


## DEMONSTRATION SITE: YAMATAKE RESEARCH CENTER JAPAN

### Description of building: Environmental Engineering Research Center of Yamatake

	☞ Location: Ootaku Tokyo – Japan
	☞ Type of building: Office and laboratories building
	☞ Year of construction: 1999-2000
	☞ Size: 1700 m <sup>2</sup> (conditioned floor )
	☞ Contacts: <ul style="list-style-type: none"> <li>• Kazuyasu Hamada : Hamada-kazuyasu@jp.yamatake.com</li> <li>• Makoto Tsubaki : Tsubaki-makoto@jp.yamatake.com</li> </ul>

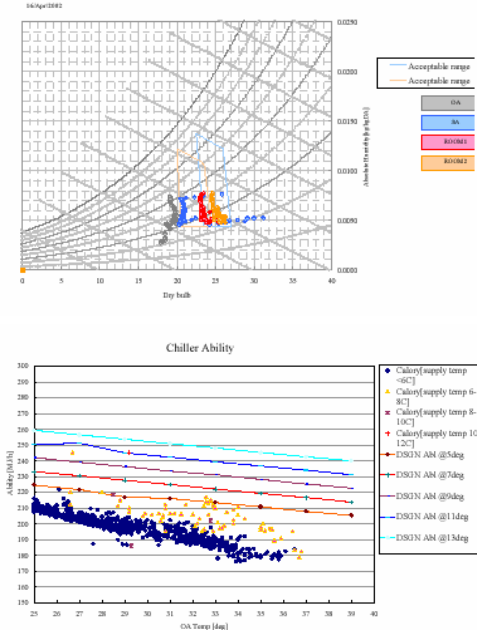
### Description of HVAC system

	<p><b>Plant level</b></p> <ul style="list-style-type: none"> <li>• 1 air-cooled heat pump chiller: 15RT</li> <li>• Water thermal storage 60m<sup>3</sup></li> <li>• Secondary pump system</li> </ul> <p><b>Zone level</b></p> <ul style="list-style-type: none"> <li>• 1F;Heat pump package</li> <li>• 2F;under floor AHU constant volume</li> <li>• 3F;VAV AHU</li> <li>• 4F;Slub thermal storage system</li> </ul> <p><b>BEMS system</b></p> <ul style="list-style-type: none"> <li>• Brand: savic-net EV(Yamatake)</li> <li>• Size: points 3000pts</li> <li>• Local controller: AHU IDC (Yamatake) VAV IVC(Yamatake) Plant PMX-3(Yamatake)</li> </ul>
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### Commissioning project

<b>Objectives:</b>	<ul style="list-style-type: none"> <li>• Owner's vision <ol style="list-style-type: none"> <li>1.Energy conservation, Reduction of Life cycle co2</li> <li>2. Getting CX knowledge of general information through construction to operation phase as CX</li> <li>3.Open to public CX knowledge through SHASE</li> </ol> </li> </ul>
<b>Type of Commissioning:</b>	<ul style="list-style-type: none"> <li>• Initial Commissioning(including design CX)</li> </ul>
<b>Phases concerned:</b>	<ul style="list-style-type: none"> <li>• Though Construction phase to Operation Phase</li> <li>• On-going Cx is processing</li> </ul>
<b>Target users:</b>	<ul style="list-style-type: none"> <li>• Building Owner and operator, Maintenance personnel</li> </ul>

## Tools and methods tested

<p><b>Manual tools</b></p> 	<p><b>Project management(Check list, guideline etc)</b></p> <ul style="list-style-type: none"> <li>Maintainability check list</li> <li>Functional specification document for Building Automation System ,etc</li> </ul> <p><b>Functional performance test procedure</b></p> <p>&lt;Component level&gt;</p> <ul style="list-style-type: none"> <li>DDC engineering tool(as data logger 1sec interval)</li> <li>Measurement for every input and output of equip</li> </ul> <p>&lt;Building level&gt;</p> <ul style="list-style-type: none"> <li>BEMS data logging(1min interval)</li> <li>BEMS grapf tool</li> </ul>
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## Practical experiences

### Users interview

Occupant Interview	Operator Interview
	<ul style="list-style-type: none"> <li>Enough information about Owner's and Designer's intent</li> </ul>

### Cx actions


- Design review, collect and check of the available documents
- Confirmation of OPR
- Installation review and verification of the HVAC equipment and the components of BEMS like sensors and actuators
- TAB verification
- FPT implementation
- Operator training
- Documenting: FPT test results, performance of AHUs and evaluation of cost-benefit of commissioning

### Cx Recommendations

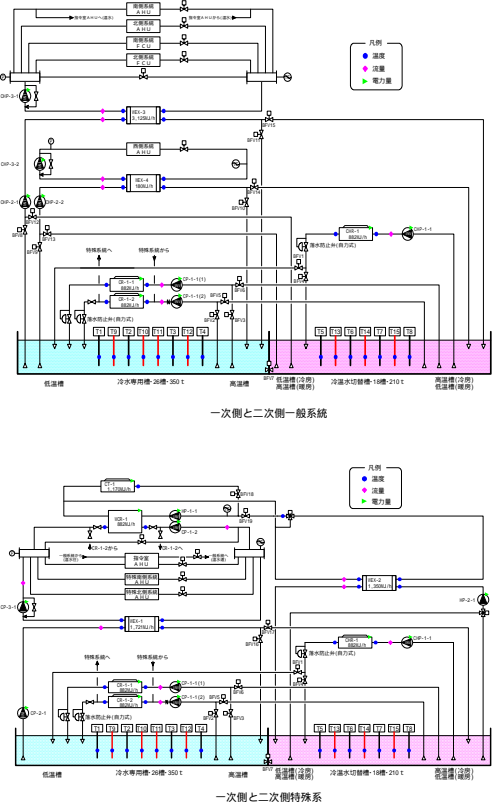
Manual	1	Design Review	Check control logic, sensor placement and sensor accuracy with design documents Detail set-point and value should be defined provided by OPR as possible
	2	TAB Verification	Conduct a field inspection to determine installed characteristics of the equipment including condition and maintainability
BEMS assisted	3	Control logic verification	Verify mismatch between the control logic and design documents
	4	Forced Response Testing and Analysis	Analyse performance of the equipment with the Commissioning tools.
	5	FPT	The detail procedure of FPT authorized by the CA should be defined The result of the integrated control test should be judged by the CA
	6	Documentation	Document the result of the commissioning analysis
	7	Training	Training should have conducted by the CA and the design team

## DEMONSTRATION SITE:

**Description of building:** TEPCO (Tokyo Electric Power Company) TACHIKAWA Branch

	☞ Location: Tachikawa, Tokyo, JAPAN
	☞ Type of building: Office
	☞ Year of construction: Jan. 2002 – Aug. 2003
	☞ Size: total/HVAC area: 16,765/8,981 m <sup>2</sup> Normal HVAC/ 24hs HVAC :6,334/ 2,647 m <sup>2</sup>
	☞ Contacts: Akihiko YOSHIKAWA <a href="mailto:yosizawa.akhiko@tepcoco.jp">yosizawa.akhiko@tepcoco.jp</a>

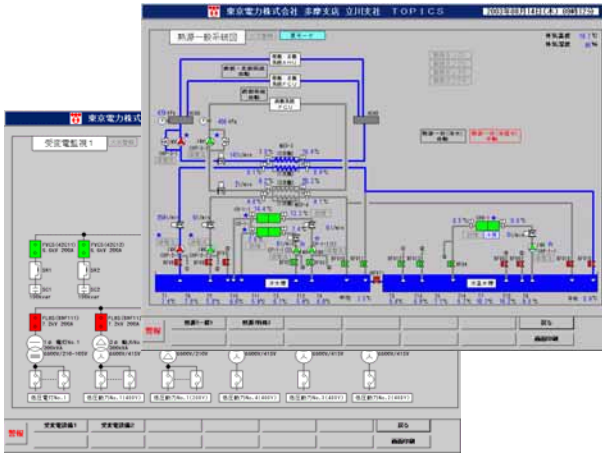
### Description of HVAC system

	<p><b>Plant level</b></p> <p>1) Generation:</p> <ul style="list-style-type: none"> <li>• 1 ASHP: (htg/clg cap) 245kW/300Iw with VVW</li> <li>• 2 ASHP: (clg cap) 245kW with VVW</li> <li>• 1 WCHP: (clg. cap.) 245kW</li> </ul> <p>2) Thermal Storage:</p> <ul style="list-style-type: none"> <li>• Chilled 350m<sup>3</sup> (chilled) 210m<sup>2</sup> (chilled/ warm)</li> </ul> <p><b>Zone level</b></p> <p>1) HVAC:</p> <ul style="list-style-type: none"> <li>• AHUs for each floor &amp; FCUs for perimeter zones</li> </ul> <p><b>BEMS system</b></p> <ul style="list-style-type: none"> <li>• Available</li> </ul>
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### Commissioning project

<b>Objectives:</b>	Energy and Environmental Quality Control by Initial Commissioning
<b>Type of Commissioning:</b>	Initial Commissioning
<b>Phases concerned:</b>	Whole phase
<b>Target users:</b>	Building owners, in-house engineers and whole participants in addition

## Tools and methods developed

Manual tools		Development and employment of procedure documents																																																																																																				
<table border="1"> <thead> <tr> <th>要求文書名</th> <th>(A)</th> <th>(B)</th> <th>(C)</th> <th>(D)</th> <th>(E)</th> </tr> <tr> <th>要求記述項目</th> <td>必要文書・記述の有無</td> <td>同左内容(必要に応じて記述)</td> <td>文書等の適不足確認 :合格 x:不合格</td> <td>内容の妥当性確認 :合格 x:不合格</td> <td>是正提案(CA) (発注者・設計者)</td> </tr> <tr> <th>大項目</th> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>中項目</th> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>細目</th> <td>(設計者による文書)</td> <td></td> <td></td> <td></td> <td></td> </tr> </thead> <tbody> <tr> <td>2) 検討書</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2)-1 空調システム検討書</td> <td>有り</td> <td>無し</td> <td></td> <td></td> <td></td> </tr> <tr> <td>8 部分負荷時運転対応</td> <td>有り</td> <td>無し</td> <td>x</td> <td>x</td> <td>検討指示</td> </tr> <tr> <td>・容量制御範囲</td> <td>有り</td> <td>無し</td> <td></td> <td></td> <td></td> </tr> <tr> <td>・システム対応</td> <td>有り</td> <td>無し</td> <td></td> <td></td> <td></td> </tr> <tr> <td>・機器対応</td> <td>有り</td> <td>無し</td> <td></td> <td></td> <td></td> </tr> <tr> <td>・その他</td> <td>有り</td> <td>無し</td> <td></td> <td></td> <td></td> </tr> <tr> <td>概略機器仕様決定</td> <td>有り</td> <td>無し</td> <td></td> <td></td> <td></td> </tr> <tr> <td>・空調機</td> <td>有り</td> <td>無し</td> <td>x</td> <td>x</td> <td></td> </tr> <tr> <td>・FCU</td> <td>有り</td> <td>無し</td> <td></td> <td></td> <td></td> </tr> <tr> <td>・その他</td> <td>有り</td> <td>無し</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		要求文書名	(A)	(B)	(C)	(D)	(E)	要求記述項目	必要文書・記述の有無	同左内容(必要に応じて記述)	文書等の適不足確認 :合格 x:不合格	内容の妥当性確認 :合格 x:不合格	是正提案(CA) (発注者・設計者)	大項目						中項目						細目	(設計者による文書)					2) 検討書						2)-1 空調システム検討書	有り	無し				8 部分負荷時運転対応	有り	無し	x	x	検討指示	・容量制御範囲	有り	無し				・システム対応	有り	無し				・機器対応	有り	無し				・その他	有り	無し				概略機器仕様決定	有り	無し				・空調機	有り	無し	x	x		・FCU	有り	無し				・その他	有り	無し				<ul style="list-style-type: none"> <li>Development and employment of procedure documents</li> <li>Development and employment of documentation tools requisite at each phase (Commissioning planning documents determine the framework of each phase of commissioning and, thus, has significant importance.)</li> <li>Development and employment of check-list sheets with grades of items which require the verification at each phase</li> </ul>				
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Automatic Cx Tools		Development and employment of check-list sheets with grades of items which require the verification at each phase																																																																																																				
		<ul style="list-style-type: none"> <li>This BEMS treats operational data of heat source systems, pumps systems (including heat storage tanks), air-conditioning-units, and VAV systems.</li> <li>Automatic accumulation of data at intervals of 1 minute, 10 minute and 1 hour</li> <li>Automatic real-time graphs of the data and the part of calculated data which contribute to check the every-day operational conditions and even function performance tests.</li> <li>Coordination of the BEMS functions and forecast estimation system of heat-storage</li> </ul>																																																																																																				

## Practical experiences

### Users interview

Occupant Interview	Operator Interview
<ul style="list-style-type: none"> <li>mostly no troubles</li> </ul>	<ul style="list-style-type: none"> <li>up until now, no severe troubles</li> <li>heat storage operation has proceeded well.</li> </ul>

### Cx actions

- interview with the owner, designers and constructors.
- development and verification of documentation tools
- verification of construction conditions
- verification of TAB results
- execution of function performance tests
- operational data check assisted by BEMS

### Cx Recommendations

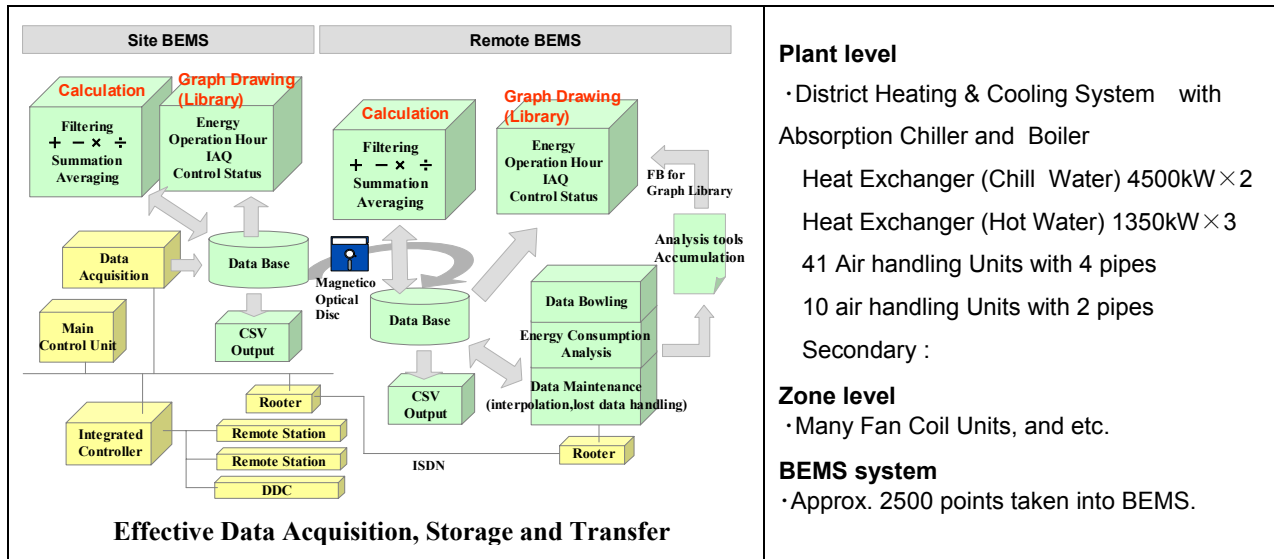
Manual	1	development procedure	Identification of purpose and scope of Cx, role and responsibilities of stakeholders, schedule, distributing information etc ( in FPT )
	2	documentation tools	development of documentation tools at each phase to organize systematically and to distribute information accurately
BEMS assisted	3	measurement	planning of measurement means to verify the owner's requested performance
	4	TAB	identification of TAB implementation items and prior check of the site, confirmation of acquiring the data at TAB and execution considering design intents
	5	function performance tests	prior check (confirming the acquisition of data)
	6	operation management	organizing documents to convey the design intention to operators

## DEMONSTRATION SITE: K-BUILDING JAPAN

### Description of building:K-Building

	☞ Location: Kokura - Japan
	☞ Type of building: Complex (Hotel, Shopping Mall, Station, etc. )
	☞ Year of construction: 1996-1998
	☞ Size: Approx.86,000 m <sup>2</sup> (Total Floor Area )
	☞ Contacts: <ul style="list-style-type: none"> <li>• H.Izumiyama : <a href="mailto:izumiyama-hiroo@kajima.com">izumiyama-hiroo@kajima.com</a></li> <li>• N.Sagara : <a href="mailto:sagara@env.kitakyu-u.ac.jp">sagara@env.kitakyu-u.ac.jp</a></li> </ul>

### Description of HVAC and BEMS system



### Commissioning project

<b>Objectives:</b>	<ul style="list-style-type: none"> <li>• Energy Saving</li> <li>• FDD tools development</li> <li>• Basic Design Data Collection</li> </ul>
<b>Type of Commissioning:</b>	<ul style="list-style-type: none"> <li>• Manual Initial Cx-like</li> <li>• Initial Cx-like with BEMS</li> <li>• ReCx-like with BEMS</li> </ul>
<b>Phases concerned:</b>	<ul style="list-style-type: none"> <li>• All phases from Design through Post-acceptance</li> </ul>
<b>Target users:</b>	<ul style="list-style-type: none"> <li>• Building Owners</li> <li>• Design Professionals</li> <li>• Engineers, Building</li> <li>• Operators/Facility manager</li> </ul>

*Strictly speaking, this isn't a commissioning project because there wasn't a commissioning agent employed by the owner and wasn't enough commissioning documents fully illustrated with owner's project requirement, commissioning plan, commissioning specification and operation manuals. That's why commissioning is said commissioning-like.*

## Tools and methods tested

### Manual tools

**An Energy Saving Example**

### Energy Saving Tools from Expertise

At the first year after turnover the dehumidifying with reheat were monitored at the site BEMS. It happened at an air handler for a dining hall in the hotel. We investigated the data carefully through the remote BEMS. Finally we found that operation was caused by the chill water control valve logic and the hall humidity setting. The valve opening was determined by humidity relating to the relatively low settings..

After the correction for the causes of dehumidifying the chill water valve opening followed Gaussian Distribution with the mean of 50%. We proved our guess was right by showing the energy consumption reduction for a dining hall. The chill water energy decreased almost half and the steam energy disappeared at the 2nd and 3rd year.

We also found other faults and rectified some of them from an energy saving point of view.

### Automatic Cx Tools

**Graph Selection and Date Assignment**

The necessary graph is selected from the menu shown right. You are expected to pick up a standardized term from each section. When you would like to know how much energy the chill water is monthly consumed, highlight "04 Air Handler", " 01 Daily.....", "06 Chill Water Energy" with mouse.

## Practical experiences

### Users interview

Occupant Interview	Operator Interview
<ul style="list-style-type: none"> <li>Entrance temperature is too hot in summer</li> </ul>	<ul style="list-style-type: none"> <li>Occupants are not energy –conscious, say they always set temperature lower than designer expects.</li> <li>When humidity setting was changed by 10 % RH, Energy Consumption reduced. But There were some dew condensation occurred in a corridor.</li> </ul>

Many faults were detected through 3-year Cx-like activity with/without BEMS. Some of them were corrected under the owners' approvals. The temperature and/or humidity setting, the energy loss with pump, and the energy medium temperature fluctuation from the DHC plant were analyzed in details for energy savings.

### Cx actions

- Design review
- Verification of sensors and actuators
- DHC contract renewal
- Tentative investigation
- Recommendation for DHC plant operation
- Regular meeting with owners and operators etc.

### Cx Recommendations

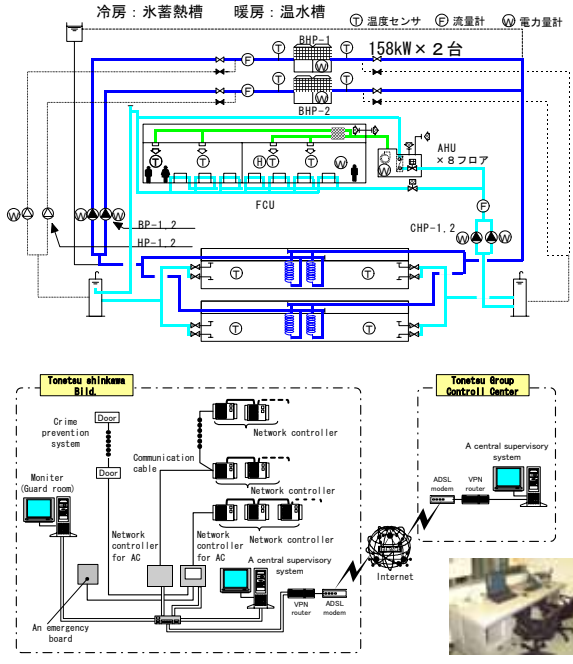
When BEMS is installed it better to utilize BEMS as a commissioning tool. It is very effective to do functional performance test.

## DEMONSTRATION SITE: SHINKAWA JAPAN

### Description of building: Shinkawa building

	☞ Location: TOKYO – JAPAN
	☞ Type of building: Office building
	☞ Year of construction: 1988 Winter -Renewal :2003
	☞ Size: 5400 m <sup>2</sup> (Heating & Cooling conditioned floor)
	☞ Contacts: <ul style="list-style-type: none"> <li>• K,KAMITANI <a href="mailto:kkamitani@tonets.co.jp">kkamitani@tonets.co.jp</a></li> </ul>

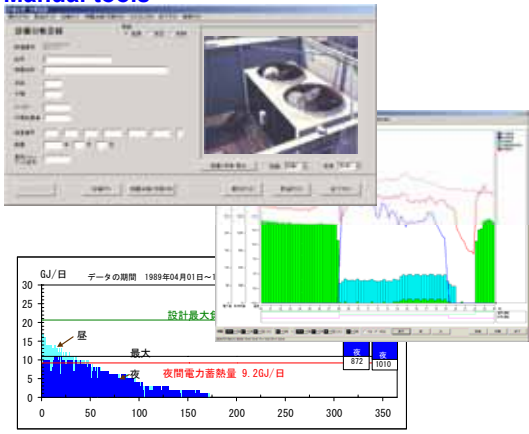
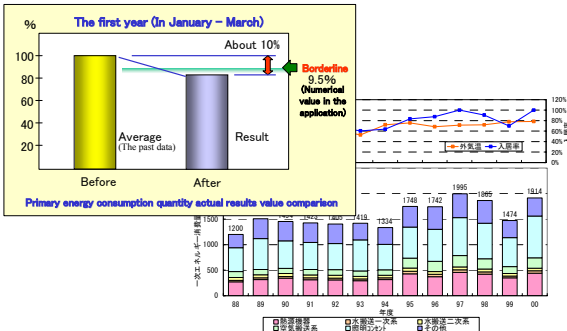
### Description of HVAC system

	<p><b>Plant level</b></p> <ul style="list-style-type: none"> <li>• 1 Air-Source Brine Heat Pump(158kW×2)</li> <li>• 2 Ice Thermal Storage Tank(64m<sup>3</sup>×2,IPF=8%) (Also used heating water in winter.)</li> <li>• 3 AHU/CAV on each floor FCU for perimeter zone.</li> <li>• 4 VAV system W/2-way control valves.</li> </ul> <p><b>Zone level</b></p> <ul style="list-style-type: none"> <li>• AHU &amp; Fan Coil Unit</li> </ul> <p><b>BEMS system</b></p> <ul style="list-style-type: none"> <li>• Brand: Original(EASY Net-1000)</li> <li>• Size: 800 points</li> <li>• Local controller: Original(EASY Net-10)</li> <li>• Supervisor: Design Insight</li> </ul>
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### Commissioning project

<b>Objectives:</b>	<b>Renewal of BAS/BEMS and automatic controls</b> <ul style="list-style-type: none"> <li>• Evaluation and practice of commissioning</li> <li>• Energy saving</li> <li>• BEMS assisted tools</li> </ul>
<b>Type of Commissioning:</b>	<ul style="list-style-type: none"> <li>• Re Commissioning</li> </ul>
<b>Phases concerned:</b>	<ul style="list-style-type: none"> <li>• All phase</li> </ul>
<b>Target users:</b>	<ul style="list-style-type: none"> <li>• Building owners</li> </ul>

## Tools and methods tested

<p><b>Manual tools</b></p> 	<p><b>Commissioning process controls by MQC and check lists</b></p> <ol style="list-style-type: none"> <li>1. Equipment ledger</li> <li>2. Graphical analysis (Trend Graphic)</li> <li>3. Compare Results data with deal value</li> </ol>
<p><b>Automatic Cx Tools</b></p> <p>NEDO year end report</p> 	<p><b>BEMS assisted</b></p> <ol style="list-style-type: none"> <li>1. Primary energy Consumption analysis</li> <li>2. The comfortableness evaluation of the indoor environment</li> </ol>

## Practical experiences

### Users interview

Occupant Interview	Operator Interview
<ul style="list-style-type: none"> <li>• There is a cold place by the place with the hot place 【 indoor temperature 】 .</li> </ul>	<ul style="list-style-type: none"> <li>• The control of indoor temperature is difficult. (There are many partitions between the insides.)</li> <li>• Some technical equipments are not accessible</li> </ul>

### Cx actions

- The optimisation of the operation of the heat source system
- Control of saving energy of the building
- Installation review and verification of the sensors and actuators

### Cx Recommendations

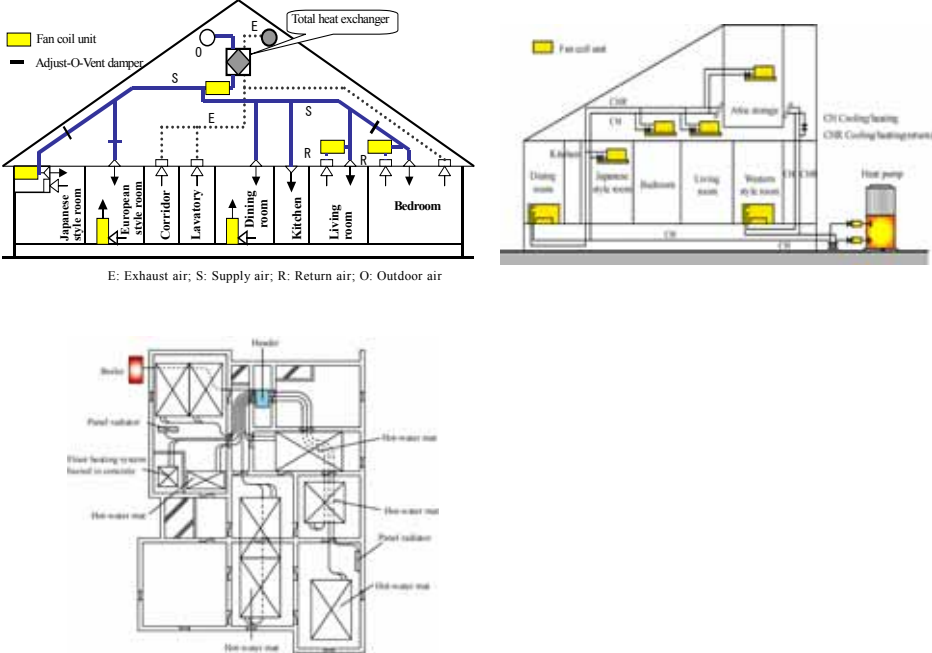
1	Design Review	Collation confirmation with the design specification of the selection machine
2	Installation Review and Verification	While a tenant continued business activities, the verification of the process control and the control of execution was done to the condition that construction was carried out.
3	Installation Review and Verification with BEMS	The test verification of control logic
4	Measurement Verification with BEMS	<ul style="list-style-type: none"> <li>• Relative comparison with the standard thermometer of the temperature sensor</li> <li>• The performance verification of the machine ability</li> </ul>
5	Forced Response Testing and Analysis	An unusual value detection test
6	Documentation	Design Drawing、 Manufacture Specifications

## DEMONSTRATION SITE: O-HOUSE JAPAN

### Description of building: Residential building, O-House

	☞ Location: Hyogo – Japan
	☞ Type of building: Residential building
	☞ Year of construction: 1996
	☞ Size: 151 m <sup>2</sup> (60 m <sup>2</sup> conditioned floor and heated floor)
	☞ Contacts: <ul style="list-style-type: none"> <li>• S. Hokoi : hokoi@archi.kyoto-u.ac.jp</li> <li>• N Nakahara : nob_naka@sa.starcat.ne.jp</li> <li>• H. Miura : be.hisashi@archi.kyoto-u.ac.jp</li> </ul>

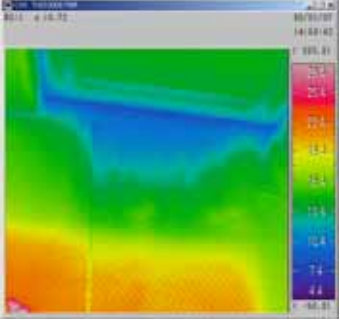
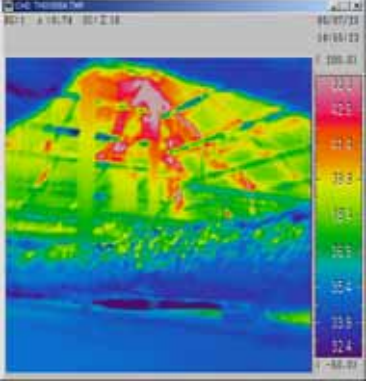
### Description of HVAC system

 <p style="text-align: center; font-size: small;">E: Exhaust air; S: Supply air; R: Return air; O: Outdoor air</p>	<p><b>Plant level</b></p> <ul style="list-style-type: none"> <li>• 1 Heat-pump chiller: 6 kW</li> <li>• 1 gas boiler: 10kW</li> </ul> <p><b>Zone level</b></p> <ul style="list-style-type: none"> <li>• Floor Heating Panel (First Floor)</li> <li>• Fan Coil Unit</li> </ul> <p><b>BEMS system</b></p> <ul style="list-style-type: none"> <li>• none</li> <li>• Supervisor: Designo Insight</li> </ul>
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### Commissioning project

<b>Objectives:</b>	<p><b>Identify and clarify the problems for thermal comfort and energy</b></p> <ul style="list-style-type: none"> <li>• Evaluation of the occupant's thermal comfort</li> <li>• To check whether the energy is wasted and to improve energy consumption</li> <li>• To clarify the residents' behaviour and operability of equipments</li> </ul>
<b>Type of Commissioning:</b>	<ul style="list-style-type: none"> <li>• Initial Commissioning</li> </ul>
<b>Phases concerned:</b>	<ul style="list-style-type: none"> <li>• All phases</li> </ul>
<b>Target users:</b>	<ul style="list-style-type: none"> <li>• Residents</li> </ul>

## Tools and methods tested

<p><b>Manual tools</b></p> 	<p><b><u>Manual Cx for air supply and exhausted airflow</u></b></p> <ol style="list-style-type: none"> <li>1. Are proper airflow routes realized according to design?</li> <li>2. Is the room temperature distribution uniform during heating/cooling period</li> </ol>
<p><b>Manual Cx Tools</b></p> 	<p><b><u>Manual Cx for insulation performance</u></b></p> <ol style="list-style-type: none"> <li>1. Is insulation installed as specified according to design intent</li> <li>2. Is there an insulation deficit?</li> <li>3. Are there any metal frame/fittings that act as a heat bridge ?</li> </ol>

## Practical experiences

### Users interview

Occupant Interview	Operator Interview
<ul style="list-style-type: none"> <li>• The control panel is too difficult to operate, since there are too many switches to be adjusted.</li> <li>• The bedroom temperature becomes sometimes too cold or too hot.</li> </ul>	<ul style="list-style-type: none"> <li>• None (because no operators)</li> </ul>

### Cx actions

- Measurement of airflow rates at the inlets and outlets
- Comparison of measured and calculated ventilation rates between rooms
- Check of there is insulation deficit and/or heat bridge
- Testing of heat supply by floor heating system and air-conditioning systems
- Documenting: test results, performance of central air-conditioning system

### Cx Recommendations

1	Project & Planning Phases	The concept of commissioning should be prevailed widely between builders, energy suppliers and engineers.
2	Construction Phase	Good information transfer by well-experienced staff is needed. An in-company inspection should be checked by other objective means.
3	Acceptance Phase	The commissioning in this phase should be done thoroughly , since the problems in the following phases might be avoided.
4	Operation Phase	Infrared thermo-camera is very effective in checking the insulation in hidden areas such as the inside of the walls or crawl space. Simple measuring method of overall heat transfer coefficient is required. Appropriate and simple method is required to measure airflow rates through the small openings such as door undercut. A simpler method should be developed for measuring water temperature and heat flow rate, since measurements are difficult. Simple calculation of heat balance provides a lot of information.