

ed by examples of the 35 ha Area and the building pilot projects. The LIFE Center will create employment opportunities and it will be a place for general education, for vocational education and training, and additionally it is intended to offer space for temporary student/trainer habitation and proper recreation in conjunction with the educational facilities.

Due to the importance to develop the awareness for high quality building regarding sustainability and earthquake resistance, the building for the

vocational training center shall become a basis for these points. According to this, the building complex for the vocational training center in Hashtgerd New Town is planned integrating regarding the functions. Those are orientated on analyses of the present building situation in Iran. The Center may contain (some of the items being optional, though highly recommended):

- Administration facilities,
- Seminar rooms for theoretical lessons and for vocational education,
- Media center, public library, computer pool, projection room etc.,
- Flexible, multifunctional rooms and open areas offering space for representation, for exhibition and fairs, for information and consideration and for cultural events,
- Shopfloors and storage areas for practical vocational training,
- Public gastronomy: a cafeteria with kitchen for students and guests,
- Residential accommodation with recreation space and sports facilities.

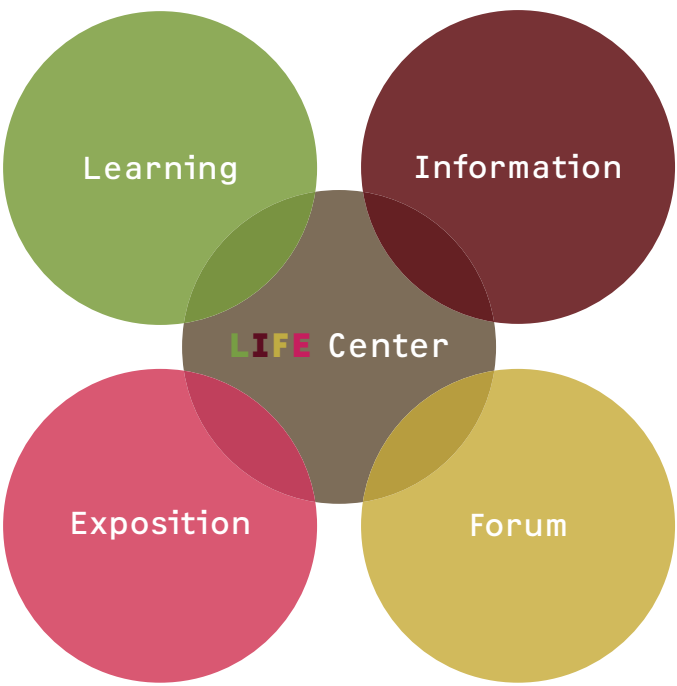

Fig. 5. Concept idea LIFE Center (sketch by A. Böhm)

The space program was generated on the basis of a detailed survey on a number of similar vocational training centers not the least in Germany as reference buildings. The needed spatial interrelations were clarified; design schemes were developed and tailored to the regional conditions. The following shopfloors are suggested for the vocational training center:

- Building construction I
  (concrete, reinforced concrete),

- Building construction II (AAC, bricklaying, floating floors, waterproofing etc.),
- Building services engineering, supply engineering, maintenance and repairs,
- ETICS, construction diagnostic, sustainability, energy efficiency,
- Drywall construction, fitting doors and windows,
- Steel construction and welding, earthquake protection,
- Civil engineering, road construction, construction machines, as well as
- Construction site management, logistics, documentation and communication, execution plans.

An important idea is that the building itself is aspired to be a show-and-tell-object for the training and lessons about high quality and sustainable building. Adequate building constructions and detail planning is arranged.

A main part of the work on the pilot project building is the research about cladding systems and sustainable building materials, which are adequate for the regional climatical and economic situation. Therefore, it is necessary to get in contact with different producers, providers and applicators. Different systems and materials are collected and analyzed. Building simulations are intended regarding building materials, the cladding systems especially for the shopfloors, the quality of surfaces, the building position and form, the wall-window-ratio, the prospective building users, the technical building equipment and the building structures. For the envisaged evaluation, the search for reference buildings in the region and the ongoing redefinition of indicators are envisaged.

Fig. 6: Course control technology (B. Mahrin)

Fig. 7: Interplant vocational training center KOMZET Cottbus—Show-and-tell object building equipment (BFW BB)

The LIFE-Center combines an attractive, modern design, the use of highly sophisticated materials and energy efficient building services engineering. Its high building quality, the earthquake resistance and the expected above-average lifespan shall be results of both, professional planning and proper workmanship. But beyond the technical aspects and progresses, its exemplary character and the functional opportunities are worth taking notice: People in the neighborhood can take benefit in multiple ways, such

as participating in vocational training, general education courses, cultural events and exhibitions, getting information and advice in the field of construction for their private projects. Even the center's infrastructure with lodging catering and sports facilities etc. may be opened to the people and enrich their living environment. Thus, it may become a regional center of competence and meetings.

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Fig. 8: Interplant vocational training center: Course reinforced concrete (BFW BB)

Fig. 9: Vocational training center in Hamburg: Trainee practicing tiling (AZB HH)

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Pilot Project

New Generation Office Building

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The New Generation Office Building is one of the pilot projects of the overall Young Cities research project. Due to the high energy consumption of buildings in Iran, the main objective of New Generation Office Building pilot project is the reduction of energy consumption and the improvement of internal thermal comfort in comparison to existing office buildings in Iran. The secondary objective of this project is cost efficiency. For cost efficiency

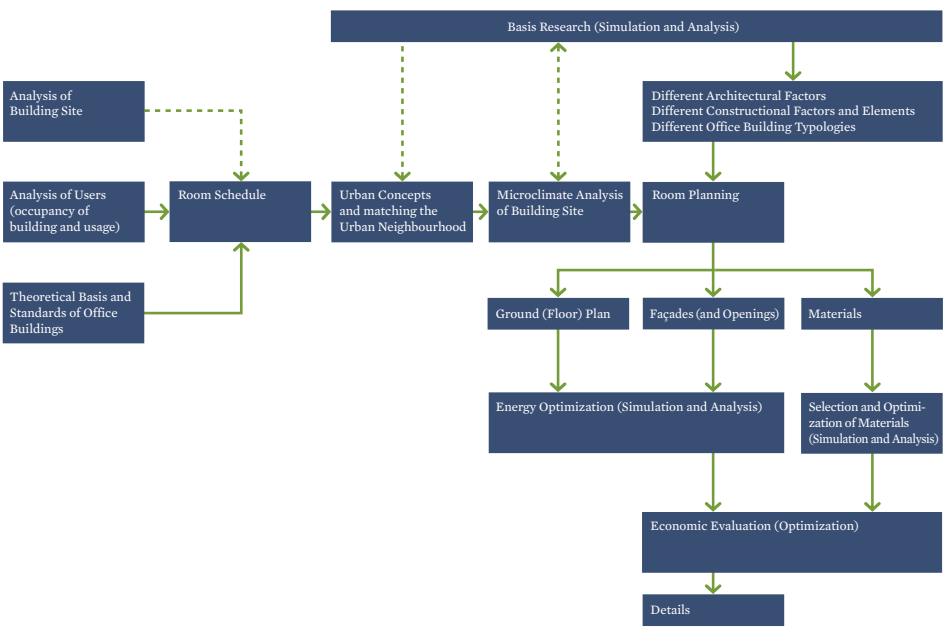


Fig. 1: Methodological approach of the New Generation Office Building pilot project (Research & Design)

it is decided not predominantly to save energy through cost intensive methods but through cost-neutral methods such as architectural energy efficiency, which do not increase the building costs. Therefore, architectural design will be applied as the main source for saving energy in this pilot project. Less emphasis will lie on construction and technology related fields, however, these fields will be used as means of energy saving, too.

Constructional energy efficiency in this building deals with the optimi-

zation of constructional and physical characteristics of the thermal envelope, such as finding the optimum heat transfer coefficient, thermal bridge coefficient, airchange rate etc., in order to minimize unwanted heat gain and loss, while aiming at high standards of cost-efficiency.

The Hashtgerd New Town branch of the "New Town Development Corporation" (NTDC) will be using the resulting New Generation Office Building. Therefore, this pilot project has been planned based on the spatial requirements of this corporation.

Methodological Approach

As the New Generation Office Building is a pilot project with the aim of energy efficiency, basic researches regarding energy efficiency in office buildings have accompanied the design process of this building. Therefore, parallel to the site and user analyses, theoretical inquiries, room schedule, urban concepts etc., and the effects of different architectural factors on the energy consumption of office buildings in Hashtgerd New Town is studied. After finishing the design process of the New Generation Office Building based on the results of the studies, simulations and analyses, the office building will be simulated and evaluated from energetic points of view for a possible optimization. Then, this pilot project will be economically evaluated and optimized. The following graph illustrates the methodological approach, which is used for designing the New Generation Office Building pilot project.

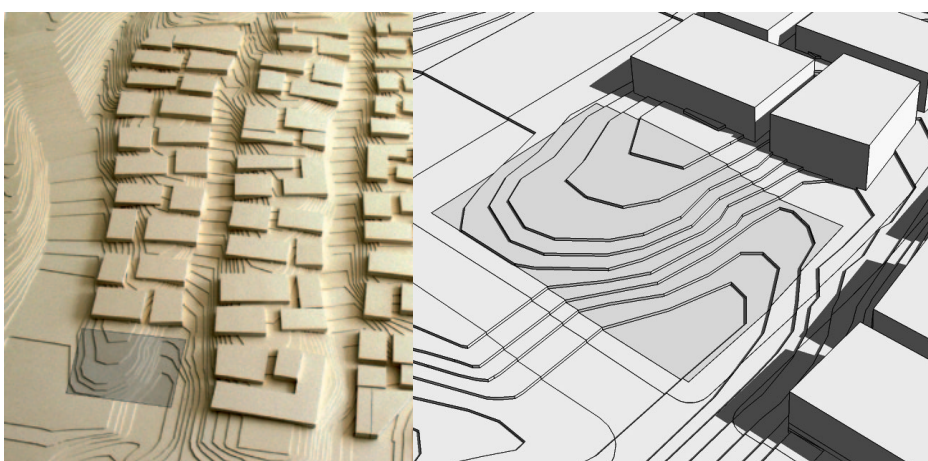


Fig. 2 | Fig. 3: The site of the New Generation Office building within the 35 ha Area

Building Site

One of the most representative sites on the 35 ha Area for an office building is a site located in the southwest corner of the 35 ha Area in Hashtgerd New Town. The site is surrounded from north and east by a mixed-use area with residential buildings as the main land-use type.

This site has also optimum connection to other parts of the city for an office building, which will have many clients. This site is framed from west

and south sides respectively by a 50 m main road and a 45 m main collector road. A 35 m access road and a path/footway surround this site from east and north sides, too.

The designated building site is about 7,800 m², while according to the room schedule done for the Hashtgerd branch of NTDC, the gross floor area of this building will be about 3,500 m². If this building is built in three stories (according to the 35 ha Area Comprehensive Plan), the site occupancy index will be only 0.15. So, a big part of the site will remain unbuilt area and can be used as open or green space. Such a site occupancy index is not efficient from the economic point of view and does not match the urban concept because the site occupancy index of the surrounding area is about 0.7. Therefore and in order to increase the site occupancy index and to having higher site efficiency, several alternatives should be analyzed. In the following, three alternatives are explained.

Three Building Alternatives

The first concept is to divide the site in the east-west axis in two equal 3,900 m² sites. The southern site would be used for the NTDC office building. The northern part could be a continuation of the surrounding urban usage, in this case residential and mixed use. Thus, NTDC should invest only on the southern part of the site.

The second possibility for optimum utilization of the whole site is to plan more office buildings than needed by Hashtgerd branch of NTDC. These office buildings not only fulfill the space requirement of NTDC in Hashtgerd, but a part of it can also be designed as renting office spaces

The third concept is to have a mixed used area focusing on office works and related utilization, which can be used by architectural offices, consulting companies, banks etc. The NTDC or other institutions can be the investor for these buildings for renting or selling.

After analyzing the above three concepts, it seems that the best choice

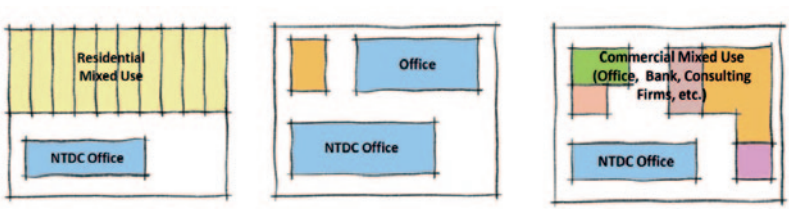


Fig. 4: Three building alternatives for an efficient use of the building site

is to divide the site into two parts. However, planning a commercial mixed-use area in the whole site has several advantages, too. For that reason, a combination of these two choices will be used. Therefore, the southern half of the whole site will be used as the site of the New Generation Office Building pilot project. This plot is a 3,900 m² site and is located in the southwest corner of the 35 ha Area. At the same time, the northern part of the site will be planned as a commercial mixed-use.

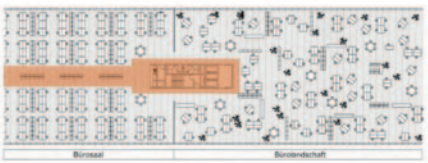
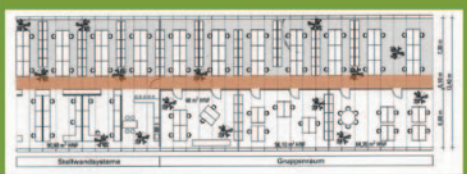
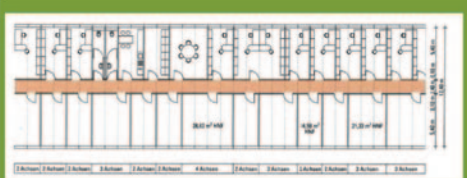
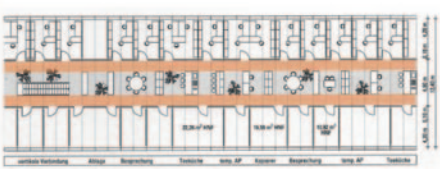
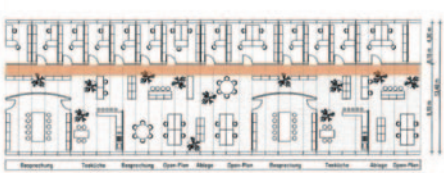
Disadvantages	Advantages	Plan	
- Acustic and visual disturbance (SBS) - Lack of privacy - Artifical lighting & ventilation - Expensens	- Communication & team spirit - Flexible arrangment of workplaces - Flexible allocation of space		Open-plan office
-Acustic disturbance - Lack of privacy - High percentage of facades - No individual climate control	- Communication & team spirit - Short ways - Workplaces of identical quality		Team office
- Non-flexible monofunctional structure - Lack of team spirit - Corridor only for traffic purpose	- Lighting and ventilation - Privateness		Individual Office
- Transparency of the individual office - Space consumption for middle-zone	- Concentration & communication - Individual control of lighting and vent. - High user acceptance		Combi office
- Lack of privacy - Technical complexity - Low user acceptance	- Spatial & organizational efficiency - Individual control of lighting and vent.		Business-Club
- Non-optimal use of space - Height between floors - Expenses	- High flexibility - Sustainability		Reversible Office

Fig. 5: Different typologies of office buildings (based on data from Eisele 2005: 60–65)

The exposed position of the NTDC office in the southwest of the 35 ha Area makes not only the NTDC office a representative building, but also marks the southern "entrance" to the 35 ha Area.

Theoretical Inquiry

Different office typologies and their characteristics and spatial requirements have been studied. The common office typologies include open plan office, team office, individual office, combi office, business club, and reversible office. The following figure shows various office typologies and their characteristics. Among all typologies, two typologies, namely 'team office' and 'individual office', are more suitable for Iran from different viewpoints.

	Open-plan Office	Team Office	Individual Office	Combi-Office	Business-Club	Reversible Office
Average Required Space per Employee (m^2)	12–15	12–15	10–14	8–12	8–12	8–15
Room Length (m)	20–30	20–30	4.5–7.2	3.6–4.5	3.6–4.5	3.6–7.2
Room Width single-user workstation (m)	–	–	2.4–3.0	2.3–3.0	2.3–3.0	2.3–3.0
Room Width double-user workstation (m)	–	–	3.6–4.5	3.5–4.5	3.5–4.5	3.5–4.5
Building Depth (m)	20–40	20–40	12–13	14–17	14–17	14–15
Height Between Floors (m)	3.75–4.5	3.75–4.5	2.75–3	3.25–3.5	3.25–3.5	min. 3.75
Clearance Height (m)	min. 3.0	min. 3.0	min. 2.5	2.75–3.0	2.75–3.0	min. 3.0
GFA/Workstation single user (m^2)	–	–	33	23–26	23–26	23–33
GFA/Workstation standard (m^2)	ca. 26.5	ca. 26.5	ca. 22.5	20.0–24.0	20.0–24.0	20.0–28.0
Amount of Employees per Room	20–100	20–100	1/2–5	1/2–5	1/2–5	Concept dependent
NIA/office unit (m^2)	400–1,600	400–1,600	–	–	–	–
GLA/workstation according to GIF (m^2)	ca. 20.5	ca. 20.5	18.0–28.0	ca. 20.0	ca. 20.0	from ca. 20.0

GFA: Gross Floor Area | GLA: Gross Leasable Area | NIA: Net Internal Area

Tab. 1: Spatial characteristics of different typologies of office buildings (based on data from Eisele 2005:60–65)

Therefore, a composition of these two typologies is used for the pilot project building.

Every office building typology has its own characteristics and its optimum dimensions such as room length, room width, height between floors etc. Therefore, each building typology has a certain building depth. The following table shows the spatial characteristics of different office typologies.

Simulation

In order to study the behavior of office buildings regarding different architectural and constructional factors, several buildings have been simulated and evaluated. The simulation results show an optimum for every architectural and constructional factor for minimizing the heating, cooling and lighting energy consumption of office buildings under the climatic conditions of Hashtgerd New Town. In every stage of the work, a proper software tool is used for simulation or data analysis.

The following graphs show, for example, the behavior of energy consumption of an office building regarding orientation and window area (for more information refer to Project Dimension Energy).

The results of simulation and analysis regarding the reduction of total energy consumption of office buildings are implemented in design of the pilot project.

Spatial Planning

Since the Hashtgerd New Town branch of NTDC will carry the costs and use the building, its corporate organization was analyzed for determining the number and functions of rooms.

Based on the number of employees and corporate organization of the Hashtgerd branch of NTDC as well as regulations regarding spatial requirements of office buildings, the room schedule of the New Generation Office Building is developed. The room schedule of the office building is done based on both German and Iranian regulations and standards.

This room schedule together with results of theoretical inquiries, analyses and related researches form the basis for room planning and design of the New Generation Office Building. Different spaces and rooms can be used in the office building including:

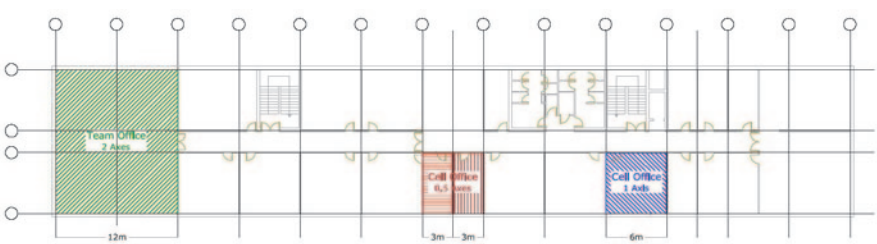


Fig. 6: Different types of Cell Offices as well as Team Office and Axes in the New Generation Office Building

- Management Cell Office
- Regular Cell Office
- Open-Plan/Team Office
- Meeting Room
- Conference Room/Auditorium
- Reception Space
- Circulation Space

- IT Equipment Space
- Archive Space
- Store Space
- Tea Kitchen
- Prayer Room
- Toilet
- Library
- Urban Concept

Different mass models and urban layouts have been sketched for the Office Building under two conditions: 1) when the whole site area is used for office buildings and the office floor area is more than NTDC requirements, and 2) when only the southern part of the site is used for the NTDC office and the northern part for commercial mixed used. These models are being evaluated from an energy efficiency point of view and are being developed by matching the urban design of the 35 ha Area pilot project.

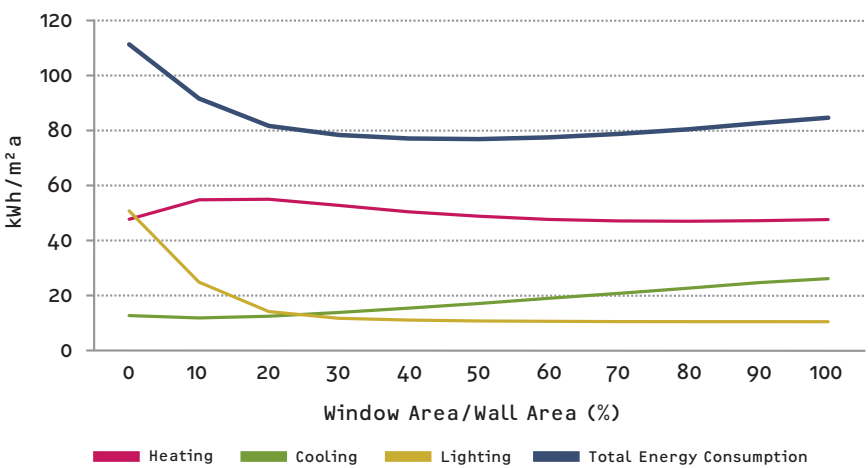


Fig. 7: Heating, cooling, lighting and total energy consumption of office buildings with different window ratio without shading devices (Nasrollahi 2010)

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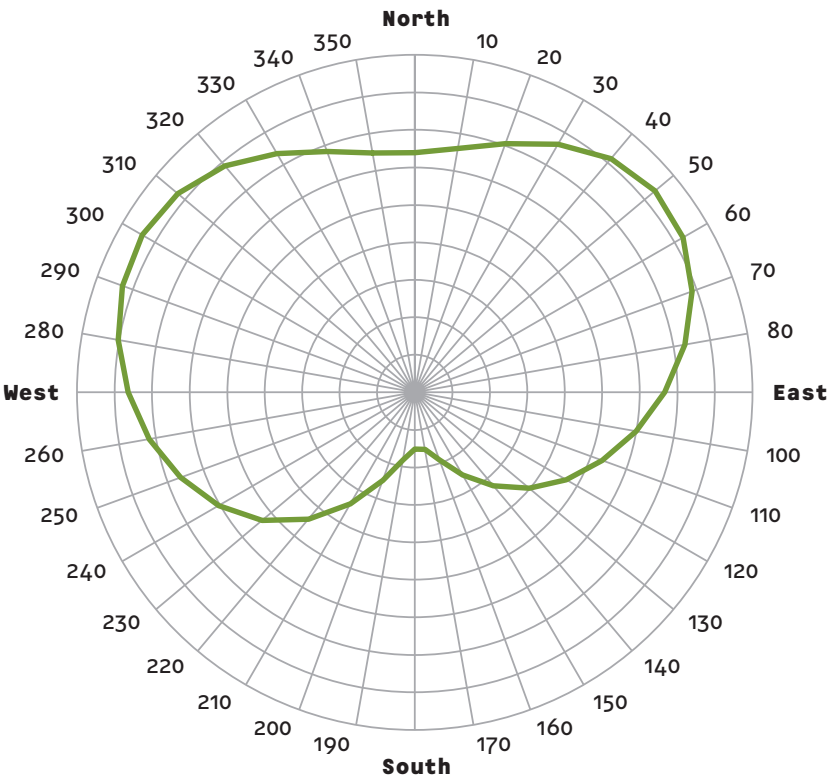

Fig. 8: Total energy consumption of an office building with different orientations (in kWh/m²a) (Nasrollahi 2010)

Pilot Project

New Quality

Klaus Rückert | Jan Grunwald | Bernd Mahrin, TU Berlin

The pilot project "New Quality" has been developed by Iranian and German scientists with the aims of:

- Improvement of the overall building quality
- Reduction of energy consumption of the building
- Improvement of the buildings' earthquake resistance.

Fig. 1: Design New Quality

The project is a Residential Block, with two neighboring buildings each includes eight units. As the one of the current Iranian housing typology; this type was selected. After three years of intensive planning and exchanging information, the corner stone was laid in Hashtgerd New Town in March 2009. Starting of construction phase dating back to June 2009, was aimed at being completed within ten months. The executing and leading investor of the project was HIC, who is therefore responsible for selling the Flats after completion of project.

Aims and Development

As the main aim the optimization of the building's concept, envelope and structure is combined with innovative building services, engineering and urban design aspects. This may cause a reduction of energy consumption for cooling and heating drastically in compare to prevalent building types. With respect to local economic conditions and costs, achieving less than 60 % of the total energy use of a comparable prevalent residential building is the project's aspired target. Optimization is aimed regarding energy-use and total life-cycle costs aspects, whereas later on the focus was on the three dimensions: construction, maintenance and operating.

Further aim was the optimization of the architectural design including an entirely new construction system combined of the load-bearing and non-load-bearing components as well as achieving building with high quality as a whole. Architects and engineers have closely worked together on the pilot project to achieve the indented reduction of energy demand, earthquake protection and building quality. In addition, the application of Iranian

Fig. 2: Corner stone ceremony in Hashtgerd New Town, May 2009

Building codes for design and construction and selecting products and materials which are certified by the BHRC had been considered, to realize the pilot project aims as much as possible.

The New Quality building is characterized by the following technical innovations compared to typical residential buildings in Iran:

- Horizontal stiffening with reinforced concrete walls and slabs which take the apparent horizontal loads in the event of an earthquake;

- Use of light-weight and heat-insulating autoclaved aerated concrete blocks (AAC) which allows (apart from its advantageous technical properties) a fast progress of works;
- External thermal insulation composite system (ETICS) at the outer walls which reduces the demand of heating and cooling energy and improves the wintry and summery thermal protection;
- Floating floor for the reduction of the sound transmission within the building.

Quality Management

To achieve a work with high quality, professional planning, selecting materials with high quality as well as permanent controlling during the realization is essential. Therefore regarding permanent controlling factor; a daily base building supervision was realized by the BHRC with assistance of experts from the TU Berlin. The main task of this supervision was to detect possible mistakes in design and structural construction early enough to react adequately. It was a successful approach because several defects have been identified, documented and followed by corrective measures. The progress of work has additionally been reported by photographic documentation.

Practical Training Workshop

During the course of the construction process it became apparent that some difficulties in execution were caused. Based on the daily supervision, the main reason was the lack of experience and practical qualifications of workers and construction site managers. Therefore, German experts of the Berufsförderungswerk e.V. des Bauindustrieverbandes Berlin-Brandenburg

Fig. 3: Supervision New Quality, December 2009

Fig. 4: Supervision New Quality, January 2010

e.V. (BFW-BB) and the Department of Vocational Training of the Technische Universität Berlin (TU Berlin) prepared a practical training workshop. It was performed in January and February 2010 by two vocational trainers from BFW-BB at the New Quality construction site in Hashtgerd New Town. The aim of this course was to train Iranian construction site managers and experienced workers in the practical execution of building measures. During the two-week course main attention was paid to following topics:

- AAC masonry
- Fitting of windows and doors
- Floating floor
- ETICS
- Waterproofing

Both, theoretical basics and practical execution at the construction site of the New Quality project were taught. Throughout the course there were twenty participants. Many of them will now distribute the acquired knowledge and experience as trainers in their own professional sphere.

Regarding the positive feedback of participants, partly disappointing situation of vocational education in the field of construction in Iran (Majedi Ardakani, 2004) and vocational education master plan (Naficy & Khallaghi 2003), it is recommended to continue with practical orientated qualification activities in close proximity to working places on construction sites. The close cooperation of Iranian and German vocational training experts proposed the following measures to be developed:

- Further short practical training courses with specific topics flanking construction processes in the framework of the Young Cities project at an early phase;
- Instruction sheets describing and explaining proper workmanship concerning special work processes, e.g. use of new technologies and innovative materials;
- Exemplary learning media (print, video and multimedia);
- Mobile learning concepts and environments to enable and support "on the job training" at construction sites.

Fig. 5: New Quality Training Workshop—Theory, February 2010

Fig. 6: New Quality Training Workshop, February 2010

Monitoring

The monitoring of the pilot project after its completion is an important component. Primarily energy and water consumption shall be measured. These measurement results will have to be compared with existing those from common Iranian buildings to indicate energy and water savings gained by the Young Cities project's work. The structural substance will be checked in order to correct potential damages by time.

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Pilot Project

New Technology

Klaus Rückert | Effat Shahriari | Jan Grunwald, TU Berlin

The New Technology pilot project building was developed up until the stage of approval of implementation planning by the German Team 3 (mainly by the TU Berlin departments of Prof. Dr. K. Rückert and Prof. R. Hascher).

Fig. 1: New Technology building: Perspective

The Project is an important opportunity to transfer technologies, which are not commonly applied in Iran construction industry. The main objectives of the proposed new technologies have been:

- Improving the standards of earthquake resistance
- Improving energy consumption patterns
- Paying more attention to the important issues such as climatic comfort.

Innovative and high-tech system of construction method and materials suggested for the project are as follow:

- Double-skin façade
- Base Control System,
- Innovative heating and cooling systems
- Light building materials
- ETFE foils
- Phase Change Material.

The implementation of these state-of-the-art technologies contributes to the objective of reducing heat gain in summer and heat loss in winter and thereby enhancing the energy consumption performance of the building. The application of ETFE foils and ETFE blinds, both support this approach.

Fig. 2: New Technology building: Interior view

The further advantages of application of these new systems and materials are related to the hazards situation such as earth quake cases, while these materials are less likely to cause damage to human beings (compared to the prevailing construction types in Iran). The improvement of earthquake resistance is sustained by a substitution of brick stone to light building materials such as plasterboard.

After finalization of implementation planning in early 2007, the building was expected to be constructed from the early main phase of the project. The two-storey building shall be erected on a plot owned by the BHRC compound in Tehran. It shall be used as an office and show case building for BHRC. Following the planning phase, the Iranian and German partners have been involved in detailing of construction costs and materials to be applied. BHRC and TU Berlin have generally agreed on the construction of the New Technology building on the BHRC side.

Another major innovation of the research within the New Technology pilot project is solar cooling. This technique uses solar energy for air conditioning. Through application of this type of air conditioning the energy consumption for cooling can be reduced up to 90 %. There are several basic types of solar cooling technologies e.g. absorption cooling, desiccant cooling or vapor compression cooling and so forth.

The project research team will focus on absorption cooling. Solar cooling is mainly used for large building units, as the machinery is not yet developed for small applications. The major task will be the optimization of size and efficiency of the units in order to be able to realize solar cooling systems for housing projects and other fields of small scale application.

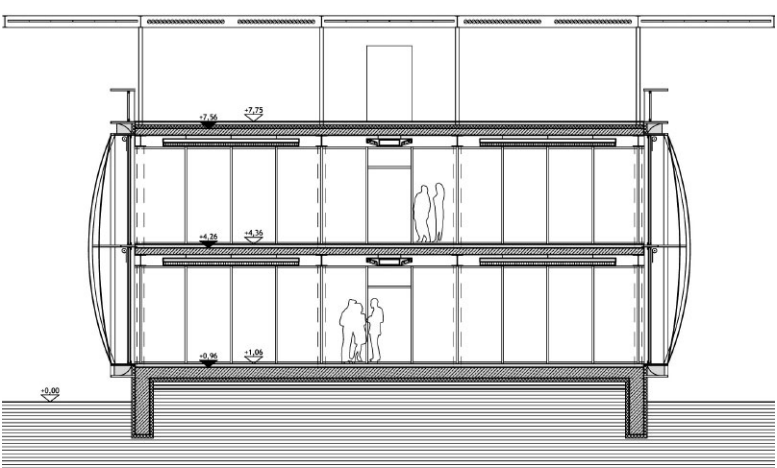

Fig. 3: New Technology building—Section

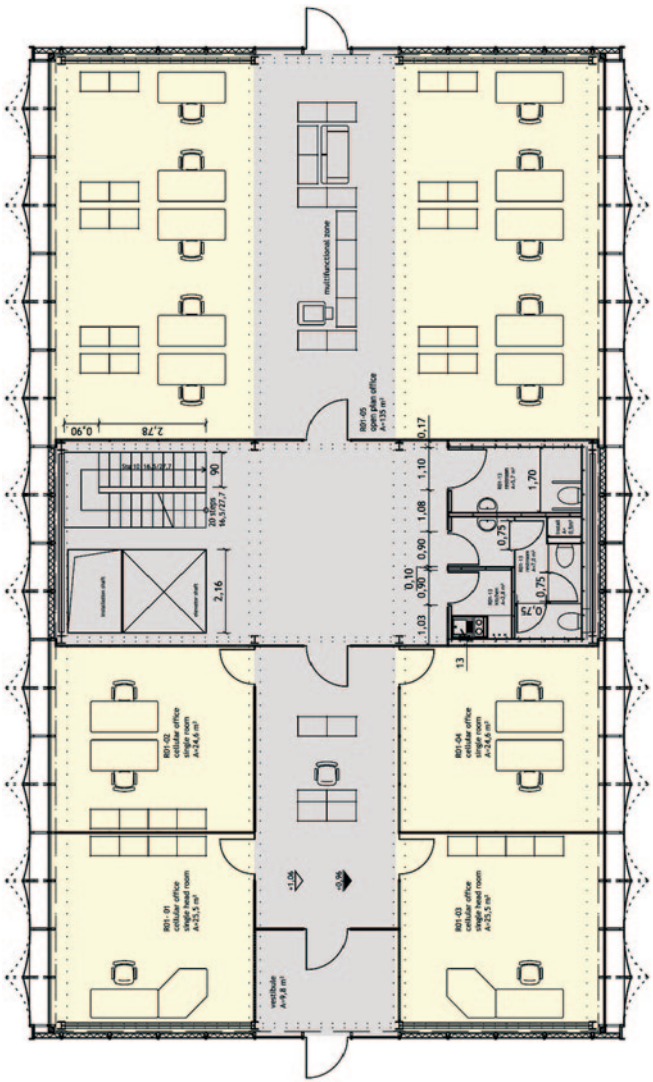

Fig. 4: New Technology building—Footprint 1st floor

Project Dimensions

In the following, all of the fourteen Project Dimensions are introduced with regard to their respective objectives and accomplishments to date, in order to show the broad range of research issues encompassed by the overall project. The interdisciplinary aspects within the overall research project are mainly covered by the pilot project articles above.

Project Dimension Urban Planning and Urban Design

Energy-Efficient Urban Form for Low Carbon Cities

Elke Pahl-Weber | Sebastian Seelig | Philipp Wehage, TU Berlin

Fig. 1: Mixed use units in the courtyards

Urban Planning and Design can have remarkable influence on climate change mitigation and adaption since both disciplines determine spatial structures, directly or indirectly influencing energy consumption (OECD 2010): Firstly, urban planning and design defines urban form, which directly influences energy-consumption through heating and cooling demands (*Physical Dimension*) (Santamouris 2009: 6). Secondly, urban planning and design take structural decisions on densities, land use patterns and

transport systems—thus influencing the distribution of goods and users. This indirectly affects the energy consumption required for transportation (*Structural Dimension*) (Jenks and Jones 2010: 7). Thirdly, urban planning and design manages the procedure of plan-preparation and implementation. This is particularly important since both get increasingly complex, consequently effecting interactions between 1. climate change, 2. mitigation and 3. adaptation measures in urban agglomerations (*Procedural Dimension*) (Tyndall Centre 2009: 5). These three basic assumptions form the focus of the Dimension, aiming at developing, implementing and evaluating approaches for energy-efficiency on the scale of neighborhoods. According to the three dimensions, the Team researches structural aspects (land use), physical aspects (density, compactness) and procedural aspects (procedural management) and its impacts on mitigation and adaptation.

The work on the structural aspects started with a review on the interrelations of land use and energy consumption with a special focus on mixed land use strategies. The strategies theoretically proofed the energetic capacities of the mixed-use approach on the quarter level, shorter travel distances and increased use of public transport, whereas on the building level it was

Fig. 2: 35 ha Mixed Use District with Mixed Use Areas (in orange)

through waste-heat utilization (e.g. Cervero 1996, Bretschneider 2007). The results were followed by an analysis of land use approaches in both the traditional and contemporary Iranian city (Hashtgerd New Town), which led to initial considerations for a mixed-use quarter, aiming at a vital, yet energy-efficient neighborhood with a strong economic impetus. These goals translate into a land use concept that proposes a strong district center with larger social and commercial functions and a fine mix of smaller commer-

cial and residential uses on the sub-neighborhood scale in "Vertical Mixed Units". They provide space for smaller non-residential uses on the ground floors of houses around the courtyards (see fig. 1). Distances between housing, work, supply infrastructure and social infrastructure are kept short; the integration of larger social functions within walking distance and the connection to the city-wide public transportation system, as well as to walking and cycling routes supports this approach. All elements of this proposal are part of the "Mixed Use District" (MUD) as defined in the "Tarh-e Tafsili" (see fig. 2).

Starting the work on the physical topics, in the first step a literature analysis proofed the influence of compact urban form on energy efficiency (e.g. Burton 2002). This was deepened by an analysis of the energetic potentials of traditional Iranian urban form, which proofed the huge local benefits in this field, especially regarding passive design strategies. These analyses led to a further elaboration of the already developed "low rise—high density" approach on the urban design level. The design studies were accompanied by simulations in ENVI-met (microclimate), VISEVA+ (transport) and ECOTECT (energy) and proofed remarkable energy reductions in

Fig. 3: 35 ha Area Urban Concept

comparison to common Iranian housing design only through spatial measures such as compactness. It can minimize exposed building surfaces und thus reduces thermal loss. Another major factor is the orientation of each building—the north-south orientation of the buildings reduces the cooling demand by up to 23 % and heating demand by up to 16 % compared to unfavorable building orientations on the 35 ha site. Moreover buildings and open spaces were designed according to sun, wind and vegetation. This re-

duces energy consumption but also creates outdoor thermal comfort. One example is the arrangement of buildings, which block the prevailing western and northwestern winds as well as the hot and dusty winds from the southeast in summer. At the same time it allows the cool north-south winds from Alborz Mountains to channel through the site. The simulation results showing calm wind in inner courtyards in 2 m height support this hypothesis. Another important factor is the vegetation with its potentially positive effects on the microclimate in summer months. The increase of open and green spaces on 35 ha compared to the original land use program of the site fosters cooling by vegetation: e.g. simulations have shown that planted tree can decrease the surface temperature by 9°K compared to scenarios with no trees.

The third dimension covers the question of adequate plan making and plan implementation for energy efficient quarters focusing on formal planning instruments (legally binding detailed plans, Iranian "Tarh-e Tafsili"). Result of an analysis of the Iranian regulations and procedures additionally with the comparison to best-practice in Germany was the need to further develop the Tarh-e Tafsili as it currently mainly concentrates on physical and technical elements (such as plot ratio or parking facilities). Aspects of sustainability, e.g. energy efficiency or environmental protection, are not sufficiently covered; moreover the depth of regulation is not effectual for these issues. This resulted in an approach to complement contents with additional innovative elements and methods from the German planning system. The plan now introduces a range of innovative regulations, mainly on energy-efficiency and environmental protection. Examples of these are the

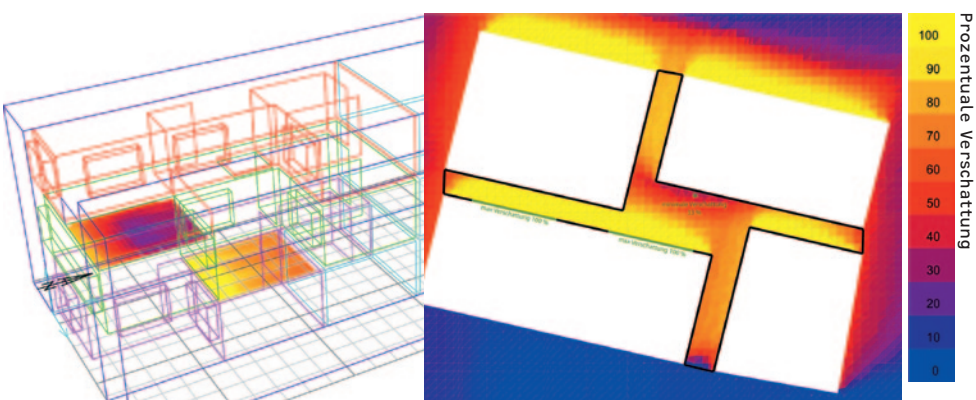

Fig. 4: Shading simulations on compact urban form

introduction of mixed-use zones, the designation of building lines, the integration of public transport and the integration of an environmental assessment (see Project Dimension Environmental Assessment). All mentioned elements were adapted and applied during the elaboration of the Tarh-e Tafsili for the 35 ha area and documented in an explanatory report.

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Project Dimension Urban Design and Architecture

Architecture and Urban Design for Energy-Efficiency in Social and Climate Context

Elke Pahl-Weber | Philipp Wehage | Annette Wolpert, TU Berlin

Architecture and Urban Design articulate the spatial expression of functional need. As the physical application of creating space, architecture and urban design have to integrate the aims of energy-efficiency in the socio-cultural, climate and topographical context of the specific site of Hashtgerd New Town.

Besides the approach of optimizing through technological efforts (e.g. materials and construction), a starting point for energy-conscious research is the spatial organization of the different scales in the urban form. The continuum of scales from the city to the quarter to the single building, reveals the interfaces and references of all planning dimensions concerning urbanity, landscape, energy and mobility.

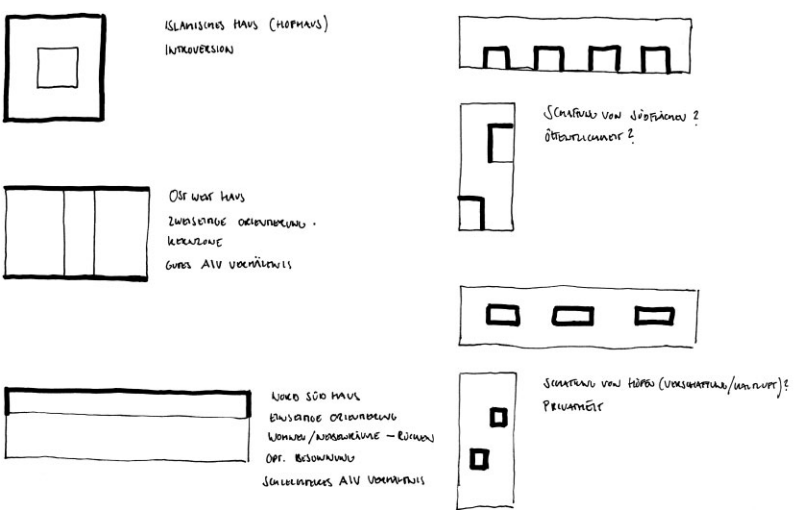

Fig. 1: Orientation of buildings

The research on architecture and urban design for mass housing in compact urban form analyzes the spatial consequences of energy-efficiency, under consideration of the research results of the dimension urban planning and urban design, with focus on the physical application in the 35 ha pilot project. The references to socio-cultural and climate aspects are investigated in research on vernacular architecture and urban design (cp. Bianca, Wirth).

A central task of the research by design process—the development of housing typologies for the 35 ha Area pilot project—is a design study for the application of scientific results concerning energy-efficiency in the compact urban form of the pilot project. With the goals of the urban design mas-

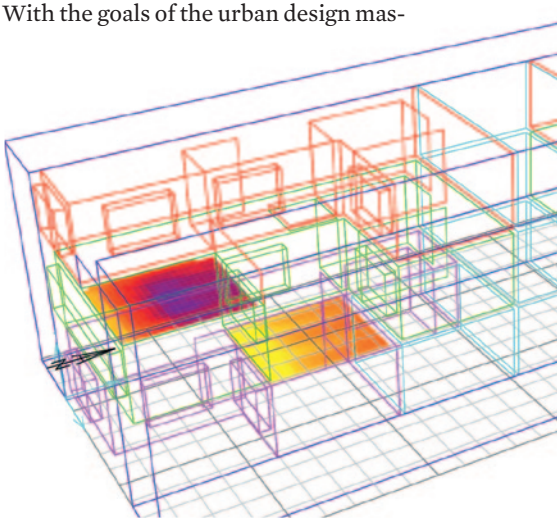

Fig. 2: Design study and shading simulation of housing unit
Fig. 3: Housing typology in urban context, urban clusters of sub-neighborhood in the 35 ha Area

ter plan as a starting point, the project focus was drawn to the energy gain that could be realized through compactness and the opportunities of traditional housing in the socio-cultural context of Iran (cp. even Hönger et al.).

Therefore the research started with the analysis of vernacular housing forms in Iran and their relevance for the urban arrangement and the climate context as well as the existing building typologies in Hashtgerd New Town. The first result of this analysis was the finding of a spatial hierarchy

from public to private in the traditional city, regarding the socio-cultural and climate situation and its comparison to the modern international style (cp. Wirth).

The identified urban space system offered an approach for a contemporary application in the 35 ha pilot project with continual guidance from urban to building scale.

This approach is characterized on one side by the importance of privacy in a compact urban form, formulated by the introversion of the courtyard house typology (cp. Bianca, Wirth). On the other side, introversion serves as a climate-regulating element, regarding the influence of sunlight and wind on buildings and their relevance for energy consumption (fig. 1) (cp. even Hönger et al., Edwards et al., Hegger et al.).

Fig. 4: Housing typology for compact urban form in 35 ha

Out of this approach the design studies for housing typologies seek to combine traditional aspects with the needs of the contemporary energy-efficient New Town.

By sculpting the building volumes through implementation of courts and niches, the south orientation of the housing units for sun impact as passive energy gain can be reached in narrowness of compact urban form. With the vertical organization of apartments, a good exposure to daylight for every

unit is possible in the compact urban form of 35 ha pilot project (fig. 2, fig. 5).

The layout of plots and buildings are also determined by the urban concept (fig. 3). For flexibility an axial system in the plot dimensions allows variations in the typological architecture on the different sites by keeping vertical constructive continuity. This system allows for simple constructions concerning the height of max. three storeys above-ground and the conventional measuring of room dimensions (fig. 4). Basement parking can be provided. The ground floor zone offers space for services and the proposed "mixed use" zones, as worked out in the urban approach.

Beside the reduction of energy demand out of the described geometric basic principle, upgrading through supplementary technical measures enable an additional increase of efficiency. The use of sub-soil-energy reduces the heating and cooling demand while light shelves or photovoltaic fabrics regulate the sun-incidence (fig. 6).

Fig. 5: Private Courtyard in Housing Unit

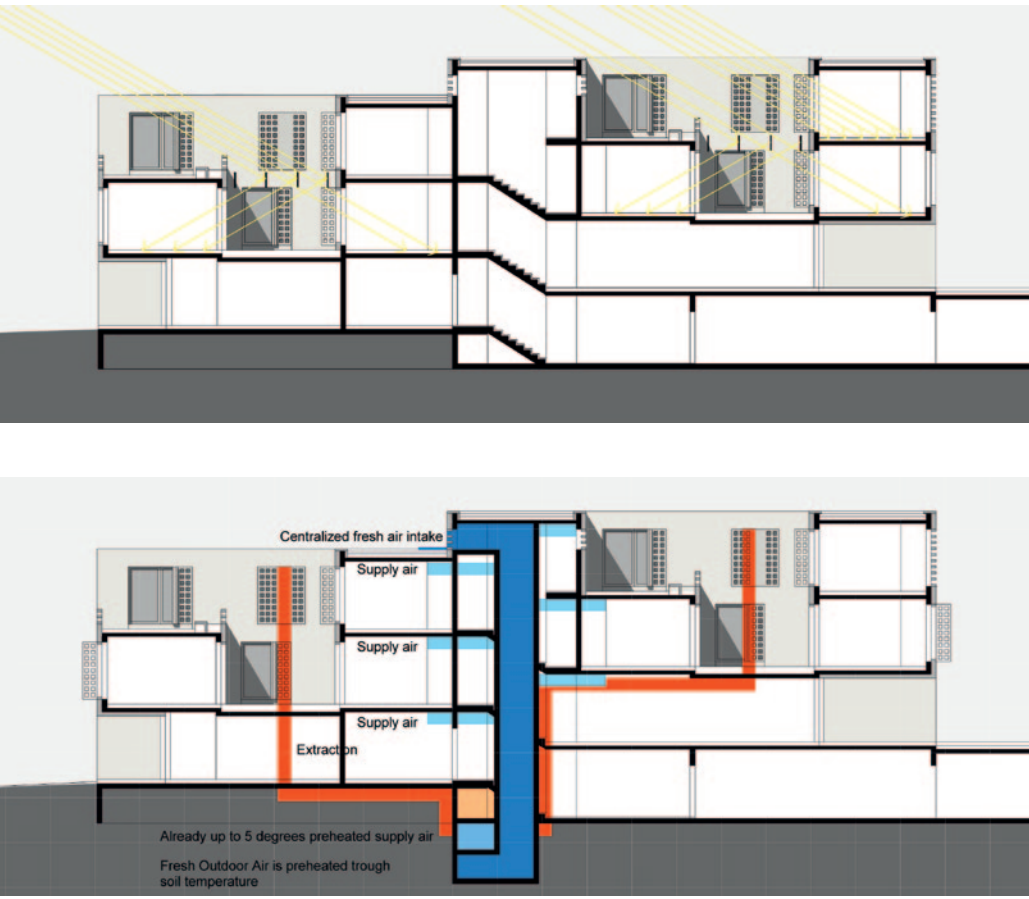

Fig. 6: Sub-Soil Energy and Light Shelves

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Project Dimension Landscape Planning

Landscape Planning in an Urban Context in the Light of Climate Change

Stefan Heiland | Bernd Demuth | Theresa Garske, TU Berlin

Scientific studies state a global temperature rise between 1.1 and 6.4°C as an aspect of the climate change, as well as an increase of extreme weather events (IPCC 2007). This will have serious consequences for inhabitants of cities (e.g. formation of heat islands). Strong impairments of health and quality of LIFE for the inhabitants are expected (Irvine 2010).

Possibilities of green and open space planning regarding mitigation and adaptation measures

In terms of mitigation and adaptation to climate change and its negative consequences in an urban environment, green and open spaces (GOS) are particularly important because:

- GOS can enhance the microclimate, especially through reducing the effects of urban heat islands (Marsh 2010),
- GOS can contain a high recreational potential, which helps to maintain a high life quality of the population,
- a higher vegetation cover can decrease the freely disposable CO_2 (considering plant selection, see below).

For the maintenance of human health and quality of life in times of climate change a sufficient provision of green and open spaces (GOS) for recreation in the vicinity of residential areas plays an important role. To describe a local provisioning status in an urban context two analysis-steps were defined:

- Screening concerning qualitative and quantitative characteristics of each GOS (e.g. proximity to main streets, slope, area size and width).
- Analysis concerning the quantitative provision of GOS (per capita value of GOS within a 500 m walking distance).

Consequently, an analysis of the open space potentials in Hashtgerd and in the 35 ha pilot project area has been carried out. To assess the GOS provisioning status as sufficient, a standard of 7m² GOS per capita (within a 500 m distance) was set (reflecting Iranian as well as German standards).

As a result, recreation facilities in the vicinity of residential areas were considered as not being sufficient in the face of the above-mentioned criteria. The remaining area requirements can only be covered through adjacent areas of Hashtgerd New Town.

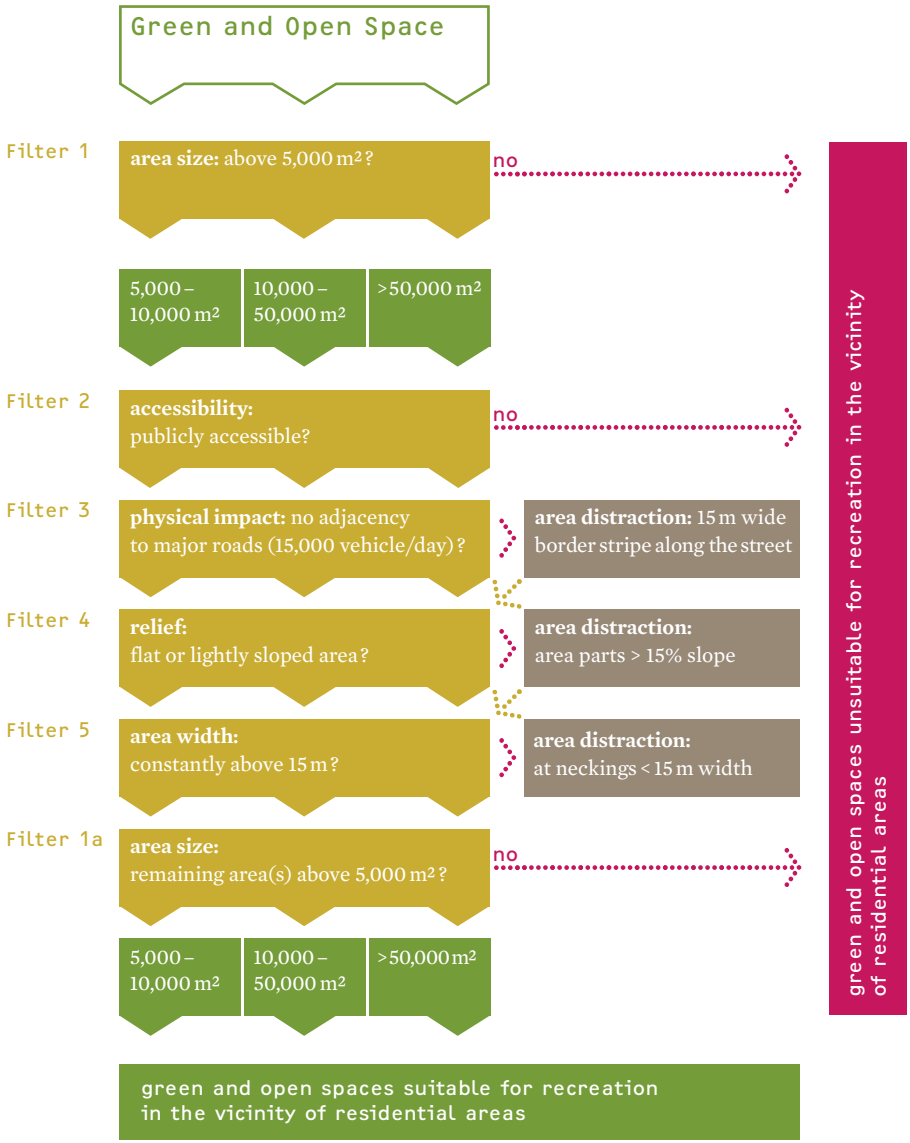

Fig. 1: Qualitative and quantitative assessment of the "suitability of green and open spaces in the vicinity of residential areas"

Open spaces in the 35 ha pilot project area, not suitable for recreation purposes will be used for CO_2-binding. In terms of mitigation of climate change the decrease of freely disposable CO_2 in the atmosphere is one of the most important tasks. As a small contribution adjusted to the size of the pilot project area, three ha will be designated for that purpose in the legally binding land-use plan. Generally all plants are suitable for CO_2-binding. Nevertheless, due to resource protection needs (especially water) only spe-

cies adapted to an arid climate should be used. This means that only native plant species will be planted which have a low water demand and which are suitable for CO_2-binding purposes in a semi-arid climate (see plant list designated in the land use plan, UNDP 2003). That way three tons of carbon would be bonded after five years, up to 23.7 tons after 20 years within the 35 ha pilot project area.

Resource-protective planning

Considering energy-saving and resource-protective planning (OECD 2010) it becomes obvious that water is the keyfactor for green and open space planning in semi-arid climates. The requirements for sustainable planning imply a balancing of the economic, ecological and social interests (Madanipour 2011, Tang & Wei 2010).

In climate zones with sufficient water supply, large vegetation structures such as gardens, parks or e.g. roadside greenery can be maintained with comparably low resource deployment. This is not applicable to semi-arid climates, prevailing in the region of Teheran and Hashtgerd.

In order to save the scarce water resources (Zehtabian 2010), only native or well adapted trees and shrubs with low water consumption are to be planted (Bobek 1951). Besides resource saving aspects, native species are important regarding nature-protection e.g. as habitats for native animal species. Native species can also contribute to the environmental education

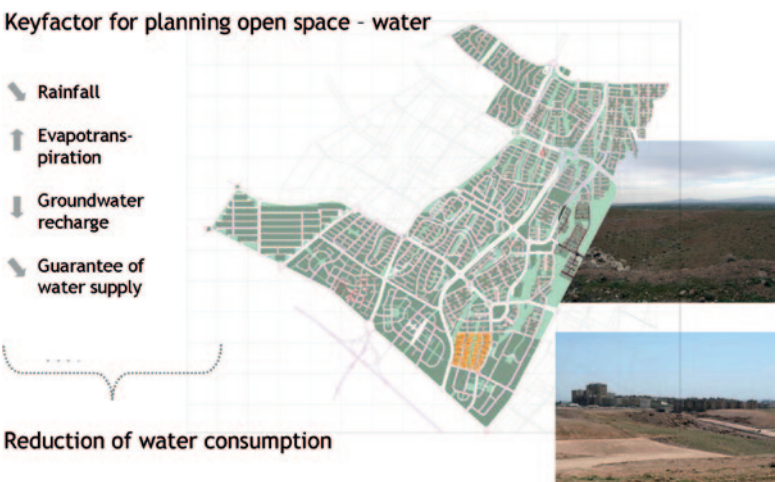

Fig. 2: Sustainable development of open space

of the local population in combination with awareness rising for “traditional”, edible, cultivated plants.

Due to the already existing shortage of water, which will be additionally increased by climate change, not much water can be provided for irrigation. Therefore the resulting landscape scenery within the pilot project area will be mainly characterized as ‘dry landscape’. Due to societal acceptance, small selected areas will be designed as ‘lush green areas’ to satisfy the local

requests of green parks, similar to oases. Beyond that improvements of the microclimate in the vicinity of residential areas in terms of shading (cooling effect) and the increase of air humidity, will primarily be achieved by technical measures (e.g. awnings and shading by texture).

For the irrigation of the vegetation no drinking water will be used. The sewage water originating from adjacent private households (only from handwashbasins and showers), will be purified by constructed wetlands. The resulting greywater can then be used for irrigation purposes. Additionally, water saving irrigation systems (underfloor and drip irrigation) are proposed. The saving of water has a long tradition in the Iran e.g. in the view of the qanat technologies (Ahmadi et al. 2010)—the awareness of the citizens for this tradition should be reactivated.

The not necessarily needed or saved greywater can be infiltrated to enrich the groundwater recharge (Haaren 2004). Following the most recent calculations and assumptions of water use in the households within the 35 ha pilot project area, about 415,500 l could be infiltrated this way every day.

Due to the reduced water demand and because of the decentralization of the constructed wetlands (locations designated in the legally binding land use plan), the effort for pumping will be reduced. As a consequence the energy consumption will decrease as well.

The legal implementation of environment and nature conservation in the legally binding land use plan of the 35 ha pilot project area may serve as motivation for the possibilities of a landscape planning process (Farhoodi 2009, Hamed 2002).

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Project Dimension Transport and Mobility

Integrated Transportation Planning for Energy Reduced Traffic

Wulf-Holger Arndt, Tu Berlin

Although new integrated approaches are in updraft in many countries worldwide, transport planning is often still focusing on the needs of a rapidly growing car stock (Petersen 2004). Especially in urban agglomerations of the developing world a fast individual motorization rate is still representing economic growth and social prosperity. In North-American and European cities for example this has led to spatially clustered urban structures, de-

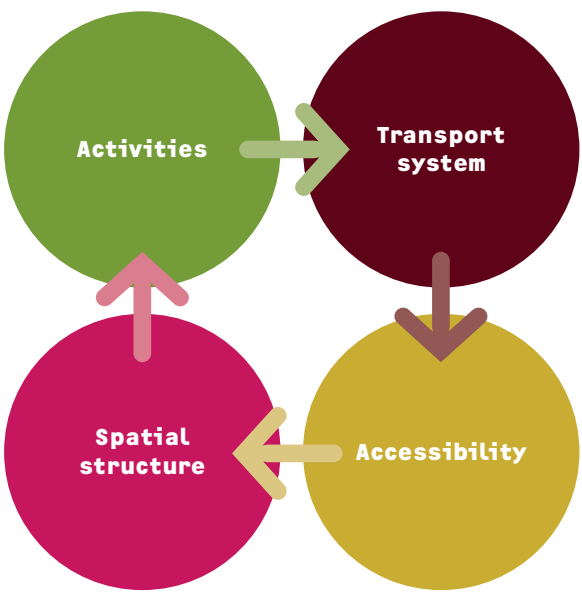

Fig. 1: Interrelations

limitated through big transit corridors, congestion during the daily morning and evening peaks, high traffic fatality rates, air and noise pollution, and enormous energy consumption. In the western world, urban sprawl with decreasing population densities and shrinking city centres was another negative effect of a growing car stock. This often resulted in a need for subsidizing the public transport systems and sometimes its abolishment.

Furthermore, within the transport sector, car traffic is with 25 % up to 30 % of all CO_2 emissions one of the main sources of carbon emissions (European Union 2011: 9).

Today Iranian cities are facing nearly the same problems: Already in 1997 20 % of all GHG emissions had their source in Teheran's urban transport sector (PLS Ramboll management 2003). Furthermore, between 1996 and 2002 the number of vehicle km travelled under congestion has increased from about 21 % to 27 % (World Bank 2005)

As already stated the origins of upper mentioned trends and problems are complex, why only a holistic consideration of mobility is capable of addressing these issues. Thus, in the case of the 35 ha pilot project area the project dimension tries to elaborate an integrated transport concept.

The guiding principle for the elaboration of a concept for Hashtgerd and the 35 ha pilot project area is to consider the interrelations between spatial structure and traffic demand (fig. 1) using innovative transport simulation software like VISUM/VISEVA. The enhancement VISEVA+ will be used for the first time in this project for optimisation of a traffic-reduced spatial structure.

"Reducing traffic and increasing mobility" stands as the envisaged target. The main approach focuses on a shift of mobility routines and the support of environment-friendly means of transport through the provision of a modern efficient public transport network, an information network on alternative ways of movement, and different measures to delimitate the attractiveness of conventional motorised individual traffic. The special situation as a New Town is a chance to influence the traffic behaviour of the new inhabitants deeply towards sustainability.

Key elements of the transport concept are:

- Support of the mixed land use approach through adequate mobility systems,
- Accessibility (social and area related),
- Integration of all traffic means in Transport and Urban Planning,
- Support of environment-friendly traffic (slow modes, public transport),
- Filtered permeability of spaces and coequality for traffic modes regarding their environmental impacts (traffic management),
- Flexible and adaptable Transport and Mobility Planning approach,
- Avoidance of extraneous traffic through residential areas,
- Increasing traffic safety,
- Participation of all stakeholders in the planning process,
- Attention to disaster management.

Up to now an approach of different instruments addressing the key elements has been developed. These different instruments can structurally be differentiated into "hard policies" and "soft policies" on the one hand and "push components" and "pull components" on the other.

Since an individual develops its future mobility routines during a short reorientation phase after the move, the instruments are intended to influence this process towards eco-mobilty.

On the level of whole Hashtgerd, a mobility management system as a major framework is envisaged. Its main task is to organize the hierarchically structured public transport system, consisting of a lightrail or lightbus rapid transit, citybus, neighborhoodbus (as midibus or minibus). The often underestimated soft policies (e.g. information packages, campaigns) should provide the consumer with adequate information about the public transport system. So far a first draft of a system, also serving the city of Old Hashtgerd, has been finalized, tested in the transport model, and is currently under revision.

Concerning the 35 ha pilot project area the Dimension Transport and Mobility is providing an integrated concept for a road, foot, parking and bicycle network, as well as a concept for a "Mobility Package" for new inhabitants. The Mobility Package is planned to provide information on environment-friendly modes of transport, on services, facilities in the neighborhood, and should be combined with incentives like a test ticket for the public transport system.

Following the above mentioned criteria, special attention is put on accessibility, barrier-freedom, information, support of the spatial mixed use approach and a shift of mobility routines. To guarantee the spatial horizon-

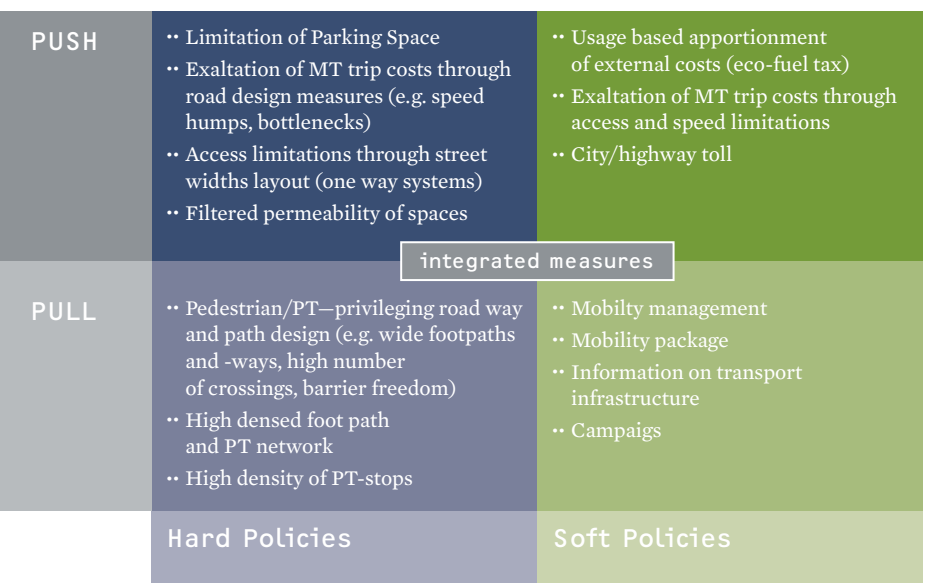

Fig. 2: Transport Approach—Possible instruments for implementing the chosen leitmotif

tal integration into the whole agglomeration, the transport system of the 35 ha pilot project area is a part of the public transport approach for the whole City of Hashtgerd. Thus the area should be served by a Bus Rapid Transit (in advance of a later Light Rail Transit) as well as a citybus at the western and eastern border, while the neighborhoodbus is planned to drive through the area.

Finally, the inhabitants of New Hashtgerd and especially those of the 35 ha pilot project area will have the chance to set Iran-wide new standards in matters of sustainable, environmental-friendly mobility.

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Project Dimension Climatology

Climatological Downscaling Procedure for Hashtgerd New Town

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FU Berlin

The climatology group of the Free University of Berlin investigates the climate of today and the future, as well as emissions for Hashtgerd New Town. To find the prediction, the double nesting of the climate model REMO (with 50 and 10 km resolution) is used. The future climate for the next 50 years will be simulated for the whole of Iran and will be downscaled for Hashtgerd with neuro-fuzzy methods. Additionally, the microclimate of (parts of the) 35 ha Area pilot project, as well as the influence of urban structure, architecture and vegetation is simulated with the software Envi-Met. Furthermore, an updated emission map will be prepared for Iran and Teheran province with high resolution using global and regional Iranian emission inventories. The Dimension climatology includes two main parts as follow:

Climatological Statistics

The analyses of current climate parameters are used for the training of Neuro-Fuzzy rules. Tehran province is surrounded by areas of the great Alborz mountain massif, West Zagros highlands and Western part of the Kavir salt desert, specified by altitude ranging from 800 m to 4300 m above sea level. The first statistics of climatological data in the investigated area show that the highest recorded summer temperature in this area was 42°C while the lowest has been registered at -8°C. The climate of Tehran province in the southern areas is warm and dry, but near the mountains cold and semi-humid. In the higher regions it is cold with long winters. The warmest months of the year are from mid-July to mid-September when temperatures range from 28°C up to 35°C, and the coldest months are December-January with the minimum of 1°C, but at certain times in winter it can reach -15°C. On the whole the province has a semi arid, steppe climate in the south and an alpine climate in the north. There is no weather station in Hashtgerd New Town, but the meteorological data from the next station which is 30 km away from Hashtgerd (Karaj-Keshavarzi) show that the minimum, maximum and mean daily temperatures have had a considerable increase of about 2°C in the last 20 years. The mean lowest daily temperature is about 9°C whereas the mean highest is about 21.36°C. The mean daily temperature for over 20 years has a value of 15.22°C at this station.

The air masses which affect the weather of the province of Tehran come from West and Northwest in winter, and from East in summer. Pluvial air

mass visits the area from either West or North which brings with it humidity then giving precipitation when crossing Azerbaijan, Zagros and Alborz mountains, eventually losing its influence as it advances further towards East and South. For this reason the intensity and amount of precipitation of the area is controlled by latitude and altitude. The area receives 700 mm or more rainfall in the Western and Northern highlands and 100 mm or less in the Southern and Eastern border, near the Kavir salt desert. The mean annual precipitation in the investigated area is about 225 mm showing a positive trend in previous last years. Some extreme events with precipitation greater than 35 mm/day have also been observed in Hashtgerd. Most of the relatively low annual precipitation falls from October–April. As the annual mean temperature has risen, the total daily evaporation has shown to have decreased in previous years, although some extreme values were observed (30 mm daily evaporation in year 2004). The mean annual evaporation at the Karaj-Keshavrazi station is about 1750 mm where the sunshine duration is 10–12 hours in summer and about 5–10 hours in winter.

The wind mainly travels from North and North Westerly regions, however in summer months the Easterly wind is also noticable (Jun–Nov). The wind speed averages around 4.48 m/s yet some extremes have been recorded which were greater than 40 m/s. The solar radiation in Karaj-Keshavarzi station is about 4.72 kwh/m² per day.

Source Sector	CO_2 (ktons)	CH_4 (ktons)
Energy production	108,831	4
Residential combustion	123,107	9
Industrial combustion	70,869	2
Industrial processes	26,267	0
Fossil fuel production	14,539	3,793
Solvents and product use	305	0
Road transport	100,359	31
Non-road transport	0	0
Waste	0	602
Agriculture	1,641	994
Total Iran	**445,918**	**5,437**

Tab. 1: Estimated Carbon dioxide and methane emission from Iran in 2005 (EC-JRC/PBL. EDGAR version 4.0, http://edgar.jrc.ec.europa.eu/ 2009)

Emission inventory of air pollutants for Tehran and the Islamic Republic of Iran

An updated emission map will be prepared for Iran and Teheran province with high resolution. The starting point is the new, recently released EDGAR v 4.0 emission inventory, which is available for the Iranian greenhouse gas emissions (see tab. 1) and other air pollutants (excluding PM10 and PM2.5). First results of the greenhouse gas emissions are already pre-

pared in high resolution by TNO, but for other pollutants the work is ongoing. Existing Iranian inventories will be used to improve and/or validate the global EDGAR inventory. Both inventories are available in GIS masks (e.g., for a province or the City of Tehran) and the regional information within Iran will be obtained and submitted to the Iranian counterparts for further checking and improvement. The feedback should result in an adjusted emission grid. The preparation of the inventory maps will be harmonized with the needs of the climate modellers, including a further definition of the model domain during a meeting with Iranian partners.

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Project Dimension Energy Infrastructure System

Improvement of Traditional Energy Systems in Combination with Renewable Energy Use

Steffen Unger, Fraunhofer FIRST | Christoph Nytsch-Geusen | Jörg Huber, Berlin University of the Arts

The aim of the Dimension "Energy Infrastructure Systems" is to optimize supply and distribution of cooling and heating energy for the 35 ha Area pilot project and thus, in particular, to reduce the energy consumption of fossil energies by new technologies and by their replacement through renewable energy sources.

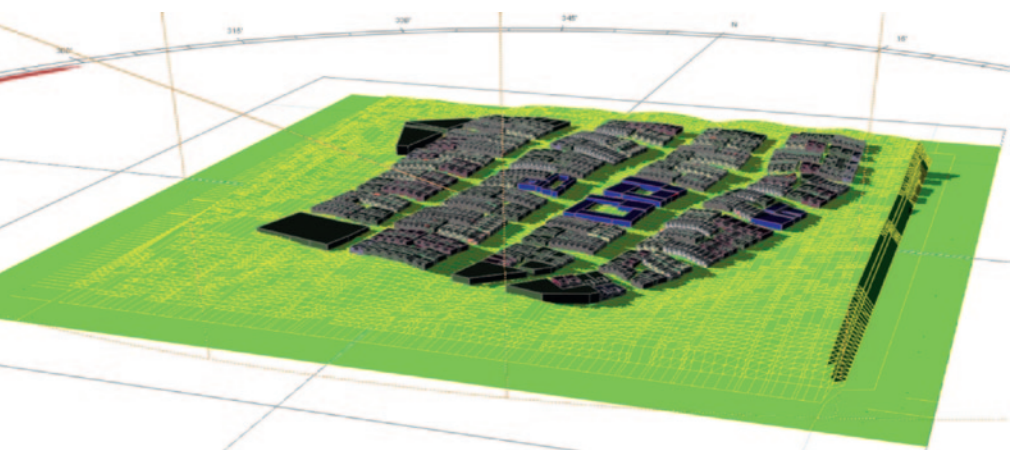

Fig. 1: Shading calculations for the 35 ha Project area (Team 2, Energy Infrastructure Systems)

The design of the energy infrastructure systems for the 35 ha Area pilot project began with a detailed view to each energy consumer and the specific energy demands, depending on the type of utilization of building (e.g. for living or working). Within 35 ha Area pilot project, there are various kinds of buildings utilized. The buildings are mainly residential, though there are several individual types for education, religion and office use.

Initially, detailed building models were developed in a dynamic thermal simulation program. These models contain detailed geometry and physical aspects (orientation, wall constructions, etc.), user behavior, ventilation, infiltration, lighting and furthermore the weather data from the region Hashtgerd New Town. The U-values for the walls, roofs, basement ceilings and windows, were selected to have a total thermal energy demand for both heating and cooling to be 50 % compared to the limits of the "Code 19" building Iranian energy standard.

All the residential building types were modelled with the 3D-energy design tool Autodesk ECOTECT and calculated with the energy simulation tool EnergyPlus (Huber and Nytsch-Geusen 2011).

The results of the simulations were determined by the heating and cooling loads for each kind of building. Furthermore this provided answers about thermal comfort, solar irradiation, shadings or temperature gradients.

The energy supply systems were calculated by the results from the heating and cooling demand, the different sub-neighborhoods, and also for the total 35 ha Area pilot project. The design of the central, semi-central and decentral energy infrastructure networks such as, the 35 ha Area pilot proj-

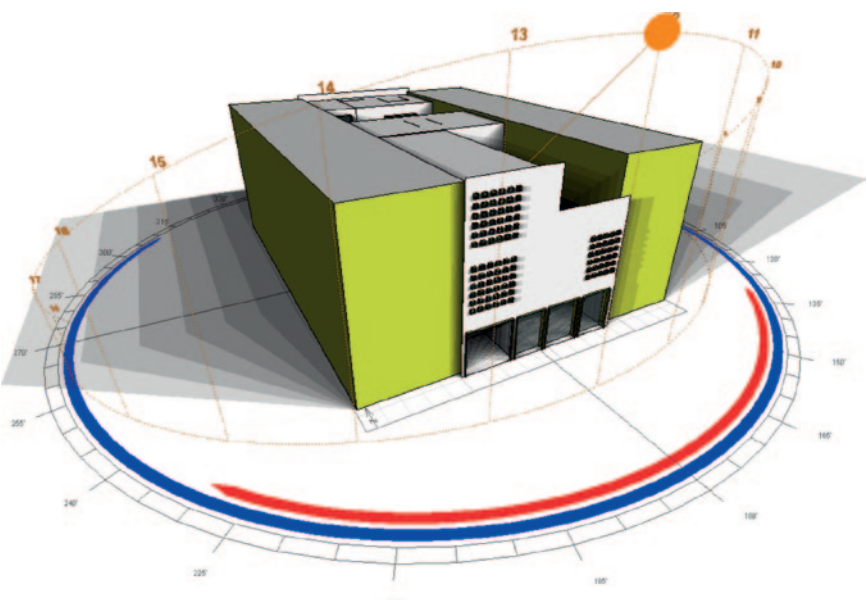

Fig. 2: 9 m building type model with shading in June (Team 2, Energy Infrastructure Systems)

ect, depend upon various variables for example the type of energy production, used energy source, redundancy, and existing surfaces. Due to the solar radiation (approximately 1.900 kWh/m²a), Hashtgerd New Town offers a large potential to use solar radiation for heating and active cooling.

Based on the simulation language Modelica, a model for centralized energy supply system was configured (Nytsch-Geusen et al. 2010). The main sub-models of this system model were an energy central model with a

cogeneration plant and a thermal storage, a heating district network model for the 35 ha Area, a decentralized solar assisted cooling model, and a set of thermal building models.

The modelled subsystems in Modelica are the energy center (cogeneration plant with a peak boiler and a thermal storage), the district heating net for the heating and warm-water demand and the thermal consumers, including the decentralized solar cooling systems. The energy supply system amounts to more than 30,000 equations from the system model.

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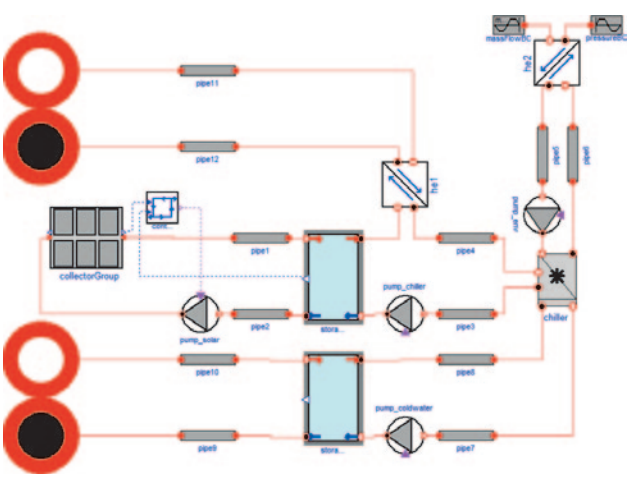

Fig. 3: Model of the solar cooling system
(Source: Team 2, Energy Infrastructure Systems)

Project Dimension Water and Wastewater Management

Increased Sustainability through Water Saving Measures and Reuse of Grey-water in Iranian New Towns

Shahrooz Mohajeri | Tamara Nuñez von Voigt, inter 3

Water scarcity, high water consumption and anthropogenic (man-made) pollution of water and environmental resources are affecting human health, as well as limiting yet current urban development so that industrial and commercial development of the region around Hashtgerd is retarded.

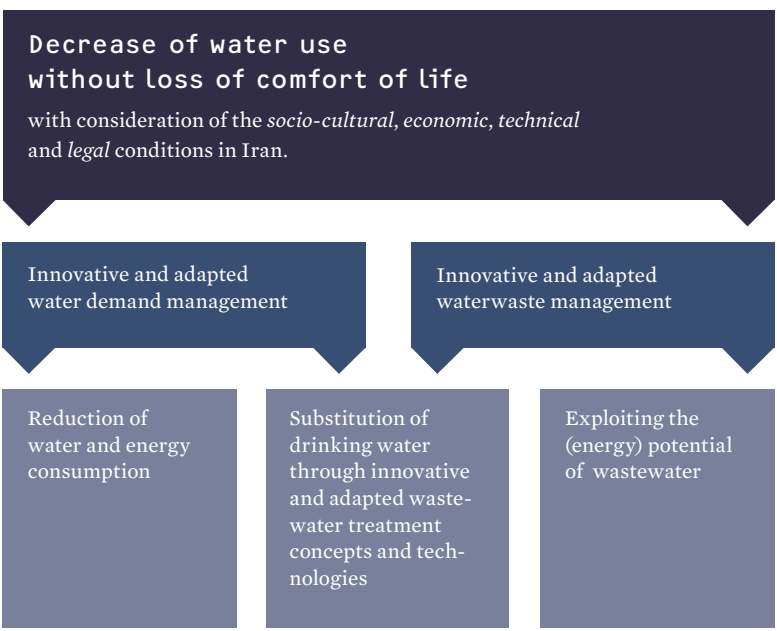

Fig. 1: Targets of Sub-Projects

Therefore modern and integrated concepts and technologies have to be developed to protect environmental and water resources on the one hand, yet to use wastewater as a new resource is essential on the other.

Especially by the construction of new infrastructural systems in New Town Hashtgerd the responsible agents have the unique opportunity to develop a modern and integrated water supply and disposal system, by adapting a sustainable resource management.

Additionally, emerging New Towns provide the opportunity to apply innovative technologies and processes.

Due to this conviction, the water management team targets to develop an integrated and sustainable water and waste water infrastructure for New Town Hashtgerd, which should focus on protecting the health of inhabitants, regional environmental and water resources as well as at the same time focus on using upcoming waste water efficiently as a source for energy supply and as a substitution for drinking water.

Hence the two main considerations related to this project are the identification of possibilities to reduce water consumption (without restricting living standards), and the use of waste water and its energy potentials (see fig. 1).

To achieve these targets, management concepts for water demand and waste water in arid and semi-arid regions, under consideration of climate change and natural conditions, as well as socio-cultural circumstances, are

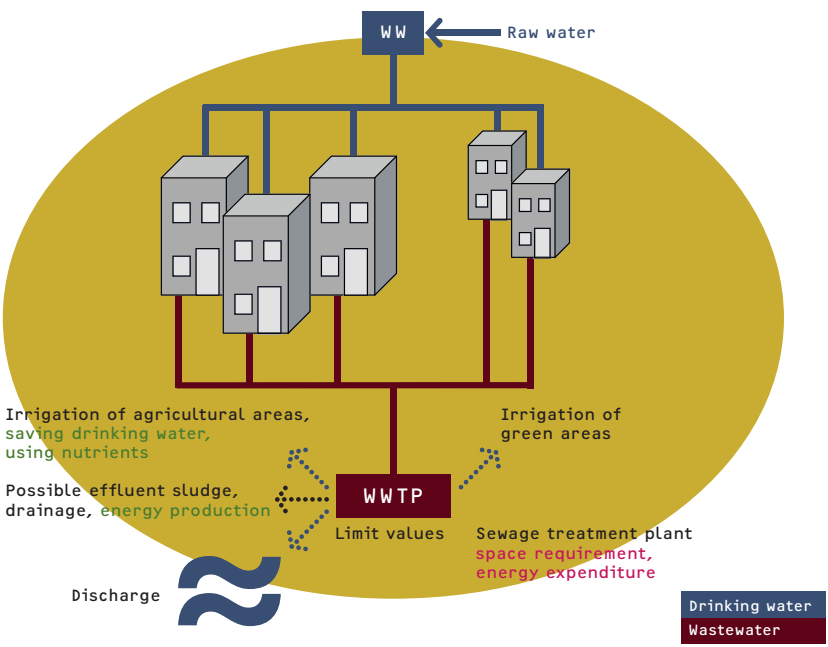

Fig. 2. Visualization of the 'Catch up strategy'

being developed on the base of three different strategies (see fig. 2):

- *Catch up strategy:* strategy which aims to reach the actual state-of-the-art which is applied in most industrialised countries.
- *Modern strategy:* strategy whereby decentralized and more flexible concepts are pursued.
- *Overtaking strategy:* strategy which aims to reach the latest available technologies.

Parallel, concepts of integrated urban systems are going to be developed together with the energy management team. The main focus of the work lies on the development of integrative concepts for waste water disposal infrastructure and energy supply, to achieve a constant optimization of resource consumption in a sustainable manner.

Such concepts provide a relevant contribution to both mitigation of possible bottlenecks (mitigating measures), and adaptation to altering environmental circumstances due to climate change (adaptive measures), especially according to the water and energy sector.

The integration of the infrastructural systems considers two levels, one of about 35 ha pilot project area and one for the entire region.

During the investigation, the cooperation of the water and energy management team, as well as the urban planning and design team, assays the impact of technical infrastructural systems on the development of the resi-

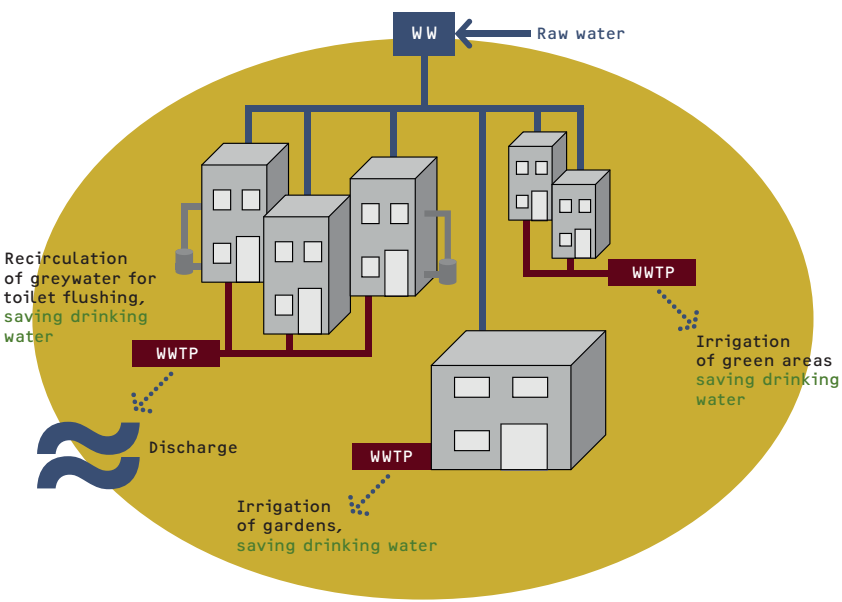

Fig. 3: Visualization of the 'Modern strategy'

dential area and/or the restrictions and limits of the compatibility of urban development concepts, with a selected infrastructure by means of water and energy.

By dint of the implementation of these concepts, the water demand should be decreased by 30 % and waste water energy potentials should be available and reclaimable.

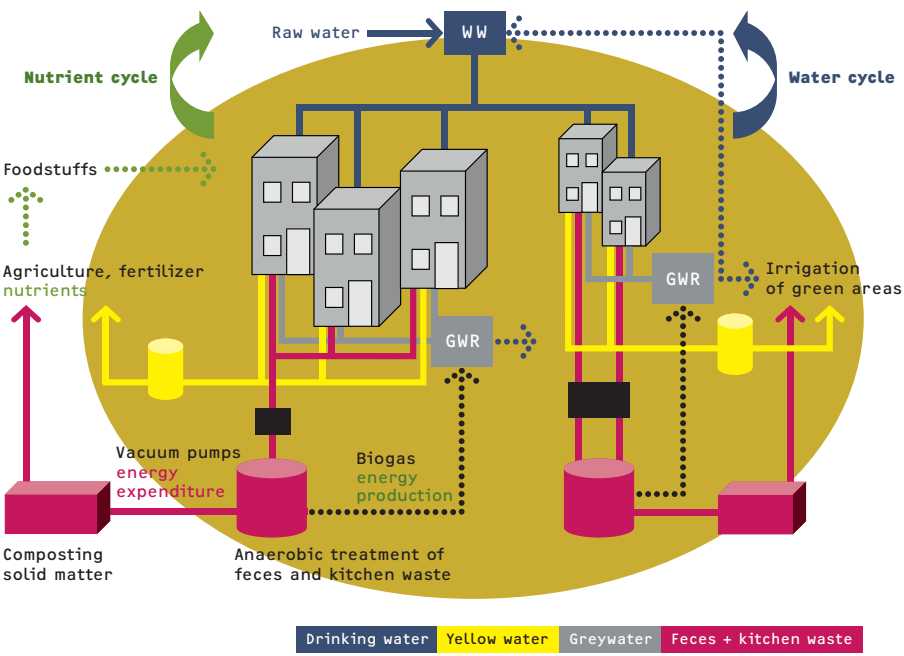

Fig. 4: Visualization of the 'Overtaking strategy'

New Educational Typologies for Distribution of Modern and Sustainable Architecture

Andrea Böhm, TU Berlin

An Active Research on the Typological Development of an Educational Center and its Architecture

The New Generation Educational Building pilot project was adopted by the Iranian and German partners to become a building for vocational training for construction workers and higher educational grades in this branch in early 2009, to be lead and managed by the Project Dimension Architecture. The dissemination of sustainable and energy efficient architectural design and planning is a main goal of the project's work. It is intended to work not only on the level of the research project but also aiming at the distribution of knowledge by information and the building itself.

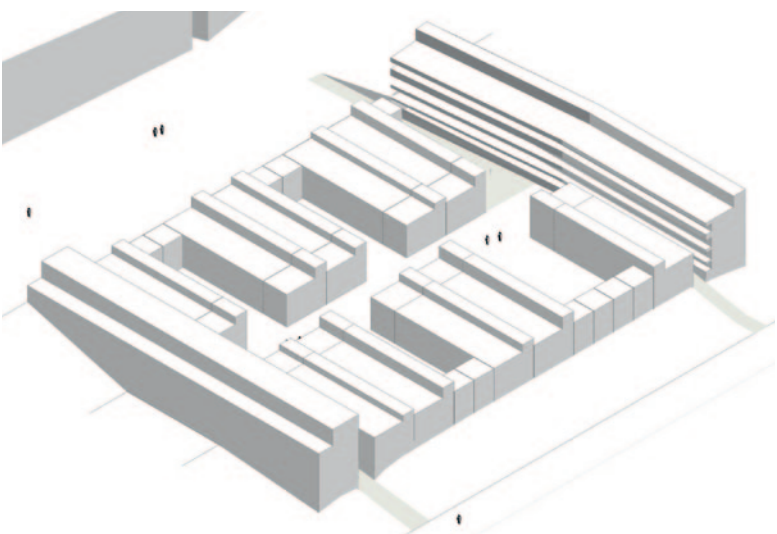

Fig. 1: Design model for the LIFE Center building complex with transverse formal structure of buildings and building elements (Böhm 2009)

About twenty percent of the carbon dioxide emissions in Germany are caused by the building sector (Künast, Kuhn 2008). One of the most direct indicators of environmental quality is the emission of carbon dioxide in the life cycle of a building. Main issues of research, hence, include the survey and evaluation of architectural and functional concepts of training centers, regarding climatic aspects but also architectural structures and facilities on the one hand. On the other hand also the adaptation to the tasks and local

conditions defined within the overall Young Cities project plays a main role. These points refer to operation models for respective centers. The research requires interdisciplinary collaboration with the respective specialists primarily from pedagogy, didactical sciences and vocational training. The findings from the research are introduced and applied to the redefinition of the functions and the design of the facilities of the building complex for the New Generation Educational Building pilot project.

The definition of a new typology of educational facility for Iran on the level of function and contents as well as on the level of architecture interrupts local traditional structures and sets new relations to the environment. By extension of the vocational training center in its functions it becomes adapted closer to local requirements in socio-cultural aspects and in economical and ecological aspects. The typology of a center for vocational training with the intended additional extending facilities is neither established nor existing in Iran. In that way it is necessary to deal with preexisting local structures and to adapt the typology, which has to become insert, to the conditions on site. Thus design and planning tie in with the social conditions. The formulation of the architectural assignment of tasks ranges to a basic programmatic issue as research on the architectural projection. A new architectural typology requires the definition of an adequate space

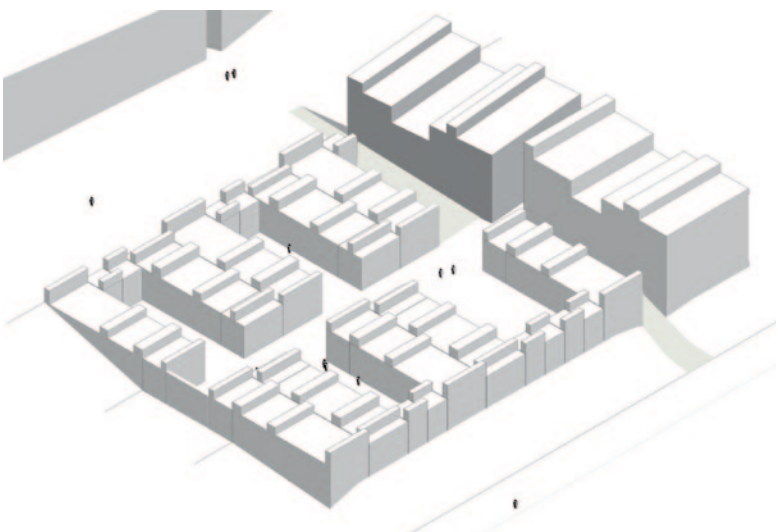

Fig. 2: Design model for the LIFE Center building complex with longitudinal formal structure of buildings and building elements (Böhm 2009)

allocation program. Different conceptual studies for training centers have been elaborated regarding spatial, functional, technological and administrative issues resulting in the spatial design for the project. The main approaches applied in research have been the survey and evaluation of relevant reference centers as well as expert interviews. In collaboration with the Project Dimensions Capacity Development as well as Urban Planning & Design, criteria have been defined for the location of a training center build-

ing in a new town such as Hashtgerd New Town. The site for such building complexes have to match a number of conditions, decisive being especially the urban setting due to the center's social connection functions apart from the merely technical urban facilities. The analyses on reference centers for vocational training in Iran and Germany result in criteria to concretize contents and technical form in adaptation to the regional conditions. Other interactive factors in the assignment of the building site include the topography as well as infrastructural connections. On this basis, an adequate building site was defined for the New Generation Educational Building.

Within the architectural research, the focus is set on the research of earthquake resistant structures and efficient cladding systems for the delicate configuration of the big shop floors and the climatically circumstances with special concern to energy efficiency. A media and pattern-center as part of the center's concept study has been introduced in particular with respect to adequate product samples, documents and analyses. As first steps, this process of "research-based drafting"—a research by design—results in design schemes for the pilot project that are regularly discussed in-depth among the Iranian and German project partners. Responsibilities for particular research topics to be applied to the New Generation Educational Building pilot project are arranged on the Iranian and German sides.

Upcoming research topics include the concretization of design schemes, an assortment of cladding systems for the special typology of the shop floors, the evaluation of adequate codes and regulations for energy efficient building from Europe and Asia with respect to this special building typology, the analysis of Iranian vernacular architecture, and the further development of the urban building structure, all in context of the architectural planning for the pilot project as well as the New Generation Office Building pilot project and the 35 ha Area pilot project.

Based on the research, accomplished in April 2009 at the bilateral decision-making meetings in Berlin, the concept for the pilot project was widely differentiated towards the concept of a LIFE Center: a center for Learning Information Forum Exposition (see chapter about pilot projects for details). The pilot project has been successively detailed with respect to the operator model, the architecture and facilities. Result of this work was a complex functional typology for an educational facility, which integrates any levels of education and information and combines them with public facilities a city requires. A center for vocational training, for information on sustainable and high quality building as well as a place for communication and flexible public functions became developed as LIFE Center.

City structures and urban environment react very sensitive on the climate change. At the same time good working parts of cities are an important condition for sustainable economical development. Only the reaction on the results of climate change creates an escalation of costs for arrangements of adaptation. Realisable and cost efficient arrangements for adaptation and prevention are necessary.

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Project Dimension Energy

Architectural Energy Efficiency in Office and Residential Buildings

Farshad Nasrollahi | Claus Steffan, TU Berlin

The main goal of the Project Dimension Energy is researching on the energy efficiency at building scale in the climatic condition of the Tehran-Karaj region and in Hashtgerd New Town as the case study. This New Town is located in the cold "winter climatic region" and in the warm and dry "summer climatic region" of Iran (Based on climatic classification of Kasmaei 2004).

Previous studies and analyses by the authors have shown that only cost-neutral and low-cost methods of energy-saving such as architectural energy saving are economically and technologically suitable for Iran. Therefore, architectural energy efficiency is applied in the further researches in this part of Young Cities project as the most important method of energy efficiency on the building's level. Architectural energy efficiency from the ecological and economical points of view is a sustainable method of saving energy and is also very effective in the climatic condition of Tehran-Karaj region. The effect of architectural and constructional factors is studied via energy modeling with building energy simulation software tools.

Simulation of several buildings and the analysis of the results have shown that architectural and constructional characteristics have a great impact on heating, cooling and lighting energy demand of office and residential buildings in the climatic conditions of the Tehran-Karaj region.

The first method for architectural energy efficiency in office buildings is an analytical evaluative process, which deals separately with different architectural and constructional factors including orientation, opening ratio in different orientations, shading devices, natural ventilation, airchange rate etc. The results of the studies by the Project Dimension Energy regarding these factors are as follows:

- Orientation: Among all architectural factors, orientation is one of the most important factors from the viewpoint of energy efficiency. The optimum orientation for minimum heating, cooling and lighting energy consumption is respectively 170°, 110°/260° and 330° from north. South-facing office buildings have the minimum total energy consumption and northeast and northwest-facing office buildings have the maximum energy consumption.
- Window area: The window area in different orientations effectively influences the energy consumption of buildings. For buildings with the same window ratio without shading devices in all orientation, the

optimum window ratio for heating, cooling and lighting is respectively 80 %, 10 % and 40 %. For reduction of total energy consumption, the optimum window to wall ratio is 50 %. The behaviour of buildings with external blinds is a bit different. For buildings with external blinds, the optimum window ratio for heating, cooling and lighting is respectively 80 %, 10 % and 50 %. For reduction of total energy consumption, the optimum window to wall ratio is 60 %. For buildings with different window ratios in different orientations, the optimum window ratio for south-facing, north-facing and east/west-facing facades is respectively 60 %, 20–30 % and 10 % (Nasrollahi 2010: 1).

- Overhang: Using overhangs for windows of office buildings in all orientations and also the enlargement of the projection size of overhangs will increase the total energy consumption. However, it slightly decreases the cooling energy consumption of office buildings (Nasrollahi 2010: 1).
- External blind: The type of control of the external blinds is the key factor for the effect of shading devices on energy consumption within office buildings in Hashtgerd New Town. However, the effect of external blinds on decreasing the total energy consumption of office buildings is very little. High solar altitude in Hashtgerd, especially in summer and short work time at office buildings in Iran coupled with the conduction of a big part of work time before noon are the most relevant reasons for the little effect of shading devices on energy consumption of office buildings in Hashtgerd New Town (Nasrollahi 2010: 1).
- Natural ventilation: Although natural ventilation can be used for cooling the office buildings in Hashtgerd New Town in summer, the time of occurring natural ventilation is a crucial factor from the viewpoint of energy efficiency. If the natural ventilation does not occur in proper time, it acts as uncontrolled airchange through infiltration and effectively increases the energy consumption of buildings.
- Airchange rate: Increasing the airchange rate will very strongly increase the heating energy demand of office buildings. The influence of the airchange rate on the cooling energy demand is much less than that of the heating energy demand. The sum of heating and cooling energy consumption of office buildings will be strongly increased with an increasing airchange rate. The relationship between airchange rate and heating (and also total) energy consumption is approximately linear.

Another part of the research on architectural energy efficiency focuses on residential buildings. The simulation and comparison of several residential buildings have shown that architectural design can effectively decrease the heating and cooling energy consumption of residential buildings, too. In some of the simulated buildings, the architectural design has reduced the buildings' energy demand by about 48 %. This indicates the high potential of architectural energy saving in the Tehran-Karaj region. Simulation

and analysis also show that insulation of the thermal envelope of buildings and the use of insulated windows will also effectively reduce the energy demand of the building. This is particularly true for the insulated, well designed building. The energy consumption of a given building in the Tehran-Karaj region is reduced by about 81.8 % by proper architectural design and insulating the thermal envelope (U-value Wall: 0.25 W/m²K—U-value Roof & Floor: 0.15 W/m²K—U-value Glass: 0.781 W/m²K, SHGC: 0.471—U-value Frame: 3.633 W/m²K) (Nasrollahi 2009).

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Project Dimension Structure and Materials

Optimization of Materials and Structural System for an Efficient Architecture

Klaus Rückert | Effat Shahriari | Jan Grunwald, TU Berlin

Fig. 1: Construction site New Quality pilot project building in Hashtgerd New Town, Dec. 2010

The two main objectives of research of the Project Dimension Structure and Materials are energy efficiency and earthquake resistance. Considering the situation of Iran as one of the most earthquake prone countries in the world, this article focuses especially on the earthquake resistance aspects. The project has focused on the development of regionally adapted earthquake resistant structures. The methodology applied follows the action research approach by elaborating and examining solutions by the development and implementation of pilot projects.

In order to find compatible solutions, firstly the current predominant construction method in Iran, i.e. masonry filled frames, was analyzed. After identifying disadvantages, it was compared to alternative construction methods. As predicted; the masonry filled frame shows major disadvantages in case of earthquakes. As the main disadvantages, non-load bearing masonry receives lateral loads during an earthquake, which leads to the collapse of the wall. Hence, optimizing the details of the connections between frame and masonry contributes significantly to improve the construction.

Considering the enhancement of the seismic behavior of the building by mass reduction of load bearing and non-load bearing members, in the first step, various alternatives have been investigated.

The three following stiffening systems have been compared:

- Frames,
- Frames and shear walls,
- Shear walls.

This analysis formed a basis for the selection of construction system of the New Quality pilot project building (see figure 1 and section on the pilot project for details); namely a shear wall system with optimized connections between non-load bearing elements and the load bearing system.

In parallel, further investigations have been made on the load bearing behavior of the hybrid structure of infilled frames. Following this analysis, a calculation model was developed and a software application was programmed that verifies the described structural analysis of masonry walls under certain constraints.

In the New Technology pilot project building (see section on pilot projects for details), the proposed materials for none-load bearing elements such as partitioning walls and the façade, are very light materials. Further more in order to obtain lower lateral loads during earthquakes, in the whole building, no brick stones have been assembled.

A survey with main focus on collapsed buildings in Iran revealed the low quality of welding connections very often as the major problems. The structure has been improved by using an erection concept that makes welding on the building site dispensable.

Additional research and analysis is accomplished on possible materials and systems especially for claddings in the semi-arid climate. The common local construction methods have been investigated and evaluated with respect to the two major objectives of the Project Dimension. The most common methods were chosen for a detailed analysis and comparison. Eligible construction methods and materials have been identified analyzed and elaborated for improvement. This is partly based on surveying of procedures on Iranian building sites. The results are successively introduced and applied during the procedure of development of the New Generation pilot projects (see pilot project section for details).

Project Dimension Project Management

Strategic Implementation of Innovative Concepts and Measures for Energy Efficiency and Sustainable Development

Rudolf Schäfer, TU Berlin

A theoretically well based and practically applicable project management is of strategic importance for the successful implementation of innovative concepts and measures. In the framework of the research project Young Cities, great value is devoted to the Supportive Dimension Project Management in addition to the contents covered by the Strategic Dimensions. In particular, the following questions are encompassed by the Supportive Dimension:

- Analysis of the legal and administrative framing conditions of New Town development,
- Costs and financing of pilot projects
- Management of site and project development,
- Management of local and regional energy and climate change policies.

In these fields, studies are elaborated regarding the following three aspects:

- Surveying and describing of the prevailing state of the art in Iran,
- Identifying of weaknesses and optimization potentials in national frameworks as well as in local practices, as well as
- Formulating of detailed recommendations regarding the advancement of the prevailing approaches.

With regard to all four above mentioned topics, PhD thesis projects have been initiated and are currently in elaboration. They are designed as to allow for continuous input from the thesis projects into the current overall project work, especially into the work of the planning and technical scientific Project Dimensions and pilot projects.

In addition, feasibility studies have been initiated for most of the pilot project buildings and neighborhoods, with the feasibility study for the 35 ha Area pilot project being the first one having been finished and fed into the detailing of the pilot project.

The ex-post analysis of the New Quality Building pilot project has been initiated as well. Comparable analyses are intended for all of the pilot projects after completion.

Increased Consideration of Environmental Protection in Iranian Urban Planning through EIA and Impact Mitigation

Holger Ohlenburg | Johann Köppel, TU Berlin

The goal of this Project Dimension is the development of a simplified Environmental Impact Assessment (EIA) tool for Iranian urban development. The results of the Dimension should be summarized in guidelines or a manual for "Environmental Assessment in Iranian Urban Planning" contributing to reach stronger consideration of environmental protection aspects during the urban planning process.

Today's strategic and local urban planning decisions will significantly determine the level of sustainability of expanding New Towns and megacities for many years to come. In this context, (strategic) environmental assessment (SEA) can make a decisive contribution to a sustainability-oriented urban planning process.

To avoid undesirable negative impacts on the environment, urban development projects should undergo a (strategic) EIA. The environment pro-

Fig. 1 | Fig. 2: Negative environmental impacts caused by sealing, excavation, leveling and filling for road and housing construction (Ohlenburg, December 2008)

vides a multiplicity of ecological functions and services (von Haaren 2004). They comprise e.g. a habitat function, provision of clean water, filtering and chemical buffering function of soil etc.

According to Article 50 of the Iranian constitution, "it is considered as a public duty to protect the environment" (DoE 2009). Thus, it must be the aim of sustainable urban development to minimize negative impacts on these functions. Analyzing the protection needs and sensitivities towards a

wide spectrum of environmental subjects of protection (flora, fauna, soil, groundwater/surface water, climate/air, human health, cultural goods) is a precondition for the assessment of potential impacts by a planned project. Knowledge of the key impacts on the natural goods enable project planners to take precautionary steps to avoid, minimize and finally compensate undesired effects (cp. Köppel et al. 1998; Köppel, Peters, Wende 2004).

An analysis of the instruments of Iranian urban master plans and detail plans showed that in the current Iranian urban planning practice appropriate consideration of environmental protection aspects is not common. Thus, EIA and Impact Mitigation can serve as new innovative elements to qualify the Iranian urban planning process.

Based on these principles, the Project Dimension has developed new and adapted existing methods of Environmental Assessment and Impact Mitigation and exemplarily applied them within the 35 ha Area pilot project.

One aim and function of EIA for urban development plans is to integrate environmental aspects into the planning process as early as possible and to make them accessible and understandable for the different planning actors, not least the decision makers, by providing:

- Basic environmental information (status quo of the subjects of protection as well as their sensitivity against impacts), as well as
- Negative environmental impacts caused by sealing, excavation, leveling and filling for road and housing construction and a prediction of environmental status and development after realization of an urban development plan or project (see fig. 1 and 2).

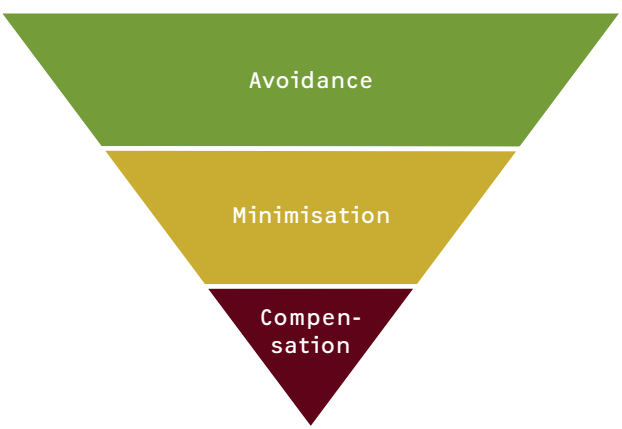

Fig. 3: The mitigation hierarchy (Darbi et al. 2010)

According to the so called mitigation hierarchy (see fig. 3), Environmental Assessment should prepare for the consideration of avoidance, mitigation and compensation of likely adverse environmental impacts caused by the plan or project by providing:

- Proposals for optimizing the planning from an environmental protection point of view (avoidance and minimization of environmental impacts),

- Proposals for environmental enhancement measures to compensate for unavoidable environmental impacts (compensation areas and measures).

Compensation areas are of high environmental quality (totally or nearly unsealed and planted with a natural share of native or adapted vegetation) and of a certain minimum area (in the actual case of the 35 ha Area 100 m²). Compensation areas and measures should be designated as "areas for protection, maintenance and development of nature and landscape" within the approval documents and plans to secure them in the best way possible for environmental protection purposes and, thus, for a long-lasting protection against other use.

So far, the Project Dimension accomplished an overview about the environmental subjects of protection and a simplified analysis of the likely environmental impacts caused by the 35 ha Area pilot project based on avail-

Fig. 4: Detail view: Map "Designations of Landscape Planning incl. environmental compensation"

Fig. 5 | 6: Valley on the eastern edge of the 35 ha Area with comparatively ample vegetation (trees and wetland species) (Grunwald, December 2009)

able environmental data, analogies and assumptions. In this context, the survey area has been widened because of an existing valley bordering the 35 ha Area to the east. This valley carries a first-order water course accompanied by noteworthy and comparatively ample vegetation (see fig. 5 and 6). The analysis showed that the area would be strongly affected by the project and due to its value and its high sensitivity an impact should preferably be avoided or at least minimized. The preservation should be achieved by a

relocation of the road and a partly restructuring of the building lots at the eastern edge of the 35 ha Area.

Additional environmental compensation areas and measures such as appropriate plantation has been proposed inside and outside the 35 ha Area (see fig. 4). In case of realization, these areas could take over both ecological functions and partly even recreational functions (see chapter Landscape Planning), which cannot be sufficiently supplied within the 35 ha Area. Plantation measures would have positive influence on different subjects of protection, such as soil (support of pedogenesis and soil fertility, preservation of erosion as well as water-related soil functions) and climate/air (combing out of air pollutants and dust).

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Project Dimension Capacity Development

Integrated Approach to Achieve Proper Workmanship

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Capacity Development is one of the Young Cities Supporting Dimensions and cares for concepts, qualification measures and further activities in the field of Vocational Training.

Fig. 1: Hashtgerd New Town—Training course on AAC materials, Jan. 2010

The main objectives can be named as:

- Development and test runs of exemplary qualification modules/courses to enhance the practical experience and knowledge of workers, foremen, technicians and engineers (Heise 2010),
- Development and test runs of a Training of Trainers concept and learning materials,

- Development of a concept for a multifunctional vocational training center including an operator model to enable apprenticeships and short-, medium- and long-term qualification courses with attention to different construction topics and professions.

The above listed activities are run contemporaneously or alternating. According to the method of action research, they are accompanied by measures of reflection and formative evaluation. Thus, the developed qualification concepts, materials, courses etc. are continuously proved, modified and optimized.

The qualification requirements and the most important construction training topics have been analyzed based on case studies. Construction site visits, expert talks and literature analysis are the main research instruments. The outcomes of these initial processes are permanently verified.

The case studies' results are summed up in an overview of bad workmanship and structural damages at the visited buildings and construction sites. Many of the detected execution errors are evidently caused by lacks of qualification. But the targets of energy efficient and high quality buildings cannot be achieved without proper execution of work. Therefore, it was agreed to set a focus on vocational training measures in the Young Cities project:

- The development of the vocational training center was brought forward. Its concept became more multifunctional: e.g. consulting services, exhibition and information events were added (see New Generation Educational Building pilot project);
- The New Quality pilot project was provided by a practical training course for the construction site staff and for engineers;
- A road map for the Training of Trainers including a coaching model has been developed;
- Practically orientated instruction sheets for foremen and workers to selected topics are in work progress. Exemplarily, complementary audiovisual learning media are in preparation;
- A rough draft of a mobile learning unit to improve the conditions for learning on the job (respectively close to the work place) was generated and is to be detailed.

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Project Dimension Awareness Raising

Participation of Citizens in Urban Planning and Awareness Raising for Energy Reduced Consumption Behavior

Hans-Liudger Dienel | Jenny Schmithals | Sabine Schröder | Nicolas Bach, nexus Institute

One of the Young Cities project's Supporting Dimensions is Awareness Raising, which engages in introducing citizen participation on the planning processes of energy-efficient lifestyles. Based on this research, developing suitable awareness raising concepts and capacity building modules fosters future energy-efficient lifestyles and behavior.

The objectives of the Project Dimension Awareness Raising are twofold. One aim is to integrate the local knowledge and needs of the local community into the planning processes of the Young Cities project through organizing participatory workshops. These include methods that integrate the citizens and representatives of the local community in Hashtgerd New Town. This is essential in order to plan urban structures that meet the needs of their future inhabitants and, thus, enhance their acceptance and attractiveness and also significantly increase the value of the planned projects and the demand for living in Hashtgerd New Town.

The research on participation in Iran carried out in the course of the project showed that there are some examples of citizen participation in Iran (e.g. The Safe City Project (Proje-ye Shahr-e Salem), The School Mayor Plan (Tarhe Shahrdar-Madreseh), The Comprehensive Plan of Green Space (Tarh-e Jame ja Pishgaman-e Fazay-e Sabz), The Safe Neighbourhood Plan (Tarh-e Mahalle-ye Salem) and the neighbourhood councils). However, the degree of citizen participation in Iran is among the lowest compared to other countries regarding the preparation, approval and implementation of urban development plans. The lack of or low level of participation was identified as one of the major reasons for one of the essential problems of urban planning in Iran, the failure of implementation and execution of urban development plans (Ministry of Interior, Centre for Urban Planning Studies, Vol. 2, 2000 and Vol. 3, 2001 in: Mohammadi 2011). This leads to a "lack of realism in goal setting, inaccuracy, inefficiency [...] and inequity in urban development plans" (ibd.) Therefore, citizen participation is regarded as a crucial part of the planning process of the Young Cities project.

The second aim of the Dimension is to increase the awareness on the need for energy-efficient behaviour and the consequences of climate change

among citizens and, thus, achieve a change in behaviour towards energy-reduced consumption patterns in order to adapt to and mitigate the consequences of climate change. This aim can only be achieved when considering the question whether and how climate change matters to people or not and, which aspects of the topic are crucial to them and why. It is necessary to analyze these questions through empirical research on existing energy-consumption patterns and attitudes towards climate change and energy saving. Based on the results of this research, suitable awareness raising concepts and capacity building modules to foster energy-reduced consumption patterns are developed and introduced.

An actor analysis on Hashtgerd New Town was prepared to identify and describe the most important actors in the sector of urban planning for Hashtgerd New Town, such as the NTDC, the Islamic Council, the Mayor's Young Consultants, the different groups of residents, and cultural/social associations as starting points for participatory processes Furthermore, different topics and open questions have been collected to be tackled with the participation of citizens (e.g. ways of using the green space, details and use of the public transport system etc.). Different participatory instruments to come up with solutions for these topics have been suggested to be integrated into the planning process for the plans for Hashtgerd New Town as a whole (like activating surveys, "planning cells", expert workshops and the like).

To achieve the aim of fostering energy-efficient lifestyles, two semi-standardized surveys on ecological awareness, attitudes towards climate change and daily routines in energy-saving have been conducted. One survey has been carried out with residents of Hashtgerd New Town, the other with students from different high schools in Tehran. The second survey was also carried out among students of German high schools in order to analyze similarities and differences. Pupils are an important target group since they are esp. open for changing consumption behavior and can function as multiplicators within their families and communities.

The results of these surveys show that there is general knowledge about climate change as well as about the anthropogenic impact on the climate, which is especially high among pupils. Most interviewers were reported to make some efforts to save energy in their living environment e.g. by using energy-efficient lamps or by turning down the heating in rooms that are not currently used or when leaving home. However, in Hashtgerd New Town, it becomes clear that poor construction of buildings often prevents residents from effectively reducing energy consumption. Also, the public transport system in Hashtgerd New Town is not yet appropriate so that using taxis and private cars often becomes a necessity.

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Chapter IV
Outlook

Outlook

Rudolf Schäfer | Florian Stellmacher, TU Berlin

The completed construction of the first of the Young Cities' pilot projects, i.e. the New Quality pilot project, in spring 2010 forms a major milestone in the overall project. The Young Cities project is strongly oriented towards application employing the pilot projects as major methodological approach. Therefore, the advancement of the pilot projects will also in future form the core of research and planning work in the bilateral project activities. Regarding the pilot projects, this will be supplemented by the monitoring of the realized pilot projects in order to build on the evaluation of the results gained both, for the pilot projects still in elaboration and for the transfer of results into guidelines, standards etc. as well as to other places. In the following, an outlook is given related to milestones and visions.

First Generation of Pilot Projects

For the New Quality pilot project, monitoring and evaluation of the completed building entering into the phase of residential use has been started, conjoined by Iranian and German scientific partners. Access to all relevant information and data has been granted by the owner of the building, the Housing Investment Company (HIC) based in Tehran. The experiences acquired during planning and implementation alongside the results to be gained from monitoring and evaluation of the performance, (especially with respect to energy consumption, energetic behavior of the building, water and wastewater flows) will form an additional reference for data on the object level available on the Tehran-Karaj region. This data is needed as reference for the evaluation of the effects reached by the Young Cities project's interventions and as future reference points for decision-makers in the region.

The legally binding land-use plan for the 35 ha Area pilot project was finalized in late summer 2010. The plan follows the Iranian regulations in principle, but might deviate from the regulations and introduce necessary innovative elements in order to safeguard the principles developed for the urban concept, with respect to energy-efficiency and sustainability. For these innovative elements, experiences and solutions e. g. from the German system of land-use and environmental planning, might be adopted. The plan was approved by the responsible Iranian authorities affiliated to the MHUD. For aspects important to the energetic design on the level of the sub-neighborhoods not applicable to land-use planning to Iranian as well as

to German regulations, an energetic guidance plan has been prepared. This guidance plan shall form the basis for agreements to be concluded between the NTDC or the municipality of Hashtgerd New Town with companies interested in investing on the 35 ha Area. From these two planning documents, realization is to be advanced by the specification of one or more investors and by starting into planning on the object level as already initiated by the New Generation Office and Residential buildings pilot projects (see below). Supervision throughout the object level planning process, simulation and refinement of the planning, as well as monitoring and evaluation of the intended implementation on the 35 ha Area will form the long-term milestones regarding this pilot project.

The New Technology pilot project is due to be implemented as a showcase building for technologies applicable for high energetic performance under the local conditions. Implementation is pending due to financial restrictions at BHRC. The pilot project is, however, currently designed to provide reference for the development of the New Generation pilot projects already from the planning stage reached.

New Generation Pilot Projects

The New Generation Office building pilot project on the 35 ha Area and the New Generation Educational building pilot project (vocational training center) directly neighboring the 35 ha Area and have already been advanced regarding concept development and planning. Among the forthcoming major milestones to be reached with regard to these two pilot projects are the definition of the respective operators and users of the buildings and the involvement of these new partners. From this step, both buildings shall be planned bilaterally within the Young Cities project and construction at least be started, requiring in turn supervision, monitoring and scientific evaluation.

Within the Young Cities project, one typical residential sub-neighborhood of the 35 ha Area will be planned by the Iranian and German project partners. This has been started on the basis of the building typologies developed for the 35 ha Area, which will form the starting point for the New Generation Residential pilot project, and of the legally binding land-use plan along with the energetic guidance plan. The respective sub-neighborhood has been specified and is being elaborated on the conceptual stage. From this step, the buildings shall be planned bilaterally within the Young Cities project and construction at least be started, requiring in turn again supervision, monitoring and scientific evaluation. The other sub-neighborhoods of the 35 ha Area will have to be planned by the investor or investors specified also according to the typologies, the land-use plan, the energetic guidance and under supervision and guidance of the scientific project partners.

Involvement of Companies

For the implementation of the pilot projects, especially for the 35 ha Area pilot project, Iranian and German companies shall be involved intensively.

The 35 ha Area forms the central demonstration ground in Hashtgerd New Town for the solutions and concepts developed by the Young Cities project. It is, thus, the place to test and try the solutions and concepts, especially concerning their applicability to the climatic, social, cultural and economic conditions in Iran, yet also regarding the required capacity building and awareness raising among users, the construction industry and planning staff. The solutions and concepts will simultaneously be used as showcases and for dissemination. Companies are sought that bring in experience in applying innovative, primarily energy-efficient technologies and solutions.

Capacity Building

Vocational training and qualification measures are applied both, as part of and apart from the pilot projects. The first workshops have been accomplished at the New Quality pilot project construction site in 2010.

Simulation and Evaluation

For the integrated interdisciplinary development of solutions and concepts, both, on the urban and on the object level, simulation of a variety of criteria employing a range of software programs is employed, which will form a major focus for the scientific work of the Young Cities project in the months and years to come. The software programs are being applied to evaluate different scenarios applicable in the pilot projects in depth. The simulation activities will also form the basis of the evaluation of the project's effects as the indicators specified and defined for simulation are in line with the matrices developed for project evaluation.

Manuals and Guidelines

The innovative and applicable solutions and concepts developed throughout the Young Cities project will be assembled in a manual collection providing tried and tested guidance for planners and decision-makers in the Tehran-Karaj region as well as later on in and beyond Iran. Solutions and concepts are, however, first applied, monitored and evaluated in one of the pilot projects or in another way in the region. Concepts for water and waste water management or energy concepts on a city level are partly developed and applied apart from the pilot projects. The manuals will present challenges, problems and opportunities and the related solutions and concepts adapted to regional climatic, cultural, social, and economic conditions. One of the first solutions and concepts will most likely be derived from the New Quality pilot project

for vocational training. The manuals will be elaborated as to provide reference also for planners and decision-makers in the wider MENA region and be subject to related dissemination activities by the project partners.

Research Papers, Post Doc and and PhD Research

Scientific results from the Young Cities project will not only be disseminated via articles and conferences but also by volumes of the newly founded Young

Cities Research Paper Series started with the Farsi version of this very volume. About two volumes of the series are planned to be issued per year. This will also include results from the large number of PhD thesis prepared as part of the project as well as post doctoral research accomplished. Apart from the theses to be elaborated by researchers of the German project partners and PhD theses of Iranian researchers based in Iran, the Young Cities project tremendously benefits from the scholarship program of BMBF and the German Academic Exchange Service (DAAD) created for the Future Megacities projects. About eighteen Iranian PhD, post-doc and senior expert and scientist researchers are funded from this program, accomplishing research as part of the German teams, along with one scholarship holder post-doc of the Humboldt Foundation. The research results developed by these researchers will be published successively also within the Research Paper Series.

Planning and Building Exhibition: A Vision for Hashtgerd New Town

As pointed out above referring to aspects of methodology, the Young Cities project is characterized by the strong role of pilot projects. Pilot projects are real buildings (e. g. the New Quality building) but even urban plans (e. g. 35 ha Area) or new concepts for the management of urban planning and climate change. If the Young Cities project successfully continues the implementation of such pilot projects, Hashtgerd New Town could and should be organized and presented as an international planning and building exhibition.

A planning and building exhibition (PBE) is not an exhibition in the traditional sense. The visitors do not expect pictures in a museum or display stands in an exhibition hall. The German IBA exhibitions (International Building Exhibitions) have become built reality. In Germany, the tradition of IBA goes back until the middle of the 18th century. Initiating IBAs in Germany became common in order to show innovations in building and planning. In the very beginning of the 20th century, the first building exhibition was held in Darmstadt (Mathildenhöhe). In the beginning, the focus was laid on architecture and urban design, but mainly reduced to technical and design aspects. In the last decades the IBA concept changed to a showcase for innovations also in the planning sector (PBE), introducing new instruments, processes and models in urban and regional planning and design.

Referring to the extensive experiences with the different concepts of IBAs and PBEs, Germany is a country with particular competencies in this field. This can be illustrated by the long tradition of initiating such exhibitions in Germany, resulting in examples such as:

- Weissenhof-Siedlung Stuttgart (1927)
- Interbau Berlin (1957)
- IBA Berlin (1978 to 1987)
- IBA Emscherpark (1989 to 1999)
- IBA Hamburg (2006 to 2013)

The main elements for the Hashtgerd planning and building exhibition concept would be:

- Presentation of pilot projects,
- Not only built pilots but also planning concepts and other types of activities related to sustainable urban development,
- Not only results but also processes,
- Commitment to sustainability,
- Documentation of experiences and results,
- Forum for discussion and transfer of knowledge and experiences among professionals,
- Platform for raising public awareness in the field of sustainable urban development, and
- International character in particular for countries of the MENA region.

Content elements of the exhibition are the project dimensions of the Young Cities project. According to that, the exhibition would have to contribute to different scales of urban development: building, neighborhood, district, and town.

Finally, the planning and building exhibition could also be a stimulus to initiate two other major and highly successful instruments of promoting innovation in urban development in Germany, namely Experimental Housing and Urban Development (in Germany "ExWoSt") and Demonstration Projects of Spatial Planning (in Germany "MORO").

Thus, in a middle range perspective the Young Cities project, Hashtgerd New Town could become a nucleus for a sustainable energy efficient urban development in Iran.

Appendix

List of Abbreviations

AAC	Autoclaved Aerated Concrete
BFW-BB	Berufsförderungswerk (e.V. des Bauindustrieverbandes) Berlin-Brandenburg
BHRC	Building and Housing Research Center
BMBF	German Ministry of Education and Research
CLM	Climate Limited-area Modelling
DAAD	German Academic Exchange Service
DFG	German Research Foundation
DLR	German Aero Space Center (Project execution organization on behalf of the BMBF)
EIA	Environmental Impact Assessment
EMCWF	European Centre for Medium-Range Weather Forecasts
ETFE	Ethylene tetrafluoroethylene
ETICS	External Thermal Insulation Composite System
ExWoSt	Experimental Housing and Urban Development (in Germany)
FU Berlin	Freie Universität Berlin
GHG	Green House Gas
GOS	Green Open Space
GTZ	German Gesellschaft für Technische Zusammenarbeit
HIC	Housing Investment Company
IBA	International Building Exhibition
IEEO	Iran Energy Efficiency Organization
IFCO	Iranian Fuel Conservation Company
IPCC	International Panel on Climate Change
LIFE Center	Learning, Information, Forum, Exposition Center
MENA	Middle East North Africa

MENASHDA	Middle East North African Sustainable Habitat Development Association
MHUD	Ministry of Housing and Urban Development
MORO	Demonstration Projects of Spatial Planning (in Germany)
MUD	Mixed Use District
NGO	Non Governmental Organization
NTDC	New Towns Development Corporation
OECD	Organization for Economic Co-operation and Development
PBE	Planning and Building Exhibition
PM	Particulate Matter
SEA	Strategic Environmental Assessment
SUNA	Renewable Energy Organization of Iran
TNO	Netherlands Organisation for Applied Scientific Research
TU Berlin	Technische Universität Berlin
UNDP	United Nations Development Program
VINI	Iranian Natural Scientists and Engineers
WANACU	West Asia North Africa Corporation Unit
WHO	World Health Organization

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