

International conference:

HIGH-RISE BUILDINGS September 20, 2010 PRAGUE

Topic: Energy intensity of high-rise buildings in Prague and other European cities

Title of paper:

Experience with optimisation of HIGH-RISE buildings' energy supply in Frankfurt am Main, Germany

Author:

Plebs, Hubertus, Dipl.-Ing.
Prokurist, Technical Director

GGM Gesellschaft für Gebäude-Management mbH
Neue Rothofstraße 12
D-60313 Frankfurt am Main

Phone +49 69 77 01 97 32
Fax +49 69 77 01 97 99

E-mail: hubertus.plebs@ggm-re.de
Internet: www.ggm-re.de

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Dipl.-Ing. Hubertus Plebs



companies:

- Bilfinger + Berger Bauaktiengesellschaft, Mannheim
- Frankfurter Aufbau AG, Frankfurt am Main
- Hines, Houston / Texas, Frankfurt am Main
- GGM Gesellschaft für Gebäude-Management mbH, Frankfurt am Main
- etc.

**construction- and project manager
(from 1984 to 2001)**

- Stadtwerke Frankfurt am Main (80,000m²)
- Hessischer Rundfunk, Frankfurt am Main (30,000 m²)
- Fürstenhof Leipzig, Leipzig (5 star hotel)
- MAIN TOWER; Frankfurt am Main
- etc.

**property management
(since 2001)**

ca. 200 properties in Germany and Europe

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GGM

Gesellschaft für Gebäude-Management mbH

- Asset Management
- Property Management
- FM-Consulting
- etc.

for

30 clients

130 properties

1.3 million m² rentable space

currently in Europe and in Germany



Brussels



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1. Frankfurt am Main „MAINHATTAN“

- THE city of High-Rise buildings in Europe



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High-Rise Buildings managed by GGM

MesseTurm



MAIN TOWER



Westhafen



Kastor



Grüneburgweg



Eschersheimer
Landstraße



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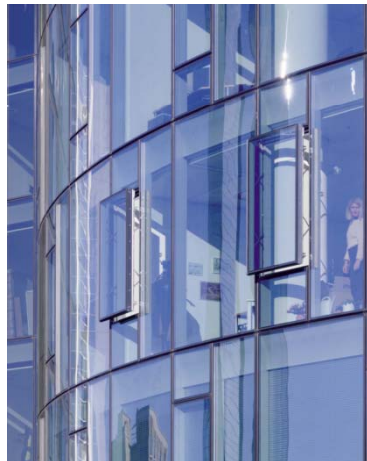
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2. Objectives

Effective energy supply for High-Rise Buildings in Frankfurt am Main, Germany,
under the aspects of guaranteed function of the building and its technical facilities
as well as high tenants satisfaction.



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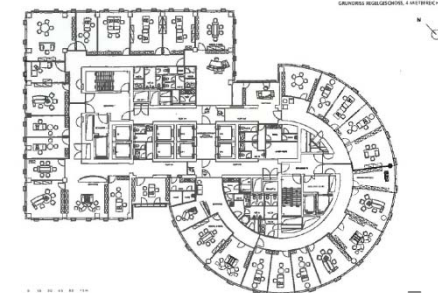
3. Initial Situation

➤ Development, Promotion

✓ Great location



✓ Great exterior and interior architecture



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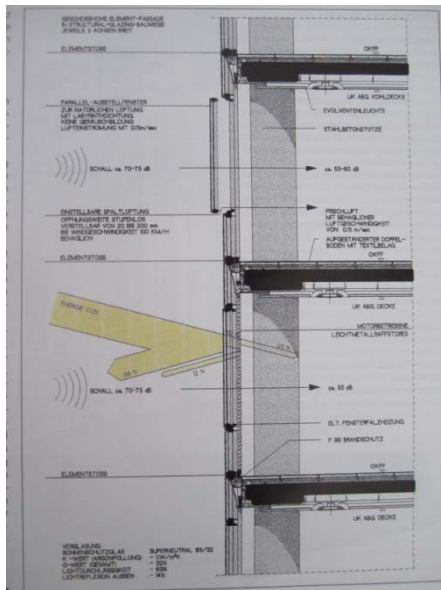
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➤ Development, Promotion

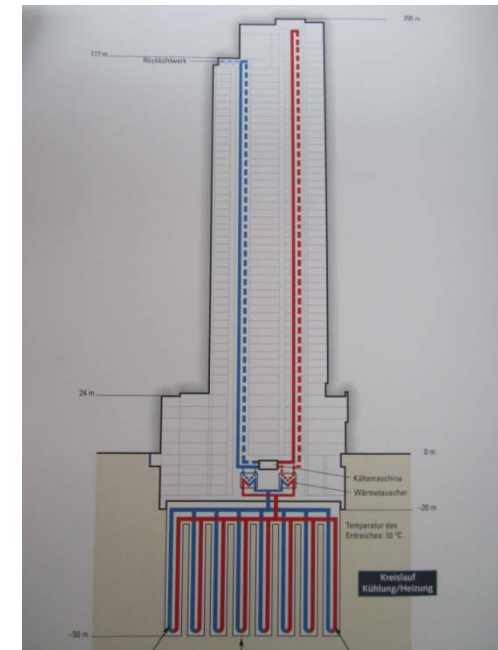
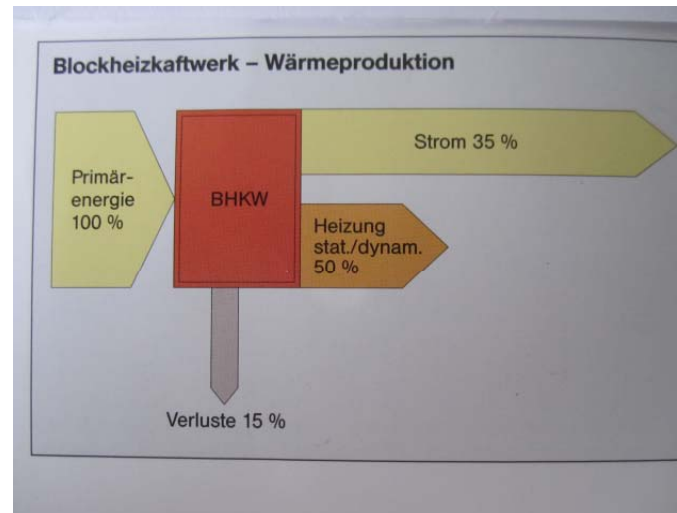
✓ Low energy costs with modern technology !!!

Geothermal energy/
earth-cooling storage reservoir

Openable windows



Block-type thermal power stations



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4. Reality: start of operation / operation / service / maintenance

➤ Operational problems

for example because of

- heating
- cooling
- electric supply
- etc.



low tenant satisfaction!



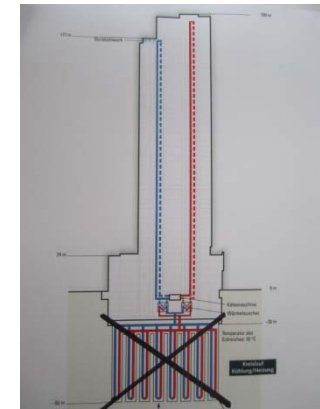
- dirty heat exchanger
- „MAINWASSER“ refrigerating machines
- mussel covering



- facilities designed too big
- „MAINWASSER“ refrigerating machines



- facilities designed too small
- cooling supply and refrigeration



- groundwater flow in the earth-cooling storage reservoir

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➤ Problems with service charges  low tenant satisfaction

Service charges accounting

	Type of costs	Estimation as basis renting	Service charges calculation after 1 st year in operation (3 to 4 years later)		Service charges calculation after 2 nd year in operation (4 to 5 years later)	
		Eur/m ² /month	Eur/m ² /month	Difference	Eur/m ² /month	Difference
		gross	gross		gross	
1110	Wasser / Water	0,06	0,05	-0,01	0,06	0,00
1120	Abwasser / Sewage	0,04	0,02	-0,02	0,05	0,01
1140	Stromverbrauch Allgemein / Electricity consumption in general	0,33	0,31	-0,02	0,41	0,08
	Strom Mieter 1 (Rechenzentrum) / Electricity tenant 1 (computer centre)		0,39		0,72	
	Strom Mieter 2 / Electricity tenant 2		0,00		0,03	
	Strom Mieter 3 / Electricity tenant 2		0,00		0,00	
	Strom Kälte restliche Mietbereiche / Electricity, cooling energy remaining areas	0,00	0,04	0,04	0,06	0,06
	Strom Kälte Mieter 1 (Rechenzentrum) / Electricity, cooling energy tenant 1 (computer centre)		0,38		0,30	
	Strom Kälte Mieter 1(Konferenzbereich) / Electricity, cooling energy tenant 1 (conference room)		0,00		0,28	
	Strom Kälte (restliche Bauteilaktivierung) / Electricity, cooling energy (remaining thermo active building systems)	0,09	0,09	0,00	0,11	0,02
	Strom Kälte Lupus alpha (Umluftkühlgeräte etc.) / Electricity, cooling energy Lupus alpha (air-cooling facilities etc.)		0,11		0,05	
1170	Fernwärme / District Heating	0,32	0,44	0,12	0,49	0,17
Total energy costs		0,84	0,95	0,10	1,18	0,34

Optimisation of energy /
Optimisation of energy costs

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5. Optimisation of energy / Optimisation of energy costs

➤ What are the most expensive energy consumers?

➤ What can you do to reduce?

Tenant

- user behaviour
- user demand



- Reduction / adjustment of demand

Technical

- heating
- cooling
- electric
- air condition
- elevators



- Adjustment of technical facilities / modification of operational mode
- Reduction of maintenance costs

Economic



- Use of inexpensive primary energies

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Sensitising user behaviour / Analysing user demand

➤ **General examples:**

- 1° C warmer or colder?!
- Turning off the lights
- Motion detectors for underground car parks, staircases, etc.
- Closing the window when too warm / too cold

➤ **Specific examples:**

- One room with 250 m² as serverroom in computer center, no occupancy
- cost saving around 10T€/month



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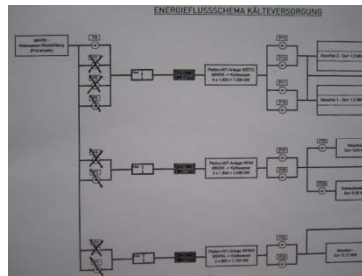
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Adjustment of technical facilities / Modification of operational modes

➤ Exchange / supplement / (partial) shutdown of technical facilities



Extension + exchange of refrigerating machines



Partial shutdown of „MAINWASSER“ refrigerating machines



Shutdown of block-type power stations



Addition heat exchanger

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HIGH-RISE BUILDINGS September 20, 2010 PRAGUE

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Flexible energy use

→ Operating with the currently most inexpensive primary energies



Operation	Operating condition till	GAS BHKW	ELECTRICITY TRANSFORMER T1 u. T6 (new)	STEAM Heat exchanger 1 WT 1 (old) 1.7 MW	STEAM Heat exchanger 2 WT 2 (new) 2.3 MW	Remarks
1	Operating conditions till 2005	in operation	T1 in operation	WT 1 in operation		favourable gas rate
2	Operating conditions from 2006 on					
2.1		off	T1 a. T6 (new) in operation	WT 1 in operation		favourable electricity rate favourable district heating rate
2.2		off	T1 a. T6 (new) in operation	WT 1 in operation	WT 2 (new) in operation	favourable electricity rate favourable district heating rate
2.3		in operation	T1 or T6 (new) in operation	off		favourable gas rate or omission of district heating
3	new condition	in operation	T1 oder T6 (new) in operation	in operation	in operation	under extrem heat requirement

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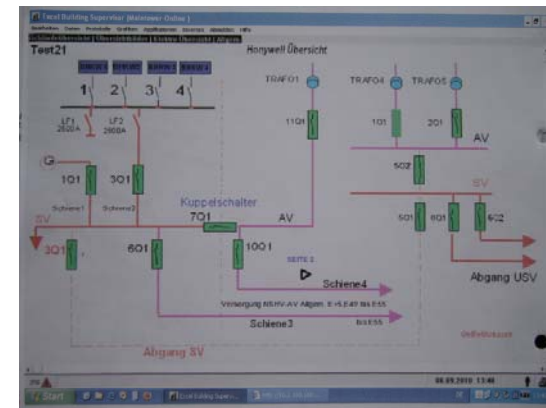
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Control of operations / Control of energy consumption

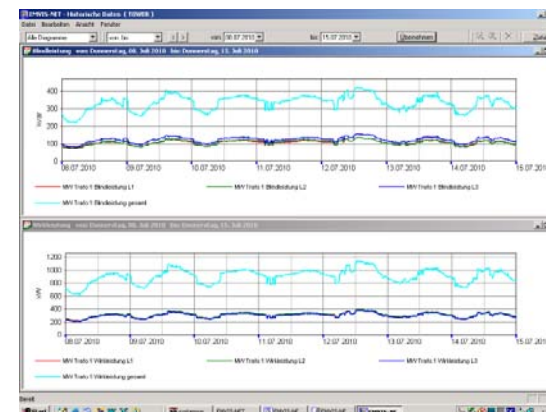
BMS-checking

- ❖ automatic control of operations



Automatic control of energy consumption

- ❖ permanent control of energy consumption



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Review, modifications

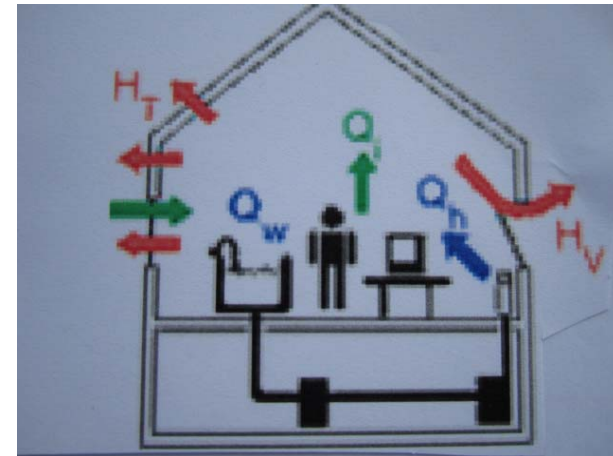
- **What kind of criteria has to be followed with regard to architecture, material, concept of technical operation and ?**

- ❖ **Reducing energy losses**

- ➔ **Avoiding high heat load**
 - ✓ proper heat insulation
 - ✓ high storage capacity of building materials
 - ✓ low solar absorption coefficient

- ❖ **Producing energy**

- ➔ **Using modern technical facilities**
 - ✓ using natural resources, for example sun, water, or soil



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What kind of alternatives do we have to reduce energy costs by alteration of the operational concept?

❖ **big points:**

- ✓ using natural resources
- ✓ natural ventilation
- ✓ free cooling
- ✓ river-water cooling
- ✓ geothermal energy
- ✓ photovoltaics
- ✓ using rainwater
- ✓ etc.



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What kind of alternatives do we have to reduce energy costs by alternation of the operational concept?

❖ a lot of small points  **BIG POINTS**

✓ for example:



Innovative facade cooling system

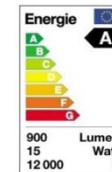


Innovative ceiling lights



Energiesparlampen
(Kompaktleuchtstofflampen)

Energieklasse A
sehr tiefer Stromverbrauch



Innovative energy-saving electric bulbs



Waterless pissoirs

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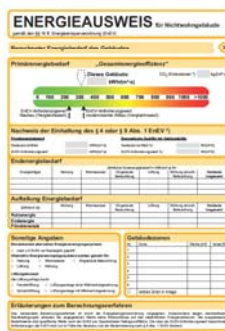
➤ What did the government do to save energy in Germany?

➤ **Wärmeschutzverordnung 1977 – 2001**
(heat insulation regulation)

➤ **Energieeinsparverordnung EnEV 2002...2009**
(energy savings regulation)
❖ **Objektive: Reducing energy consumption for heating and hot water for another 30 % as compared to EnEV 2007!**

➤ **Energieausweis**
(energy performance certificate)

➤ **LEED- und DGNB-Zertifizierungen**
(LEED- and DGNB Certificates)



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- How did architects, technical engineers and the industry react to these experiences regarding the operation of HIGH-RISE buildings?

**HIGH-RISE
building
1970ies**



FBC

**HIGH-RISE
building
1980ies**



Westend

**HIGH-RISE buildings
1990ies**



MesseTurm



Trianon



JAPAN TOWER

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- How did architects, technical engineers and the industry react to these experiences regarding the operation of HIGH-RISE buildings?

HIGH-RISE buildings at the beginning of 2000



MAIN TOWER



Gallileo

HIGH-RISE buildings 2010



OpernTurm



Tower 185



Deutsche Bank

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6. Conclusion

- What can you do to have a good energy conception?

Ask GGM-FM-Consulting

We have the experience and the knowledge



THANKS
for your attention