2013 National Institute for Educational Policy Research, Seminar on Educational Facilities Research

Nearly Zero-Energy Educational Facilities:

An overview of international trends and advanced cases

To protect environment is addressed as a top priority matter which the Japanese Government must make the utmost efforts towards.
Following the Great East Japan Earthquake and the nuclear accident, the Japanese Government mapped out a basic policy for reduction of the nuclear-dependence and maximum expansion of renewable energy and energy-saving efforts.
EU member states have set their goal for all new buildings to be "nearly zero-energy" buildings by 31 December 2020 by achieving enhancement of insulation and airtight of the buildings, making full use of high efficiency appliances and renewable energy technologies.
Under the circumstance, in the field of educational facilities in Japan, it is also required to make greater efforts to promote environmental measures, such as adoption of renewable energy technologies and energy-saving efforts.
In the first part of the seminar, Tony Sheppard, Chair of Centre for Effective Learning Environments (CELE) in OECD, gives an opening speech about international trends and advanced cases of "nearly zero-energy" educational facilities.
Followed by the opening speech, two more speeches will be given by the Japanese experts, Hiromi Komine and Osamu Koizumi about recent trends of research and investigation on environment-friendly educational facilities and introduction of recent designs of environment-friendly educational facilities aimed at zero-energy in Japan.

'nearly zero-energy building' means a building that has a very high energy performance, as determined in accordance with the below directive. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.
[DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings]

Tony Sheppard
Technical Manager, Planning and Buildings Unit
Department of Education and Skills, Ireland
Chair, Centre for Effective Learning Environments, OECD
Title: Nearly Zero Energy Educational Facilities: An overview of International Trends and Introduction of Advanced Cases

Hiromi Komine
Professor, Dr. Engineering,
Department of Architecture and Civil Engineering, Faculty of Engineering,
Chiba Institute of Technology, Japan
Title: Survey and Study on Environmentally Friendly School Facilities -Trend in Recent Years- Studies on Eco-School -From the beginning to now-

Osamu Koizumi
Chief, Architectural Design Group2,
Architectural Design Division,
NIHON SEKKEI, INC., Japan
Title: Toward Zero-energy School Buildings -Introduction of Environment-focused School Building Design in Recent Years-

Report

2013. 1. 22 (Tue)

14:00-17:00 MEXT No.2 Auditorium

NIER Ministry of Education, Culture, Sports, Science and Technology
NATIONAL INSTITUTE FOR EDUCATIONAL POLICY RESEARCH

Support
Architectural Institute of Japan

Nearly Zero-Energy Educational Facilities:

An Overview of International Trends and Advanced Cases

2013.1.22 (Tue)

14:00-17:00 MEXT NO.2 Auditorium

Contents

FY2012 Seminar on Educational Facilities Research
National Institute for Educational Policy Research

Nearly Zero-Energy Educational Facilities:
-An Overview of International Trends and Advanced Cases-

(14:00 to 17:00 on Tuesday, January 22,2013,at the No.2 Auditorium,MEXT)

Opening address **Haruki Ozaki**

Director General of the National Institute for Educational Policy Research

Title

Lecture **Tony Sheppard**

Technical Manager, Planning and Buildings Unit
Department of Education and Skills, Ireland

Tony Sheppard

Lecture **Hiromi Komine**

Professor, Dr.Engineering,
Department of Architecture and Civil Engineering,
Faculty of Engineering, Chiba Institute of Technology,
Japan

Hiromi Komine

Lecture **Osamu Koizumi**

Chief, Architectural Design Group2, Architectural Design Division, NIHON SEKKEI, INC., Japan

Osamu Koizumi

Closing address **Fukuei Saito**

Director of the Educational Facilities Research Center of The National Institute for Educational Policy Research

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Ⅰ. Opening Address

1．Opening

Moderator (Masahiro Kobayashi, National Institute for Educational Policy Research)

Sorry to have kept you waiting so long.

Now, we commence the “2013 National Institute for Educational Policy Research Educational Facility Research Lecture Meeting, Nearly Zero Energy Educational Facilities: -An Overview of International Trends and Advanced Cases-.”

Thank you for making time in your busy schedule to be here today.

I, Masahiro Kobayashi from the National Institute for Educational Policy Research, will moderate the meeting today.

First, Haruki Ozaki, Director-General of the National Institute for Educational Policy Research, will welcome you on behalf of the Institute that organized the meeting.

Director-General Ozaki, please.

2 . Opening Address

Haruki Ozaki

Director-General of the National Institute for Educational Policy Research

I am Ozaki who was introduced just now. Thank you very much for gathering here for our educational facility research meeting this year.

Needless to say, environmental measures are an issue for the nation to tackle with concerted efforts. It has been about 10 days since the Cabinet decided “Emergency Economic Measures for the Revitalization of the Japanese Economy” on January 11. The decision also advocates promotion of energy conservation and introduction of renewable energy as well as support to energy-saving renovation to contribute to the creation of a low-carbon society.

Internationally, EU countries plan to realize nearly zero energy for all new buildings by 2020 by taking advantage of renewable energy technologies to ensure thermal insulation, air-tightness and high-efficiency of equipment. Against this backdrop, it is also very important to introduce renewable energy technologies and environmental measures such as reducing energy burden through energy-saving efforts in school buildings. Their promotion has become an impending issue.

In such a situation, we organized this lecture meeting and invited Mr. Tony Sheppard who is Technical Manager, Planning and Buildings Unit, Department of Education and Skills, Ireland, and Chair of the Centre for Effective Learning Environments, OECD. He is going to give a lecture soon after this. As you can see in the material in front of you, Mr. Tony Sheppard will introduce international trends and advanced cases of nearly zero energy school buildings.

Following Mr. Tony Sheppard, Professor Hiromi Komine of the Chiba Institute of Technology and Mr. Osamu Koizumi, Chief Architect of NIHON SEKKEI, Inc., are going to talk about their respective researches and design works in recent years. Thank you very much for making time in your busy schedule to be here today. (to the lecturers)

Though limited in time, I really hope that the meeting, with the lectures introducing measures and research efforts, will provide an opportunity for us to gain useful knowledge for exploring the direction of environment-friendly school buildings. I also hope that this can contribute to the future enhancement of school facilities. Hoping these things, I finish my opening address. (Applause)

Moderator: Thank you Director-General Ozaki.

Ⅱ. Commemorative Lectures

Commemorative Lectures

Moderator:

Now, commemorative speeches will start.

Today's meeting consists of three parts.

The first speech is on Nearly Zero Energy Educational Facilities: -An Overview of International Trends and Advanced Cases-" by Mr. Tony Sheppard, Technical Manager, Planning and Buildings Unit, Department of Education and Skills, Ireland.

Then, after a 15-minute break, Professor Hiromi Komine of the Department of Architecture, Chiba Institute of Technology will give a speech on "Research Study on Environment—Friendly School Facilities—Trend in Recent Years- Studies on Eco-school – From the beginning to now—."

Then, after another 15-minute break, Mr. Osamu Koizumi, Subleader of the Second Architectural Design Group, NIHON SEKKEI, Inc., will give today's last lecture titled "Toward Zero-Energy School Building —Introduction of Environment-focused School Building Design in Recent Years—."

Please write your opinion on the meeting on the questionnaire in front of you and hand it in at the reception area before you leave.

Now the first lecture will start. Mr. Tony Sheppard who is Technical Manager, Planning and Buildings Unit, Department of Education and Skills, Ireland, and Chair of the Centre for Effective Learning Environments, OECD, will give a lecture titled "Nearly Zero Energy Educational Facilities: -An Overview of International Trends and Advanced Cases-."

For a profile of the lecturer, please see the material in front of you.

Please start, Mr. Tony Sheppard.

Lecture

Nearly Zero Energy Educational Facilities

An overview of International Trends and Introduction of Advanced Cases

Tony Sheppard

Technical Manager, Planning and Buildings Unit,
Department of Education and Skills, Ireland
Chair, Centre for Effective Learning Environments, OECD

Tony Sheppard

Since April 2010 Chair of the Board of Participants of the OECD Directorate for Education - Centre for Effective Learning Environments (CELE). An architect with over 30 years of experience with the Irish Government Department of Education & Skills dealing with the development and implementation of educational facilities policy. As a Technical Manager member of Management Team responsible for provision of educational facilities at Primary, Post-Primary, and Third Level. Direct responsibility for managing delivery of all school projects in Dublin Area.

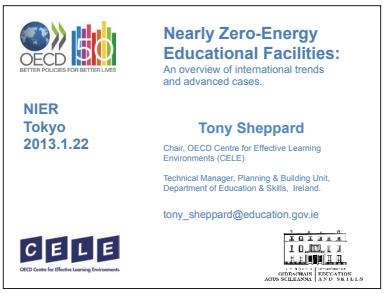
In response to urgent demographic demands, developed the strategy of expediting the delivery of multiple primary schools using type plans. Nearly 50 of these Generic Repeat Design (GRD) schools completed using the practical simplicity of its award winning low energy design and repeatability on sites with varied orientations. Organised international design competition for a 1,000 pupil Post-Primary School, in which winner was awarded the commission to build winning scheme. Currently undertaking with Department educationalists wide-ranging review of Primary and Post Primary School pedagogical and accommodation briefs for all new schools. This is drawing on leading edge international research. Target is fully revised brief that will be fully trialled in pilot projects and will be the basis for a Primary School Architectural Design Competition in 2013.

Education

Bachelor of Architecture NUI University College Dublin
Member Royal Institute of Architects in Ireland
Member Royal Institute of British Architects

Mr. Tony Sheppard:

(Slide 1) Good Afternoon. Ladies and Gentlemen, it's a wonderful honour to be invited here to share some of our experiences in OECD and also from my country Ireland. You have hardcopies of the presentation, there are a lot of slides so I will only be speaking to a few of them. (Slide 2) My intention is to give you an overview of international trends, then a number of case studies in Ireland. I will also be touching on the EU Energy Performance Directive also in their links. (Slide 3-4) So in an overview of international trends, you will note there are 34 countries in OECD and your hardcopy is incorrect. It only says 30. And there is engagement ongoing at the session talks with Russia and enhanced engagement with the other countries listed at the bottom there. (Slide 5) What is the OECD? It's a global organization. Better lives, raise living standards, a stronger, cleaner, fairer world, and in the topic of today's seminar, sustainability and environment is also listed. (Slide 6) The OECD's Centre for Effective Learning and Environments' mission is to assist its members improve the education and operational effectiveness of their buildings. The word effectiveness and buildings are linked. (Slide 7) CELE is a voluntary programme relying entirely on contributions from its members and others. The name reflects the work, it's not just about physical building but how to interact with education and the needs of education. Japan is represented as associate members by the National Institute of Educational Policy Research and also Tokyo Institute of Technology. You will see where Ireland is located, is in the far west of Europe and also of the EU. I should warn you that everything I say today is informed by the fact that Ireland has a fairly mild temperate climate that is it never too hot or too cold, so just remember that the challenges we have in terms of humidity and air conditioning are nonexistent and very cold winters are unusual in Ireland. (Slide 8) You will see there are OECD countries that commit to ensure that the economy recovery and the future economic growth are



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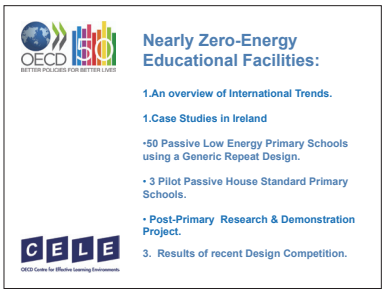

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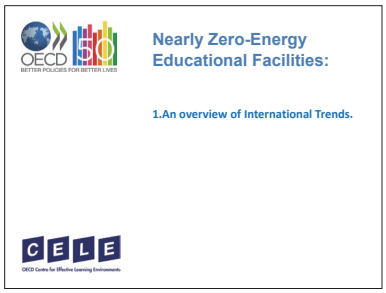

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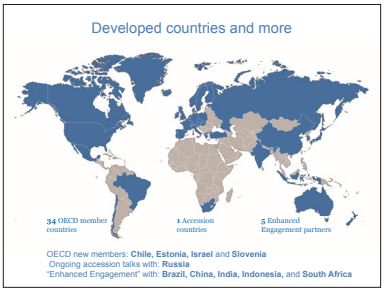

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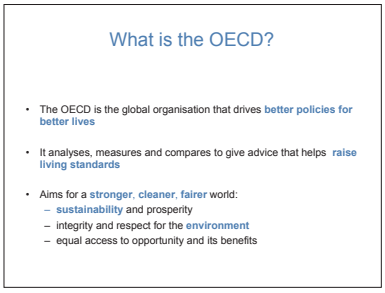
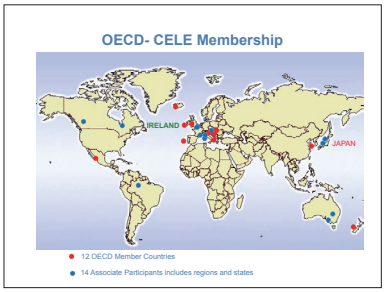


Slide 5

Slide 6

consistent with sustainable development, and these are 2006 survey indicated schools as a primary source of information on environmental issues. So there is a wider role for schools there. (Slide 9) That's the amount of Euros billions spent on educational facilities each year (Slide 10) and I won't read all of these, I think it's the best that because you have hardcopy and my limited time, then I focus on a few other slides.

(Slide 11-12) In September 2011, the OECD we launched this compendium. There was an international jury that selected 60 projects from 28 countries. (Slide 13) There were four categories; innovative design, fitness for purpose, sustainability and safety. (Slide 14) The jury identified 6 projects that were outstanding examples and I'll mention one or two later, (Slide 15) but Japan was represented by Fuji Kindergarten as the most outstanding example. I had a great honour of visiting this beautiful building last July when I was on a vacation, thanks to NIER. It is truly wonderfully beautiful. (Slide 16-18) These are just other buildings which I'm going to very quickly proceed with. (Slide 19-20) In Chile a wonderful building that is a centre of a challenged community. (Slide 21-22) This building is for special educational need children, physically



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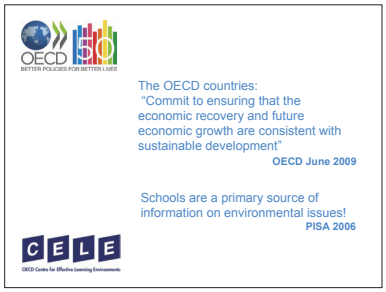

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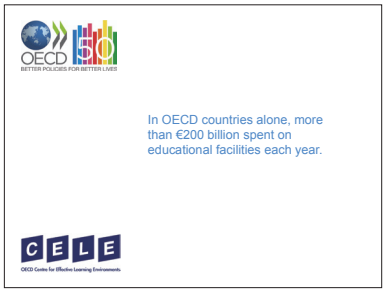

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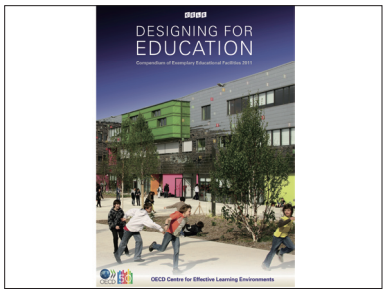

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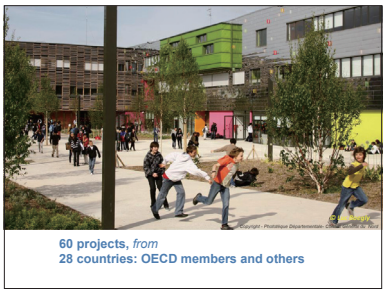

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and mentally disabled. (Slide 23) A wonderful building. This building is quite unusual and that is for blind students so there is a sensory garden. (Slide 24-25) This and the next building I just want to emphasise as incredible examples of quite sophisticated design responsive truly to the environments and the communities in which they are set. It was designed by Anna Heringer who is a Berlin-based architect but I think you will all agree that the citation up there at the top is a true reflection of how wonderful this building is. (Slide 26-27) There's a plan very simple and the form of construction is local indigenous materials and bamboo forming the roof. The cross section, once again is elegant in its simplicity. (Slide 28-29) Another example that I hold forth as an incredible example of true sustainable construction is this building in West Africa. The cross section was quite sophisticated, it's responsive to the rain and also the heat encountered in this climate. (Slide 30) There's an interior of the building. (Slide 31-32) Then, a more sophisticated design in the UK. I'm sure a number of buildings here which are truly wonderful. (Slide 33) Very sophisticated buildings. (Slide 34) This building, the designers are incredibly honest that the actual energy usage is nearly twice what they have predicted at the design stage. We all know the additional ICT

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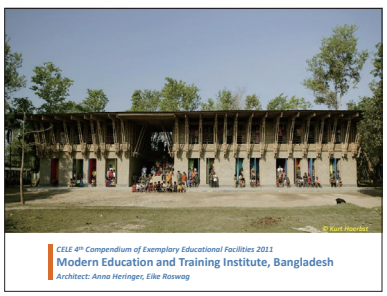
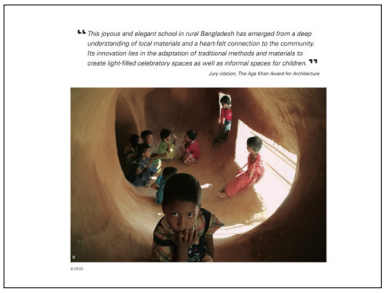


Slide 24

demands of laptops, computers, and smart boards are adding to the electrical energy demands on the building. (Slide 35-36) Very sophisticated cross sections, beautiful construction. (Slide 37) This is another example of a building in Victoria. (Slide 38) A number of virtually identical buildings (Slide 39) and the reason I show this is that the planned form of each school within a school has, rather than cellular space, it has a lot of spaces that can be opened up and there is maybe opportunities if this is a future trend for buildings to maybe exploit sustainable design, natural ventilation, and day lighting. (Slide 40) These are



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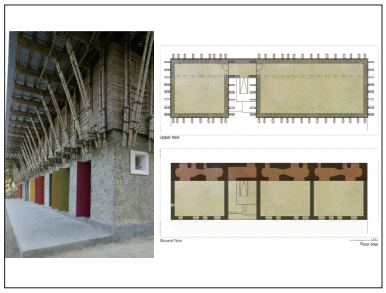

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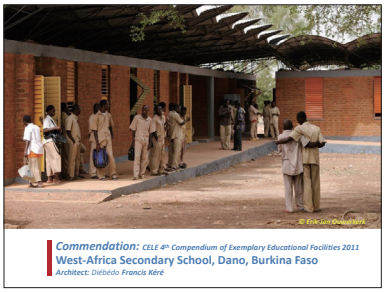

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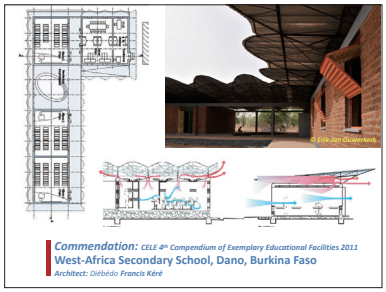

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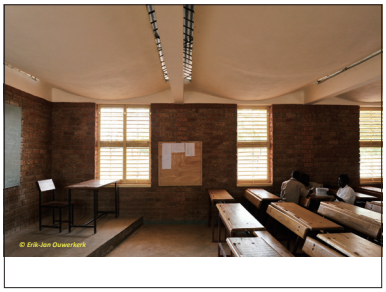

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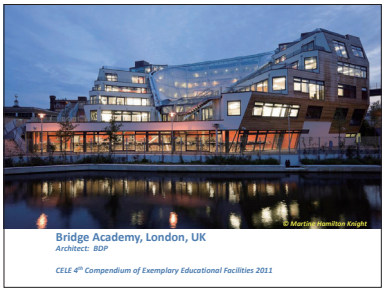

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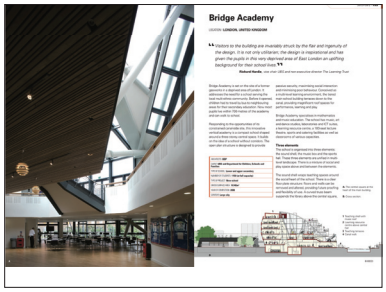

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just spaces.

(Slide 41) A country's school building stock can be a significant source of CO_2 emissions in the UK; it's something of the order of 2%. (Slide 42) This is a very interesting slide. (Slide 43) Tree buildings and if we look at their energy usage, this is the carbon footprint of the school over 110 years old. A school that is only nearly 10 years old you will see, although it's a fairy innovative school, the carbon footprint is very similar. It is just an indication of the buildings that are built in the 70s and 80s where maybe not built for very good insulation standards. (Slide 44) It is also important to measure whether sustainable benefits are being delivered. Sometimes this can be done in an educational way. There is some criticism that these indicators are fairly speedily ignored by the children and the staff, (Slide 45) but it's good to have the building as a teacher, it's up to the school then to exploit that.
(Slide 46) This is just another example of how rainwater becomes part of the school. (Slide 47) For more information on international trends I would refer you to this website on the OECD, a joint investment by

Slide 37


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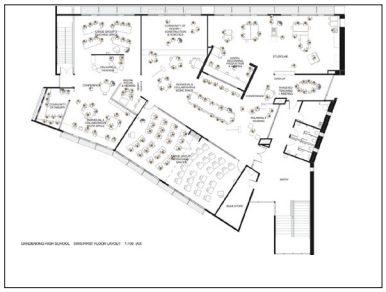
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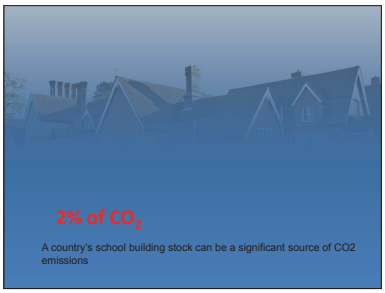

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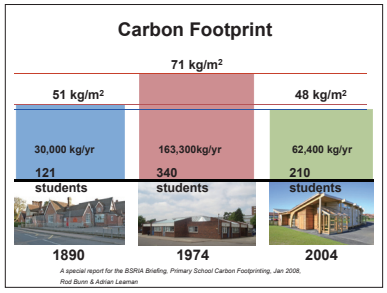

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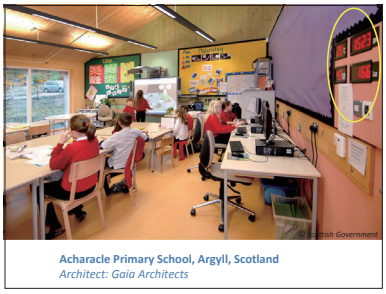

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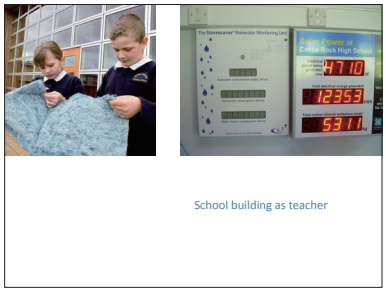

Slide 45

the European Investment Bank and the OECD under very good drawings, data reports within that website. You just have to register freely and you can see a lot of examples.

(Slide 48) I just want to move on and quickly to a number of case studies in Ireland. (Slide 49) The first is something, the drawing on the right hand side is an old drawing showing schools from the 1860s, very simple rural buildings. But to the later buildings in the 1950s and 60s which were built by means of type plans. (Slide 50) Around about year 2000 we developed within the Department's Planning and Building Unit a pilot project that tested a number of new technologies, (Slide 51) and following that then we developed a generic repeat design. By that we mean that the design can be repeated on a number of sites (Slide 52) and it's a quite simple straight forward building, easy for Irish builders to build. It was short-listed for the 2006 Chartered Institutes of Building Services Engineers' Environmental Initiative of the Year, and it also won within Ireland an award. So this is like at that time 2005, 2006 was the state of the art. (Slide 53) 22 were completed in that period (Slide 54) and another 17 were completed later on, and

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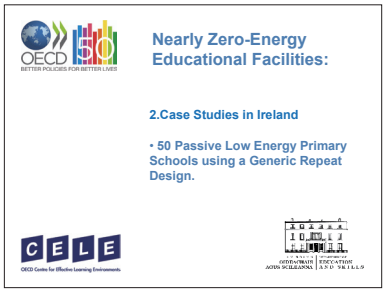

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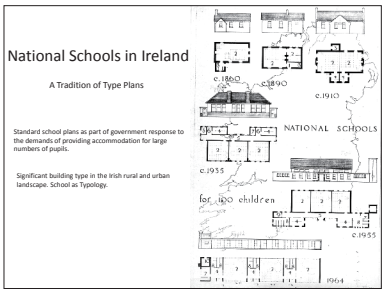

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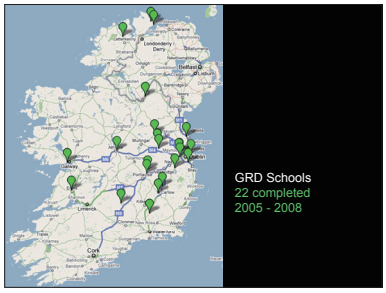

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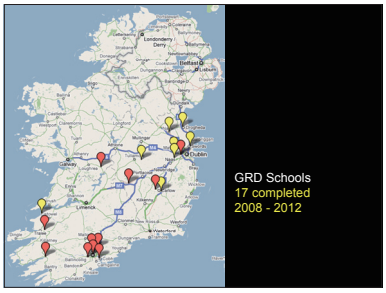
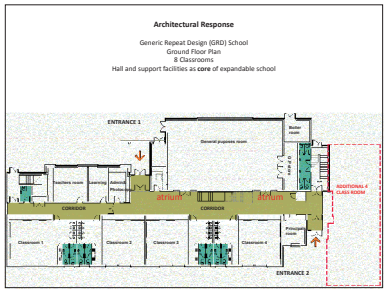


Slide 54

with improvements we are proposing to build another 10 or 20 of them.

(Slide 55) The plan, it's a two-storey building, 4 classrooms on the ground floor, 4 on the first floor. But a problem with schools everywhere in the world is how to expand, (Slide 56) so this is how you can expand the building to 12 classrooms and turn to 16. (Slide 57) It's a fairly simple building, L-shaped so there's clear way finding for pupils and visitors to the building. The exterior perimeter wall of the building is reduced to the minimum to reduce heat loss, (Slide 58) and that's the first floor plan. I should have said that to the right hand side is east, and to the bottom is south, so we enjoy a lot of paths of solar gain. (Slide 59) The bottom diagram shows the orientation of glazing towards the sun, that's towards the sun, so it's a fairly efficient path of solar building. (Slide 60) Just an image, very simple construction, we have a lot of rain in Ireland like your good selves have also, so it's important to get rain off the roof. (Slide 61-62) These were images of the building that we prepared for our planner to ensure that the building sits into the context. (Slide 63) Within the classroom daylight is incredibly important we feel. Note there is a whiteboard on the



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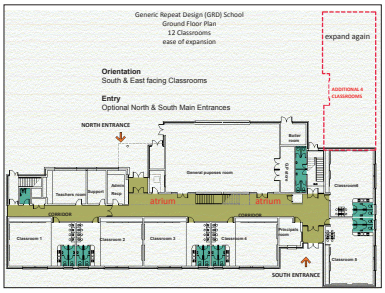

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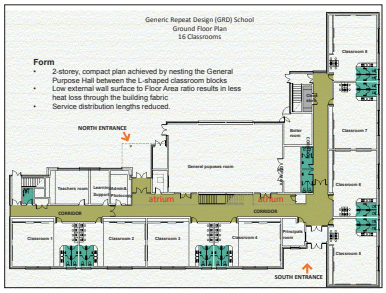

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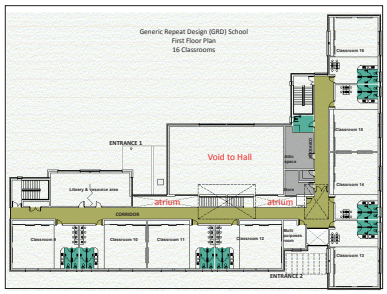

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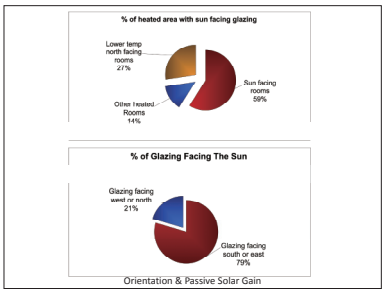

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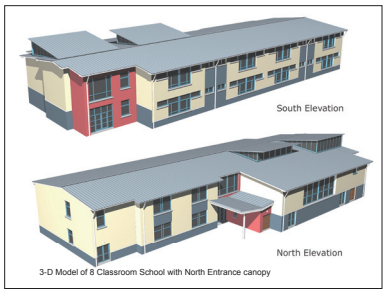

Slide 60

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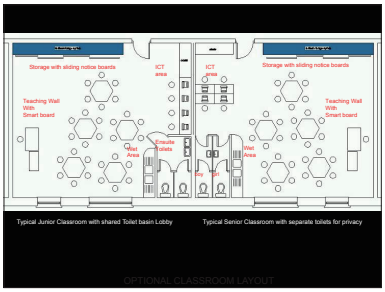
Slide 63

teaching wall, since then we have introduced a smart interactive board and there have been some issues that rooms are actually too bright so we had to introduce blinds. (Slide 64) These are just plans of classrooms. (Slide 65) The daylight within the classroom, all classrooms can operate without artificial light for up to 80% of occupied time, that's throughout the year. At bottom there you can see the blinds pulled down to prevent glare. (Slide 66) Some glare studies we undertook. (Slide 67) The first schools, there were some issues of overheating, so we introduced additional openable windows indicated in green on the bottom right slide. (Slide 68) These are just images of the building, (Slide 69) and the PE hall or general assembly space, daylight analysis done on those as well, a fairly good acoustics because it's used for art and drama and music, not just for physical education, (Slide 70) and at a high level we have daylight coming into give a good balance of light across the space, and very good ventilation because there could be up to 500 children in this room. (Slide 71-72) The central stairs give good day lighting and good visibility throughout the building. (Slide 73) These are just simple examples and the bottom is red, the colors of the rainbow so you can see the rain there coming down brightens up an otherwise dark day. (Slide 74) Now, as



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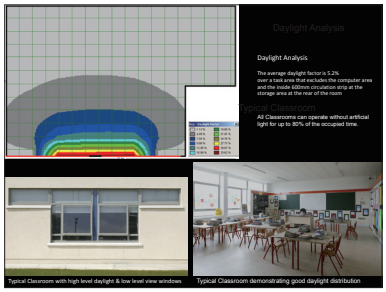

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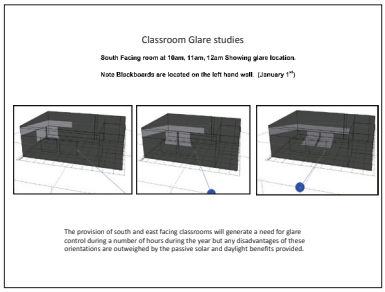

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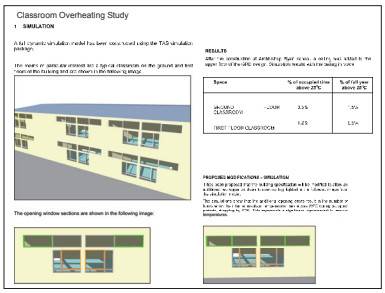

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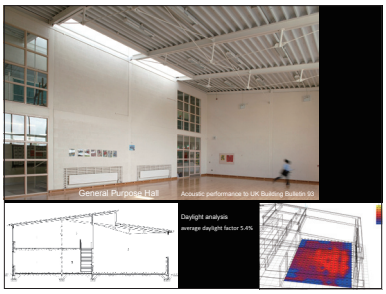

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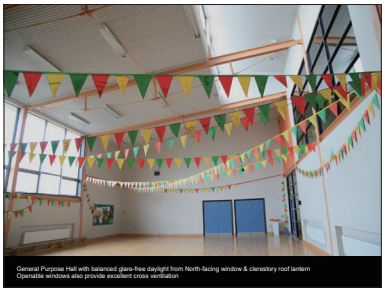

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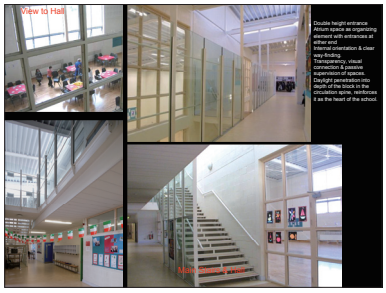


Slide 71

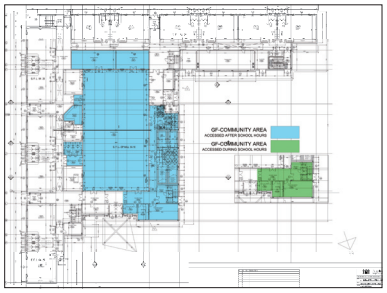
Slide 72

a result of increased demand for pupil numbers for fairly large schools we have as a result of a research we've shown you on those recent schools developed larger 24 and 32 classrooms schools, but capable of being in built in phases and delivered on several sites. (Slide 75) This is again an L-shaped building; the blue color is indicating the spaces that can be used by the local community outside the school hours, (Slide 76) a fairly large hall that's used for community use. This was at the official opening, (Slide 77) just elevations of the building. (Slide 78) The context two-storey building, you can see some of the houses 2 and 3-storey nearby, this is the context in which we build. (Slide 79) This is from the ground of one school looking back towards other school.

(Slide 80) Some shots within the schools. (Slide 81) This is just a photograph of the airtight test rig in place at the main entrance doors. The smoke coming from the school indicated that the doors were not working. The Department itself decided to have an air tight requirement, you'll see there are initially 5 cm^3, we've reduced that down to 3 because I'll show you a slide later on which shows you how cold air getting into


Slide 73

Slide 74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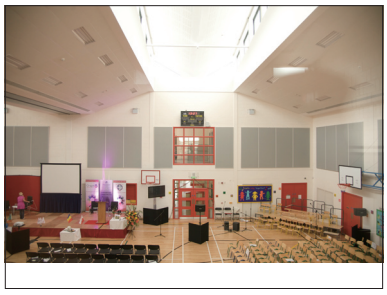
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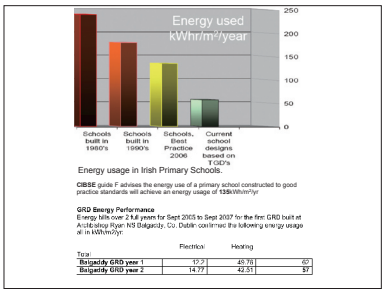
Slide 81

the building costs energy. (Slide 82) But this was the energy usage just in round terms, in round figures. The Chartered Institutes of Building Services Engineers, CIBSE, recommend a guide figure of 135kw per square meter per year. These schools are coming in roughly around 60, so it's quite good. (Slide 83) You will see there that 47% of the heat loss occurs due to unwanted cold air leaking into the building, 47% on the right hand side. (Slide 84) So this slide is just demonstrating that the majority of heating energy use in the school now relates to infiltration, that's the cold air getting into the school, unwanted cold air, and also the ventilation to open the windows to prevent CO_2 rising. So there can be no improvements to ventilation energy usage until we introduce heat recovery ventilation systems, and that is something that we are reluctant to do because we are relying on natural ventilation, but I will come back to that later. (Slide 85) You'll see there on the left hand side, night time the cold air getting into the building 36%. During the day if the spaces which are occupied, classrooms are typically occupied by 30 pupils, you need to ventilate to prevent a rise in CO_2 and 78% is due to ventilation. So unless we go for heat recovery these are the kinds of energy usage. (Slide 86) We have improved, we were aware that many school classroom teachers were not opening the windows, so we for an automatic seal to sensor triggering openable windows (Slide 87) and you can see the bottom photographs of the windows opening up to 50mm or even more to ventilate and to keep the room safe for the children. (Slide 88) This interestingly has introduced a need for more ventilation. This is a large school under construction at the moment where the entire school has those automatic windows and we hope to be able to report back on how the energy performance has improved on that school. This is like the state of the art of a naturally ventilated building. We will have an airtight requirement of only 3 cm^3, we have a fairly good builder building at the moment, it should be completed by next September, it should perform very well. (Slide 89) These are just elevations.



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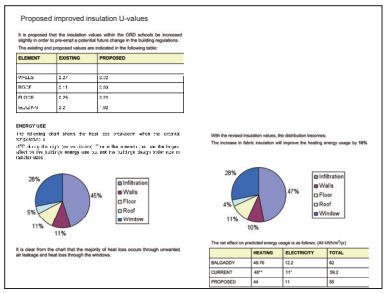

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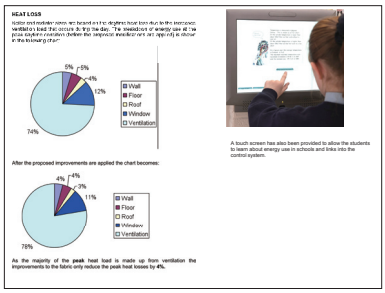

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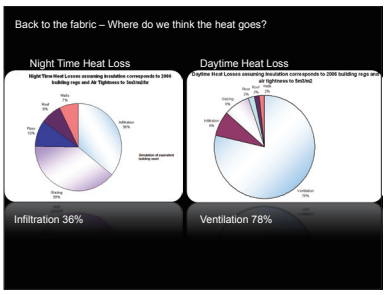

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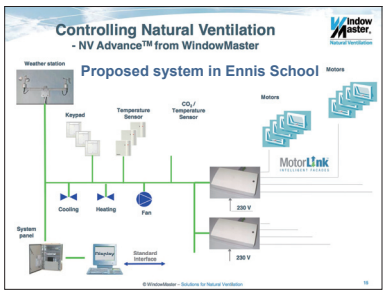

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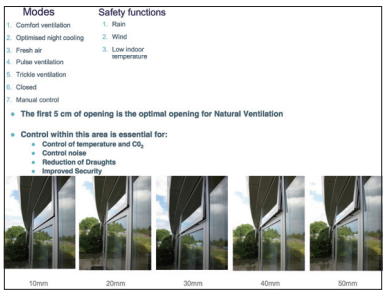
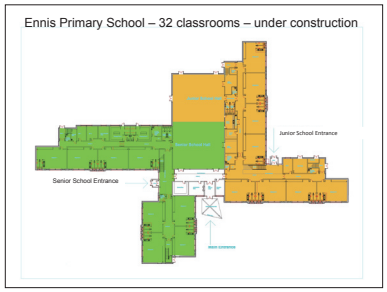


Slide 87

(Slide 90) Now the second case study is on a passive house, (Slide 91) that's the German standard for passive house schools or passive house dwellings. (Slide 92) We've applied this to a school, it's a simple school with 4 classrooms (Slide 93) that can grow to 6 (Slide 94) and can grow to 8. It's a simple rural school, single-storey, note as you can see to the right hand side so all the classrooms face south or east. (Slide 95) Side plan, playing fields. (Slide 96) These are the passive house requirements. You will see the figure of total primary energy demand of 120kw per square meter per year. That is quite a high figure and I think that results from dwellings and it's something we might examine more carefully for schools which should be a lot lower, which you can see the airtight requirement is very, very tight. (Slide 97) The figure there on the fourth line and the third line on 44 is the primary energy demand of the building, 44. I will come back to that figure later. (Slide 98) This is the form of construction of the building; it is being constructed way in advance of the insulation requirements in Ireland. I emphasized earlier, Ireland has a fairly mild climate unlike Scandinavia, Norway, Finland, Sweden where they have a fairly arctic climate and very cold climate. (Slide 99) We normally do not put the levels of insulation that is demanded by a



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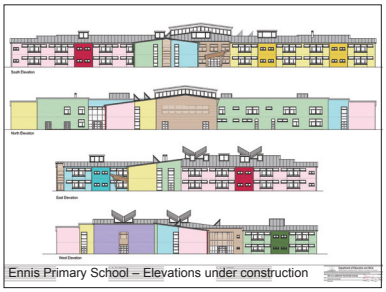

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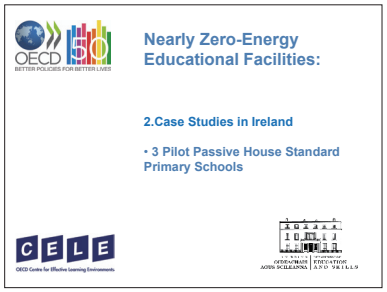

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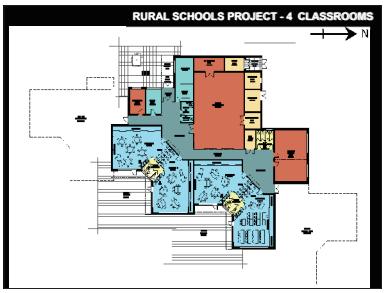
Slide 91



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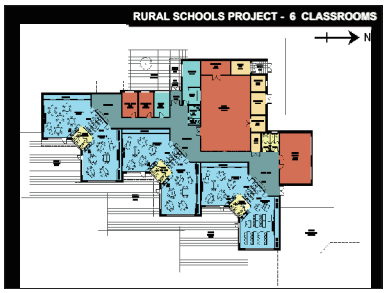

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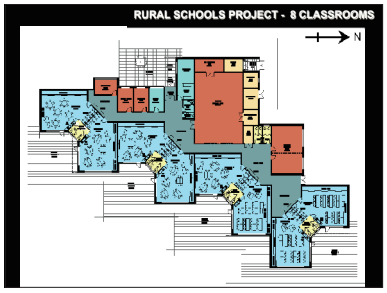

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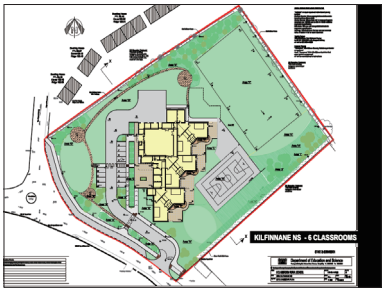

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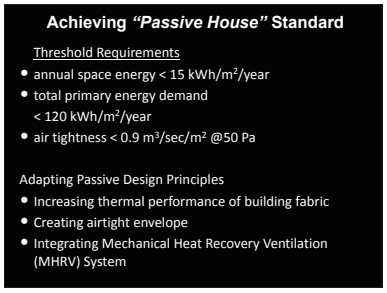
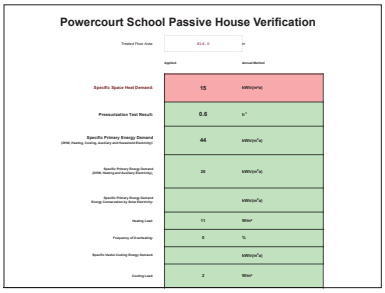


Slide 96

passive house building, (Slide 100-101) but you can see these details are showing a lot more insulation, the thermo graphic studies indicating the heat loss. (Slide 102) This slide showing the integration of ventilation systems, the extraction in red and the supply air in blue. (Slide 103-104) This is the building just completed, we have 3 of them completed; we will now study them over the next year also. Quite a simple building.

(Slide 105-106) This next building is a demonstration project which is the final built project I would like to show you. It's 575 pupils. It's called Colaiste Choilm, Colaiste meaning a college or post primary school. It's in the middle of Ireland; it has won a number of awards already. (Slide 107) These are the range of topics that are being explored in the building. It will be very carefully monitored over its first 3 years in use, it's about a year in use at the moment and you will see a number of technologies are being explored with a view to testing them and see "should we have these as our standard in all those schools". (Slide 108) That's the building, the west elevation, the main entrance. (Slide 109) I should have said that I'm an



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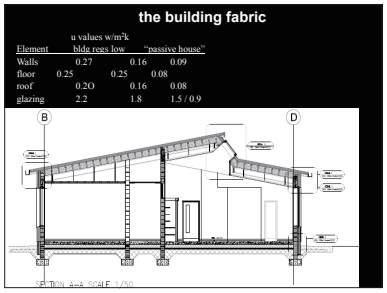

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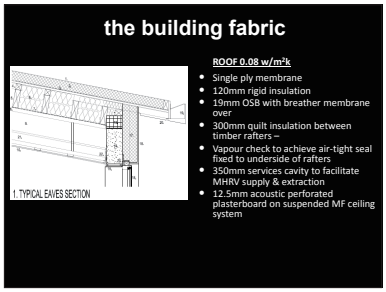

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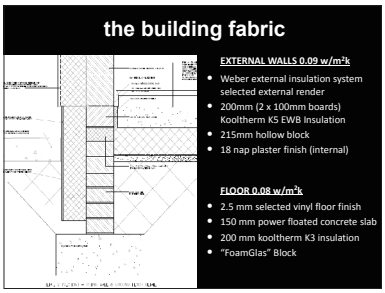

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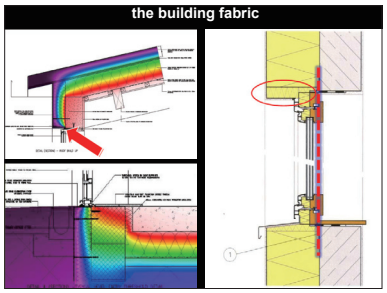

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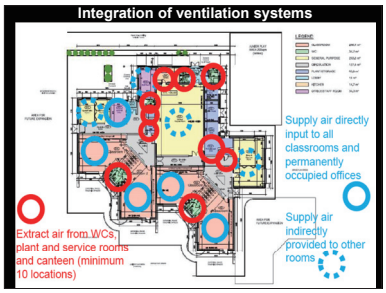

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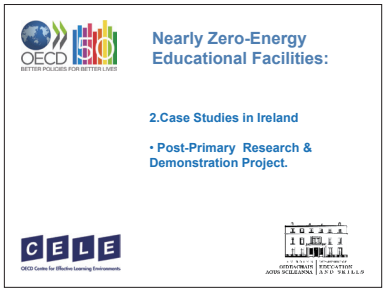
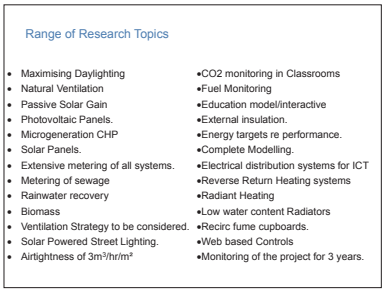


Slide 105

architect by profession and the orientation and the basic decisions architects make I believe are fundamental to the efficiency of the building. It's a fairly simple building; it's a very simple and short perimeter. To the right hand side it faces east. (Slide 110) This is just the side plan, (Slide 111) that's the west elevation; the left hand side is the student entrance. (Slide 112) This is the east elevation which enjoys a view over plain fields and has a large area of classroom glazing, so it's a passive gain school also. (Slide 113) The plan is fairly straightforward, with the large hole on the left hand side, teaching spaces, large workshops on the ground floor. (Slide 114) Typical classrooms are on the first floor. To the bottom of the page would a specialist teaching room (Slide 115) which is like computer rooms. (Slide 116) On the roof there are 90 m^2 of photovoltaic and these have been really quite successful. Ireland as mentioned has a climate with a lot of rain, lots of overcast cloudy days and these have actually been quite successful, I'll come back to that later. (Slide 117) The corridors are very simple and straightforward. (Slide 118) Student space. (Slide 119) This is the large hole which has behind the red screen is the music room which functions has a stage. Good day-light, could be better. The daylight factor here is now 3%, I'm urging architects to

Slide 106



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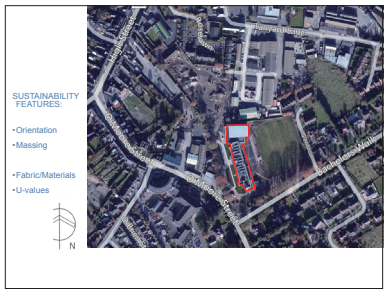

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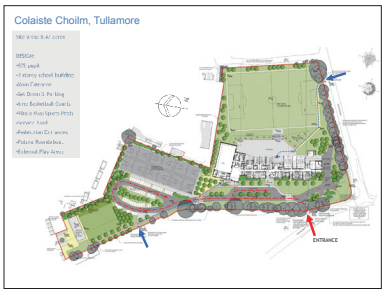

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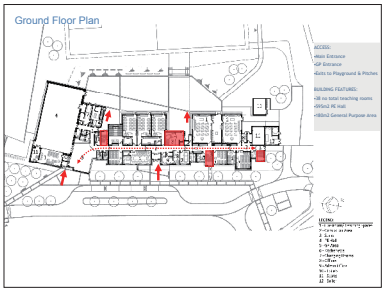

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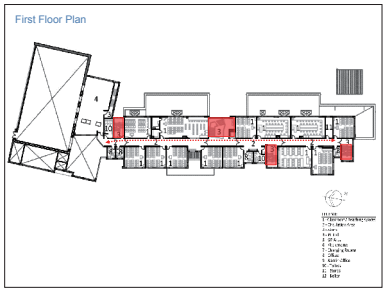
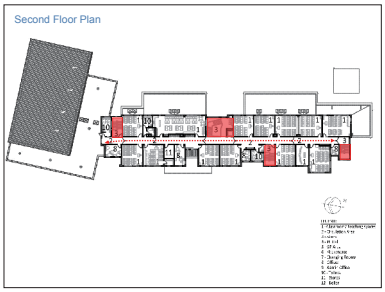


Slide 114

move to about 4.5%. Of course that will increase the energy loss but it's something that we wish them to do. Very good acoustics are also in the room (Slide 120) and you will see there at the bottom, it has achieved an A2 energy certificate, I will explain that later. It's a 51% improvement over current building regulations and 76% improvement in carbon performance. (Slide 121) You see our leakage there is only 3 m^3, (Slide 122) that has been achieved by automatic. In addition to our leakage we also have automatic carbon dioxide controls, controlling automatic openable windows or louver. (Slide 123) You can see them behind the louver there and the windows on the left opening. (Slide 124) This is the main entrance. (Slide 125) The IT demand in the building has been increasing in the last 5 years with interactive smart boards, projectors, but it has helped and has increased the electrical yields which by virtualizing the servers and the cloud computing and looking carefully at the specification of all of the IT equipment, there has been a reduction in energy but I will come back to that later. (Slide 126) I said the photovoltaics were quite successful, they are providing 14% of the electrical energy, and combine heat and power-plant, small plant is providing 25%. (Slide 127) This is the kind of monitoring we are doing, 10 million readings being



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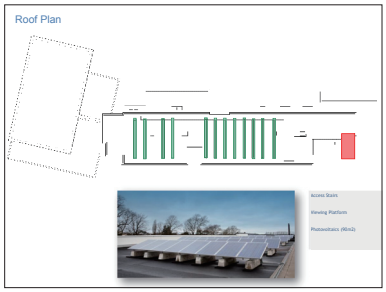

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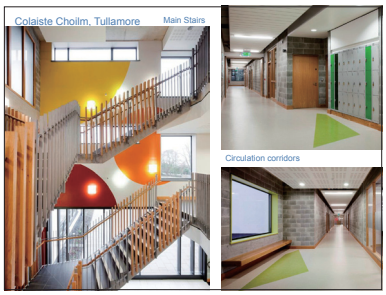

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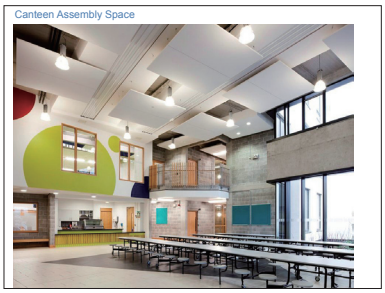

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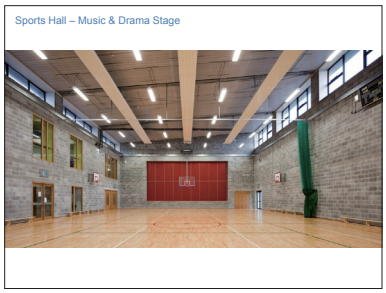

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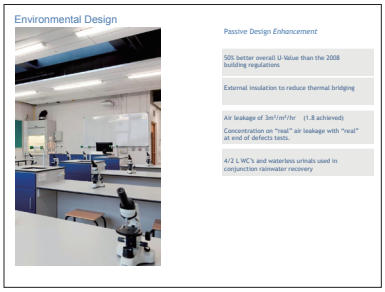

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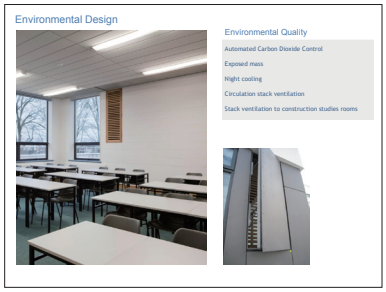
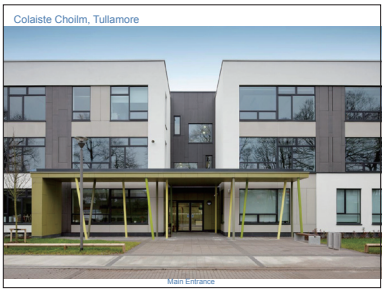


Slide 122

Slide 123

gathered each year. (Slide 128) This is an example of a very careful detailing an insulation standard achieved. 50% better than those required by the building regulations. (Slide 129) This is just the slide explaining about our leakage as oppose to controlled ventilation. (Slide 130) The top slide is showing you controlled ventilation, uniformed ventilation, warmed and in a cold building difficult to resolve, (Slide 131-132) and the reality of how this is expressed. I mentioned about interactive computers and interactive smart boards/whiteboards, and there was a need to have an actual sign telling the students to open up the blinds again when to enable daylight to come in. (Slide 133-135) I think 4 of the classrooms in this school we are trialing a mechanical heat recovery, small cassette units, and you will see the graphs at the bottom indicate an almost 50% reduction in the energy usage with mechanical heat recovery, where we have been reluctant to go this route because our strategy has been natural ventilation because the cost of maintaining schools, there is a government grant but schools that grant covers heating and lighting and insurance but does not cover the cost of maintenance. So we have a concern that sophisticated heat recovery units may not be maintained into the future. But this is something that we will need to come back to.



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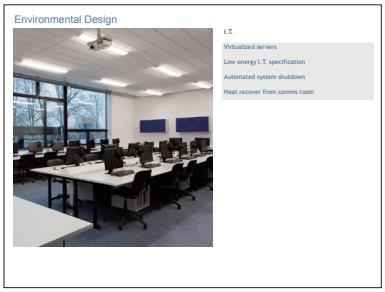

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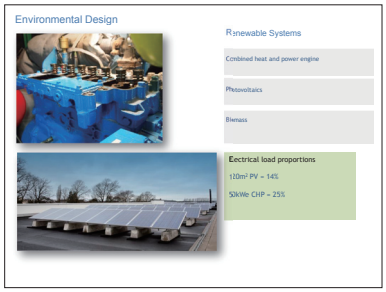

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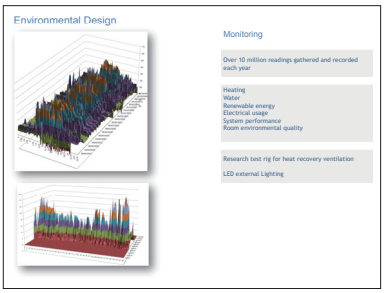

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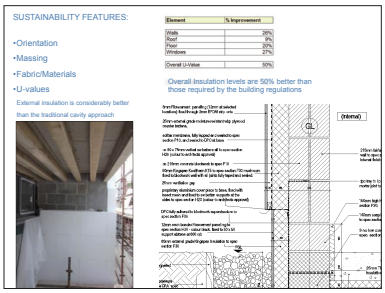

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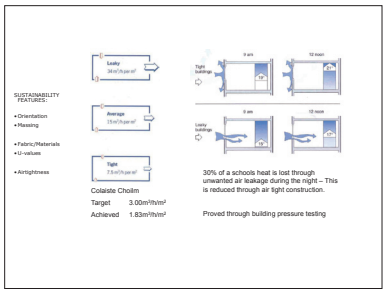

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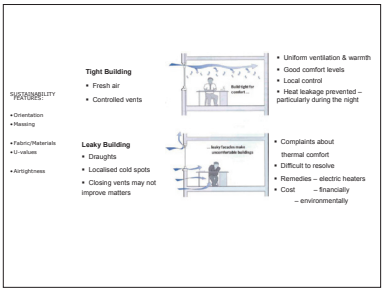

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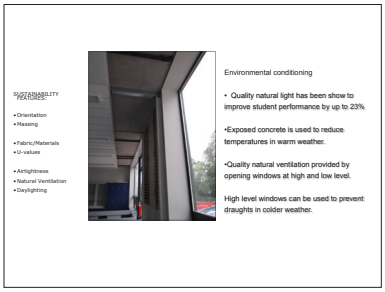

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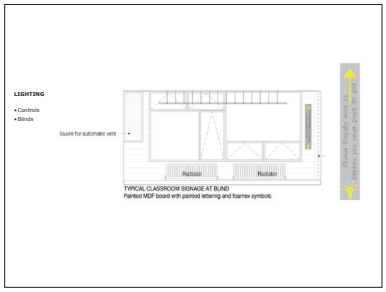
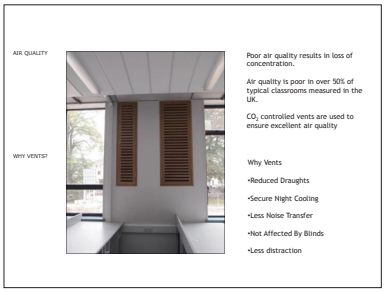


Slide 132

(Slide 136) I mentioned about photovoltaics (Slide 137) and this is just a diagram indicating the combined heat and power plant. (Slide 138) It's just a research, that's just a diagram indicating the CHP plant giving heat and also electricity. We have a biomass boiler as well. (Slide 139) It's just a diagram indicating the graph of relative heat cost. (Slide 140) The carbon implications. We use gas in Ireland that comes all the way from Russia, we have discovered some gas but it will be a while here. The security of energy is a factor so here explored biomass, (Slide 141) which is what a chip. (Slide 142) There are issues with it, it is more expensive currently than gas and there are some heating problems with maintenance and the supply of material. (Slide 143) Of course water costs money to purify to pump and it can affect energy so we have full rainwater recovery from the roofs that are used to flush the toilets. (Slide 144) The top figure is the 2.3L per pupil per day of mains water is used. There is a total rain water plus mains water usage of only 6.8L per pupil per day. The CIBSE, the international organization talks about a figure of 15 and many of our treatments plans are based on that 15 figure. But here we have figures which clearly show that by using and conserving water carefully and reusing rainwater, we can reduce the figures. (Slide 145-146) So these



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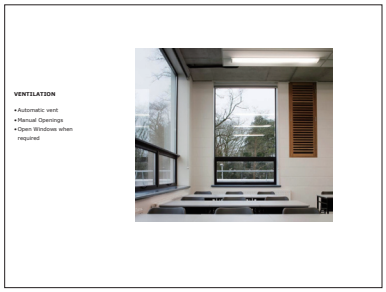

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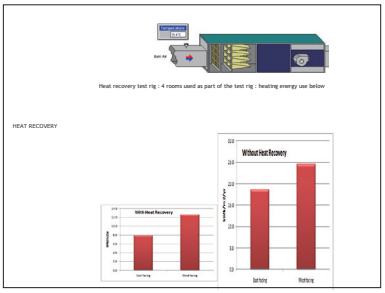

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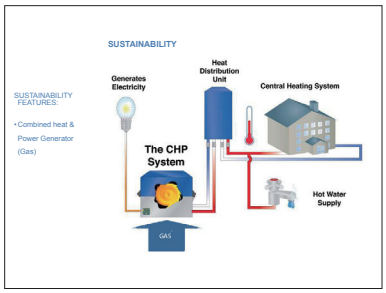

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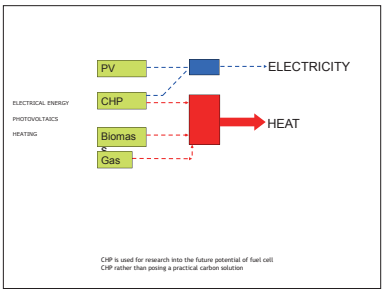

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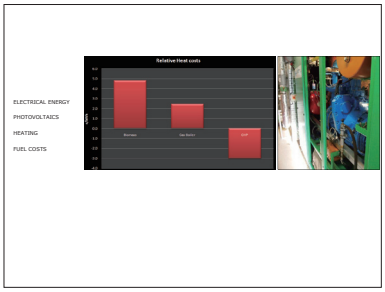

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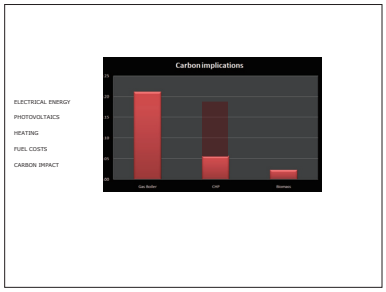
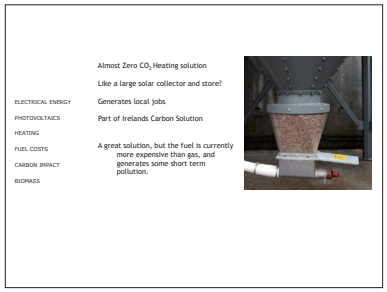


Slide 140

Slide 141

are just a few slides indicating if you put on one clothing you could reduce the energy, (Slide 147) and this is the breakdown of energy usage. Incredibly and we worked with one of the best consultant engineers on this building and still 40% of the electrical energy used occurs when the school is unoccupied. And why is that? It's because the school is unoccupied for approximately 80% of that time, and while it might only be 50W, 100W, it's a long time so it'll all add up. (Slide 148) These are the tests being undertaken. The PC computers and the servers are not being turned off, so on the next schools we are going to look at carefully how we can turn the entire energy or electrical energy demand of minimizing as much as possible. (Slide 149) Incredibly under schools in which the photovoltaics are providing 13% of energy usage. This is a fairly significant percentage in a country like Ireland where we have extensive cloud cover and limited sunlight, so it's something worth exploring. (Slide 150) This is the principle teacher has this available to him on his own PC so he can see the energy being used (Slide 151) and this school which is on the extremely right, Colaiste Choilm, uses 27% less energy compared to typical new schools like the generic schools, the primary schools I showed you earlier, so it is a very good success. (Slide 152) We have a



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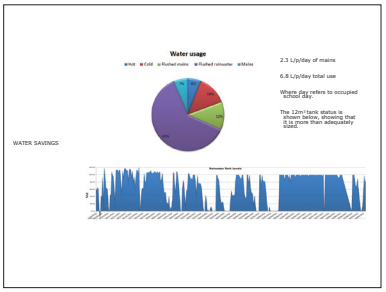

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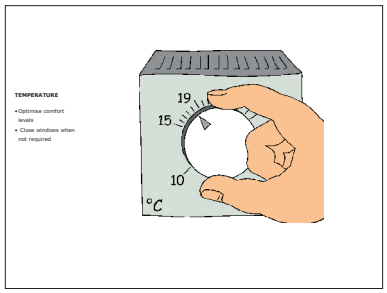

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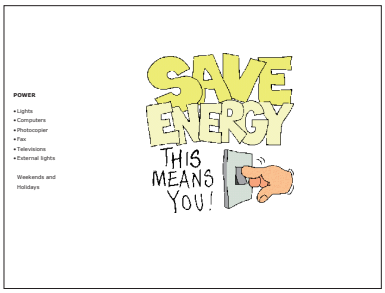

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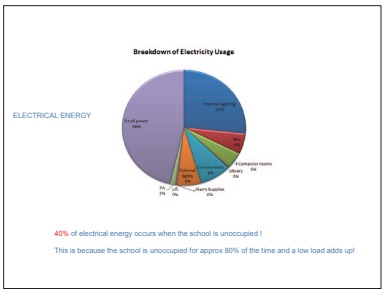

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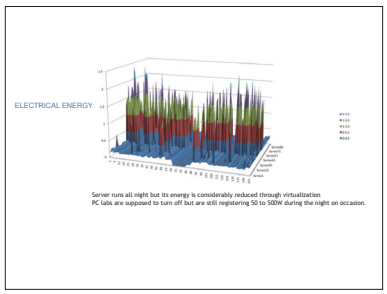

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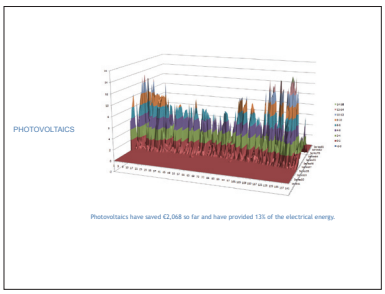

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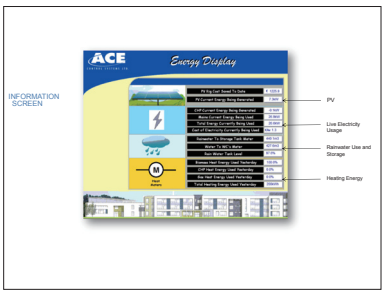
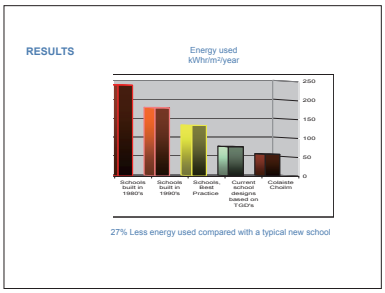


Slide 150

requirement in Ireland and the EU to have a Building Energy Rating Certificate, (Slide 153) and this school was designed and the target was on the left hand side, of an A3 rating and instead we achieved an A2 rating. It's difficult to see there but the primary energy use is about 81KW per annum which is primary energy. (Slide 154) It has already won a number of awards in Ireland and it has been shortlisted for the CIBSE, that's the Chartered Institutes of Building Services Engineers which is an international organisation.

(Slide 155) If I may for about 2 minutes speak about this slide. Buildings are responsible for approximately 40% of energy consumption and 36% of the European Union's carbon dioxide emissions. Within the buildings sector improvements in energy efficiency intended with increased use of renewable energy technologies constitutes important policy measures needed to reduce the European Union's energy dependency on fossil fuels and associated green gas emissions. Nearly zero-energy buildings are one of the most significant differences between the 2006 directive and the 2010 recast directive year. Each country was expected by September of the last year to have a national plan. Our Department of Environment is still preparing that document, the action plan in consultation with the big spending departments who are involved in buildings like education, health and public works, and in another 2 or 3 months we hope to have a plan going to the European Commission. You will see here that for new building there will be an Irish definition of near zero-energy buildings. My understanding is that we will actually give a figure. It may well be a figure around 15KWH per square meter per annum that is still up for discussion. You will have seen that our passive house schools achieved around 44 but even our test bed schools that I just showed you a moment ago, Colaiste Choilm was around 81, so we have somewhere to go to achieve this



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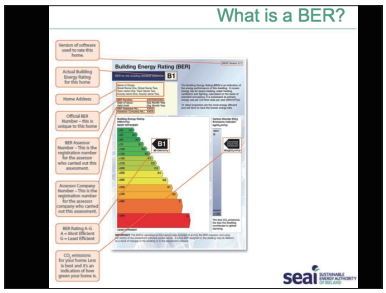

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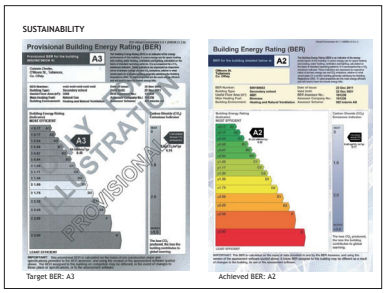

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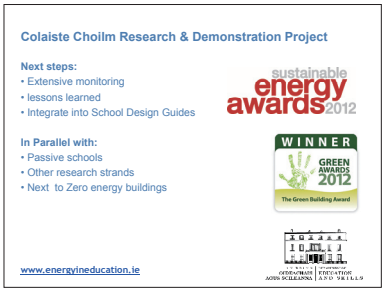

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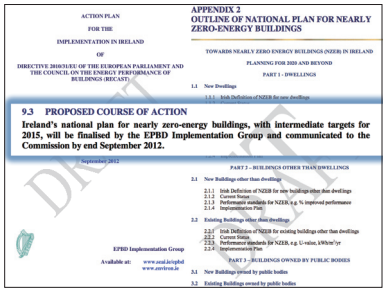

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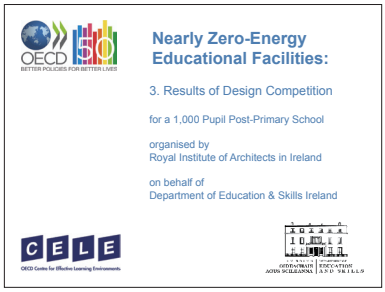


Slide 156

target. The target date is 2018 for new public buildings and 2020 for all new buildings. So in a month or two I would have a greater certainty where Ireland is going. My understanding of the 27 member states of the EU, only 2 countries have submitted their action plans to the EU Commission, Ireland hopes to do that in the next few months. I understand the United Kingdom will be setting not an actual definition but a planned target of improvement compared to what buildings are achieving today. So I'm sorry to not be able to be more definitive on this today.

(Slide 156) My last few 5 minutes will just show you the results of an international competition. (Slide 157) This was the most successful architectural competition ever held in Ireland. We had 111 entries from Ireland and 43 entries from 15 other countries including 2 or 3 from Japan I understand. The winning design team came from Scotland and their school is now being developed on a site in Dublin. The size of the building is 8,820 square meters plus a special needs unit, and estimated cost is 14 million euros. (Slide 158) These are the architects, small practice in Scotland. Their website is wonderful. They have done a lot

Slide 157

Slide 158


Slide 159


Slide 160


Slide 161

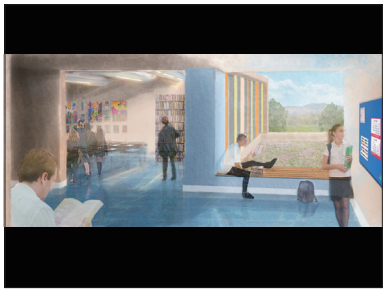

Slide 162

Slide 163


Slide 164


Slide 165

of sustainable buildings, not just educational buildings. (Slide 159-160) These are the images of the building. Note is to the top of the page, so there is a bank of specialist workshops, rooms with a need of reduced glare, computer rooms that need to minimize overheating, but in this staggered formation here to the south facing east and facing south are the classroom spaces and teaching spaces. (Slide 161) First floor plan, (Slide 162) 3 dimensional images of the building, quite a simple building, very refined building. (Slide 163) Daylight very well used throughout the building and sent form square. (Slide 164) Simple yet refined elevations that we within the jury felt could be achieved within our cost limits. (Slide 165-166) Some nice spaces and opening up teaching to informal learning places where children can relax and learn by themselves or in small group. (Slide 167) This section was very well considered in terms of construction. (Slide 168) The joint second place winners, (Slide 169-172) any architects among you will recognize some references to Louis Kahn, the famous American architect, the Principle of this practice actually studied Yale under Louis Kahn so a very elegant building, maybe not the most sustainable building but beautiful in many remarks. (Slide 173) Very elegant building developed (Slide 174) and modeled on a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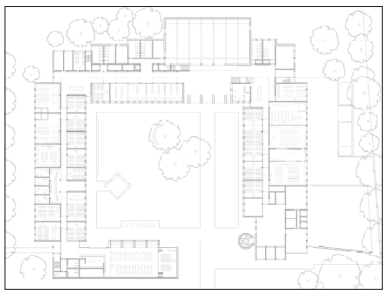
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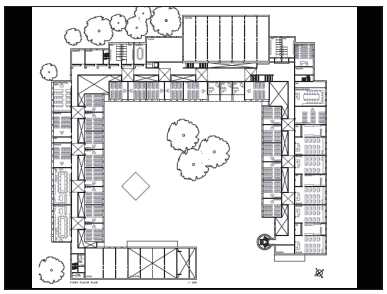
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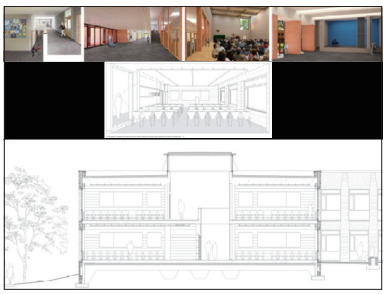
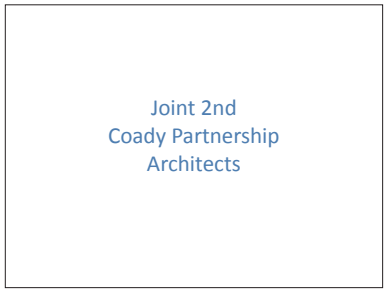

Slide 174

monastery and simple construction. (Slide 175-176) The second placed winner was a more sustainable design, the elevations were OK just. (Slide 177) We have many buildings like this in Ireland that would be held buildings and we felt that the building could be somewhat better, (Slide 178) but in terms of its location on the site, note is to the right hand side. You have an entry here, a hall here, some specialist rooms here, and classrooms facing south over plain field pitches. (Slide 179) An elegant design, simple. (Slide 180) First floor plan, (Slide 181) second floor plan. It had opened up the corridors into informal learning spaces. There were some voids giving natural light and ventilation into the depth of the building. (Slide 182) A cross section that was very well considered with natural ventilation, and you can see how well considered the natural ventilation was within the building. But incredibly and at some cost and some excess area they had introduced these docks or double ward spaces, so that in the future, maybe the future will be within the next 5 years, they could have a centralized heat recovery plant here. So rather than natural ventilation this building could have been a sealed building with heat recovery. It was not in the brief but it just shows you how one frame of architects working with very good engineers were looking



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Slide 178

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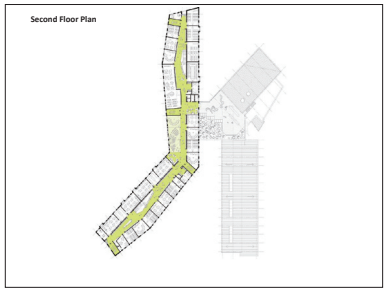

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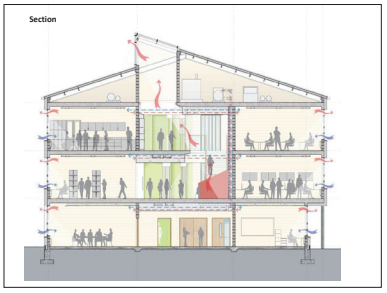

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into the future. (Slide 183) Some images of the building, (Slide 184) some cross sections, (Slide 185-186) some nice spaces.

(Slide 187) Thank you so much. I would just like to say to you also that our Minister for Education at the moment, Ruairi Quinn, happens to be an architect and was very supportive of the work we are doing in the Building Unit, is very supportive of the work of the OECD and CELE, and the competition was deemed to be a great success within the architectural profession within Ireland, and Ministers supporting the announcement next May of another competition, an ideas competition for a primary school and we will publicize that though the air and welcome any architects and design teams to participate in that. There will be a prize fund; it will be a competition for not to actually build the building but to get a prize, so I wish anybody well who might enter that competition. There are my contact details and thank you so much. Thank you.

Moderator:

Thank you, Mr. Tony Sheppard. Please offer him vigorous applause.

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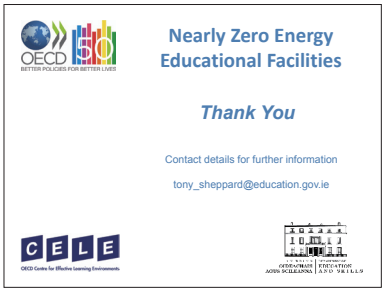

Slide 187

Lecture

Survey and Study on Environmentally Friendly School Facilities - Trend in Recent Years -

Studies on Eco-school -From the beginning to now-

Hiromi Komine

Professor, Dr. Engineering,
Department of Architecture and Civil Engineering,
Faculty of Engineering, Chiba Institute of Technology
Chair, Working Group on a Fundamental Study of School Facility Environments, NIER

Hiromi Komine

1977 M.Arch., Faculty of Engineering, The University of Tokyo
1978 Assistant, Institute of Industrial Science, The University of Tokyo
1981 Researcher, Faculty of Healthy building and Housing, The Institute of Public Health
1988 Assistant Professor, Architectural Course, Chiba Institute of Technology(CIT)
1996 Professor, Architectural Course, CIT
2002 Reorganization of CIT
Professor, Department of Architecture and Civil Engineering, Faculty of Engineering, CIT

Awards and Academic

2006 Writing of "Handbook for Refrigeration and Air Conditioning, Third volume, Application of Refrigeration and Air Conditioning, 1.4 Ventilation System and Smoke Control Equipment"
2007 Writing and Editing of "Indoor Microbiological Contamination, Measure of Mite and Mold"
Achievement Award, The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan
2011 Writing of "Building Equipment Corpus -School and Library-
Chapter 2 Building Environmental Plan for School Facilities"
2011 Member of Judging Committee for the fourth Sustainable Building Award
2011 Member of Technical Committee, New Energy and Industrial Technology Development Organization
2012 Chair, Committee on Performance Check of Disaster Prevention Devices, The Building Center of Japan
2012 Chair, Implementation Working Committee on Renewal, Kawasaki City

Moderator:

Now, let us start the second part.

Professor Hiromi Komine of the Department of Architecture, Chiba Institute of Technology and project leader of the Working Group on a Fundamental Study of School Facility Environments is going to give a speech titled "Research Study on Environment—Friendly School Facilities—Trend in Recent Years- Studies on Eco-school – From the beginning to now—." For his profile, please see the material in front of you.

Please start, Professor Komine.

Mr.Hiromi Komine:

(Slide 1) Thank you for the introduction. I have been engaged in research on Eco-schools for 20 years. I think this is why I have been given the opportunity to give this lecture here. Thank you so much.

(Slide 2) Here, I arranged past reports concerning today's topic I have on hand. There are 24 reports in total as shown in the photo. I would be happy if they are able to convey the long history and the depth of the survey study.

(Slide 3) Study of Eco-schools started in 1993 from the exploration of its basic ideas, need and social background while working to build the concept of Eco-schools. Around this time, a Japan-Canada joint research on a super-insulated house called R2000 started in 1991. In 1992, the Earth Summit was held in Rio de Janeiro, Brazil, and Agenda 21 was adopted. The fact that the survey study on Eco-schools started at the time when the global environment and reduction of environmental burden attracted attention

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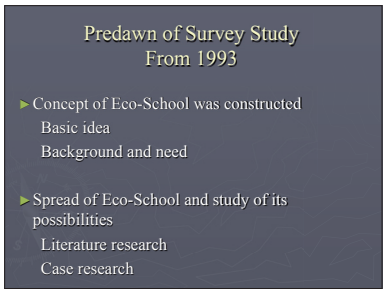

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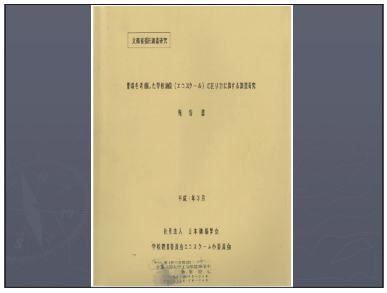

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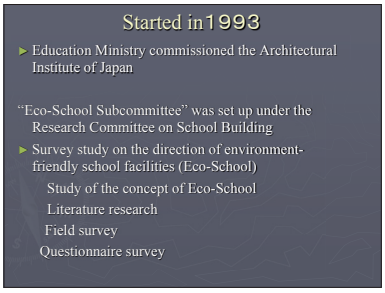

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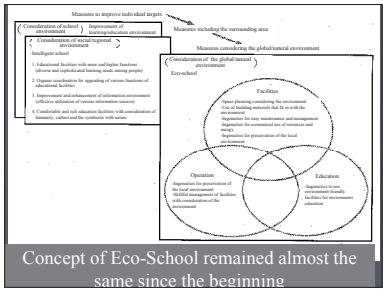

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indicates the progressive nature of the study.

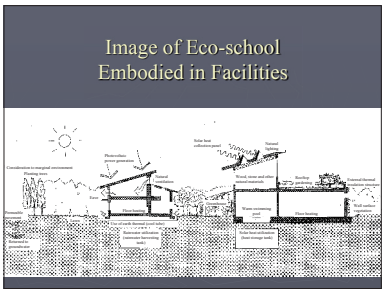
(Slide 4) This is the report. (Slide 5) Eco-school Subcommittee, the Research Committee on School Building, Architectural Institute of Japan engaged in the study commissioned by MEXT. The study covered these four items.

(Slide 6) First, we studied the concept of Eco-schools. At that time, there was a concept of Eco-schools mainly in Northern Europe. However, the concept was defined as facilities for environmental education, which is different from the concept I'm talking about today. The concept of Eco-schools in the report was also different and defined from three perspectives of facilities, operation and education, as illustrated here. Basically, this concept has been succeeded up to today.

(Slide 7) The report presented concrete images of facilities from the very beginning. They are primitive by today's measure but I hope you can see that we have been working with concrete images from the very beginning.

(Slide 8) The survey study identified devices and ingenuities adopted in environment-friendly buildings based on a literature research and field survey. The literature research covered 19 environment-friendly school facilities in Japan and 9 such facilities abroad. (Slide 9) Field survey was conducted in the five schools that were considered environment-friendly at that time. (Slide 10) In addition, a questionnaire survey was conducted for boards of education of prefectures and government ordinance cities. Its purpose was to grasp the state of eco-school development, the presence/absence of a guideline for the development and the actual conditions of eco-schools at that time. 18 boards of education answered that they have more than three eco-schools.

(Slide 11) This is the report. (Slide 12) The architectural institute carried out survey study in fiscal 1994 as



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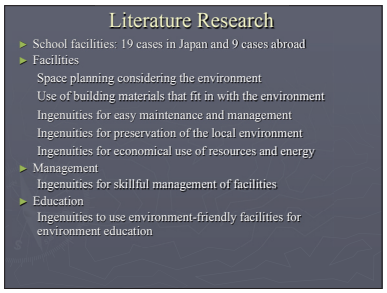

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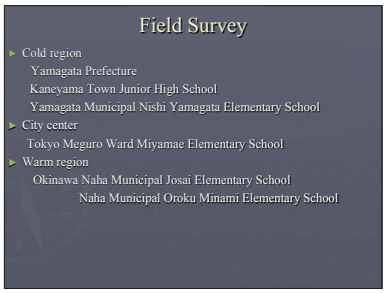

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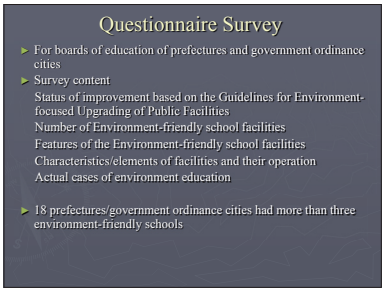

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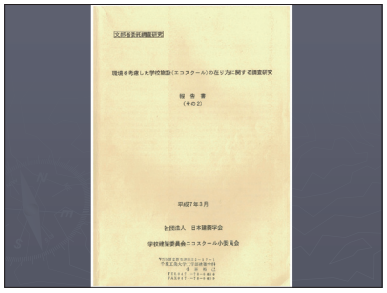

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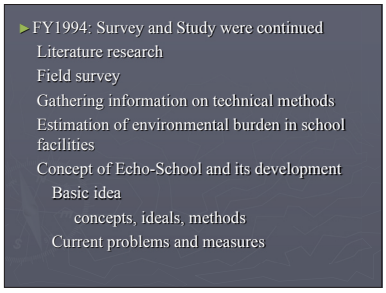


Slide 12

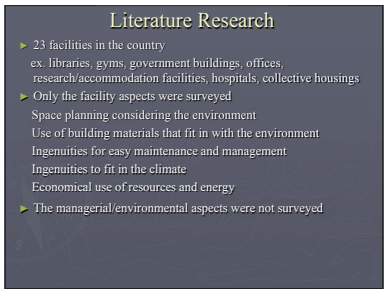
well. (Slide 13) Literature research and field surveys were carried out. The literature survey expanded the scope from school facilities to other buildings as shown here. Naturally, the survey covered only facilities; not their managerial or environmental aspects. (Slide 14) Field survey was conducted for these five facilities. (Slide 15) Based on the literature researches and field surveys for two years, we again studied architecture magazines, academic journals and books. By doing this, we gathered and analyzed methods available for eco-schools.

Based on the seven items shown in this slide, an information sheet was created for each technical method. (Slide 16) We also analyzed various materials to quantify the need of echo-schools. For example, the total floor area of school facilities was about 300 million m2 in national total, which was about 24% of that of commercial buildings. However, classrooms did not provide the right environment for learning and education. I have prepared a material showing that the energy consumption of school facilities was about 10% of that of all commercial buildings. The small energy consumption per unit floor area may lead to an indoor environment that is not appropriate for the environment.

Need for urgent reduction of environmental burdens might not be high in terms of energy consumption intensity. However, if school facilities are used as local centers for life-long learning, it will be necessary to extend the hours of use, upgrade their functions and improve their amenities. This will generate concerns over an increase of energy consumption and an accompanying increase of environmental burden in the future.

So, the study concluded that it was necessary to take measures to reduce environmental burden early and develop eco-schools.

(Slide 17) This is one of the graphs newly analyzed in the report. Because it was known that the length of



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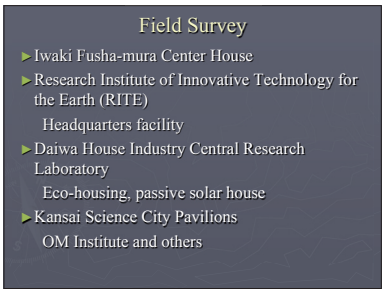

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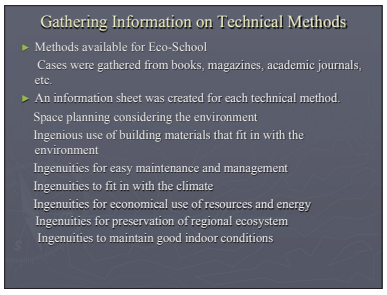

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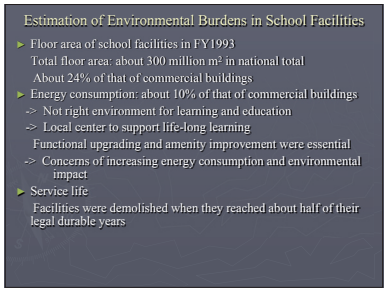

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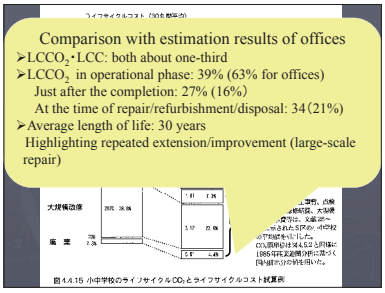

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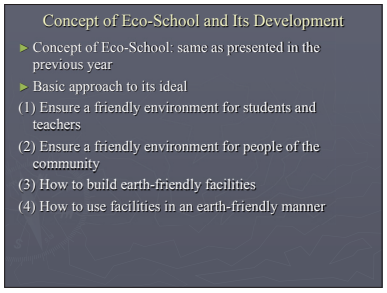


Slide 18

life of an elementary school was about 30 years, LCC and $LCCO_2$ for 30 years were estimated. Their LCC and $LCCO_2$ were both about one-third of those of office buildings. We found that the figures of $LCCO_2$ are almost the same in the operational phase and at the time of repair/refurbishment/disposal. The result highlighted anew that repeated extension/improvement had a major effect on $LCCO_2$ in school facilities.

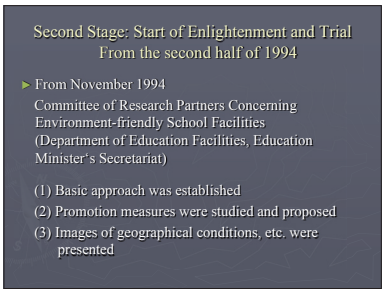
(Slide 18) The basic idea of eco-schools was summarized as a conclusion of the survey study for two years. One is that eco-schools are friendly for children/students who use them and people of the community. Consideration of environmental burden and friendliness to the earth is also required.

(Slide 19) It may have been judged that the two-year survey study by the architectural institute had created an environment for eco-school development. It moved to the second stage, enlightenment and trial of eco-schools. MEXT moved to concrete measures by setting up the Committee of Research Partners.

(Slide 20) This is the report compiled by the Committee of Research Partners in 1996. I remember that the conceptual diagram on the front cover made a very strong impression.

(Slide 21) This is the concept or basic idea of eco-schools addressed in the report. I think you know the figure because it has been used on many occasions. There are three basic ideas: in terms of facility: "build in a friendly manner" for the users, such as children, the community and the earth; in terms of management, use buildings, resources, and energy "wisely, for many years"; in terms of education, utilize facilities, principles, and systems "for learning."

(Slide 22) Further analyzing the idea of "build in a friendly manner," we have these ingenuities/planning. The big difference with business buildings is, as mentioned before, poor indoor conditions. So there are two points: ingenuities to maintain good indoor conditions and planning that considers how students will use the facilities.



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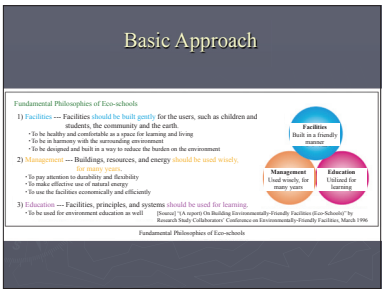

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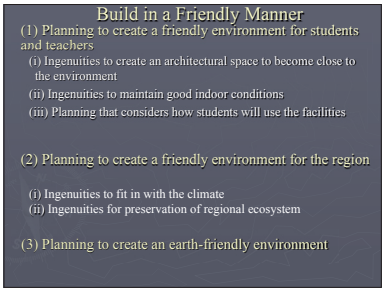

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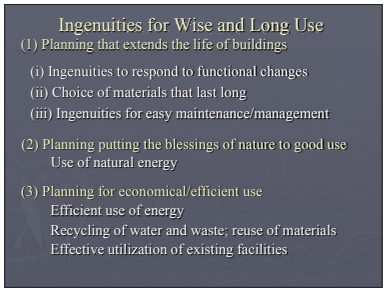

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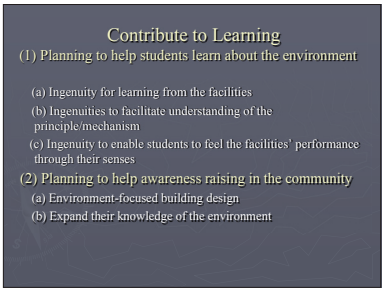

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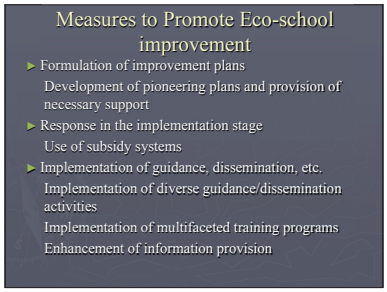
(Slide 23) Further analyzing the idea of "use wisely, for many years," we have these ingenuities/planning. Key features here are extension of the life of school buildings and easy maintenance.

(Slide 24) Further analyzing the idea of "utilize for learning" we have these ingenuities/planning. I think they are requirements specific to school facilities. Key features are school facilities that are useful for environmental education and help in awareness of the reduction of environmental burden in the community through children and students.

(Slide 25) The report also studied and analyzed necessary measures such as support and subsidy systems the government should provide to school boards that are willing to promote eco-school improvement.

(Slide 26) One of the proud achievements of the report was concrete images of eco-schools for different location conditions. The first one is an eco-school in a suburban area of a local city. (Slide 27) Next is an image of an inner-city eco-school. (Slide 28) This is an image of an eco-school in an urban area of a local city. (Slide 29) This is an image of an eco-school in mountain area. As you can see by looking at them, I think the presentation of these more concrete images helped the concept of eco-schools spread among



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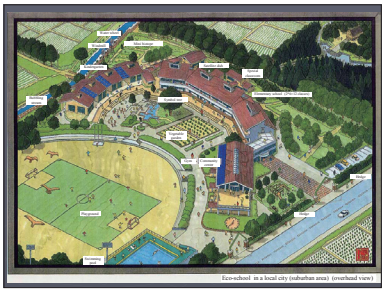
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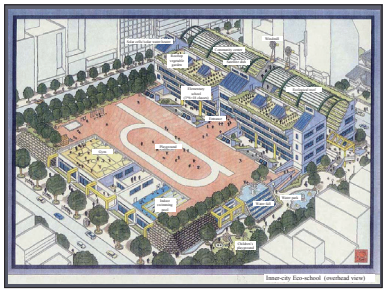
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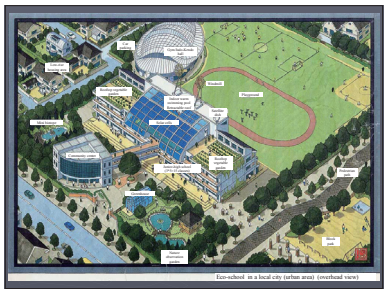
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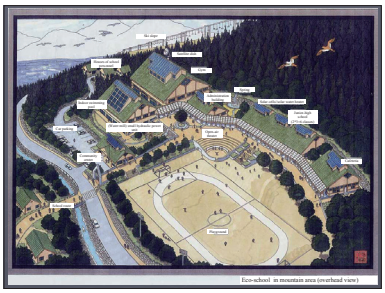
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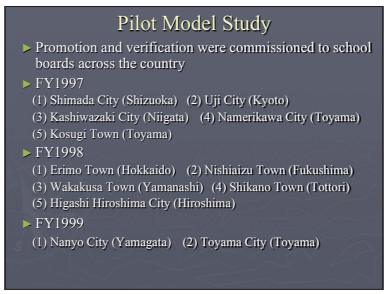

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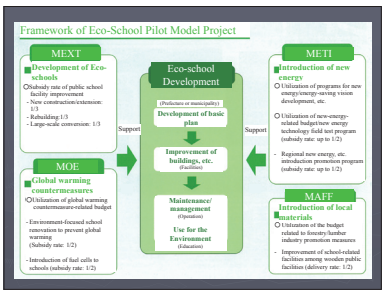

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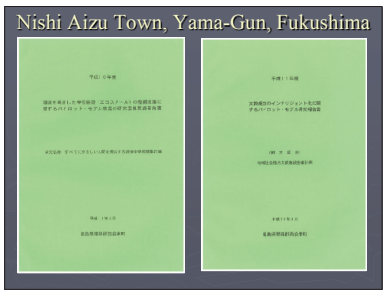

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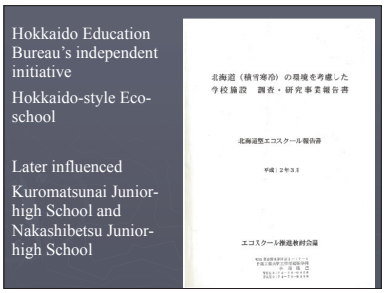
many people.

(Slide 30) In the following year, 1997, MEXT, in cooperation with the Ministry of Economy, Trade and Industry, Ministry of Agriculture, Forestry and Fisheries, and the Ministry of Environment, started the commissioning of pilot model projects to school boards of prefectures and government ordinance cities with the aim of promoting and verifying the eco-school development. (Slide 31) A pilot model study was commissioned to five school boards in fiscal 1997, five school boards in fiscal 1998 and two school boards in fiscal 1999.

(Slide 32) In the pilot model projects, four ministries provided subsidy to expenses for eco-school development with the aims of development of eco-schools, global warming countermeasures, introduction of new energy and introduction of local materials, respectively. (Slide 33) I, together with Professor Satoru Nagasawa of Toyo University, participated in a pilot model project in Nishiaizu Town, Fukushima Prefecture. This was a project to create an eco-school in a new junior high school to be built integrating four junior high schools. We discussed many things, but regrettably, I remember that the city adopted the easiest plan of installing photovoltaic panels, etc.

(Slide 34) In this period, the Hokkaido Education Bureau independently studied the possibility of a Hokkaido-style Eco-school considering the weather, characteristics and other conditions of Hokkaido. I, a person from the mainland in relation to them, participated in the initiative as a technical advisor and compiled a report in March 2000. The report was useful for environment-focused renovations of Kuromatsunai and Nakashibetsu Junior-high Schools.

(Slide 35) 1,340 schools have been designated as Eco-school Pilot Model Projects by April last year. They account for only about 4% of about 31,000 public elementary and junior high schools. The number is very



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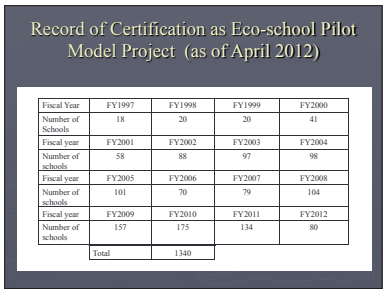

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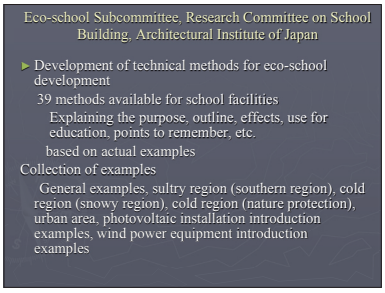

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small.

(Slide 36) In parallel with the survey studies at MEXT, the Architectural Institute has continued its own survey studies. The reason, I think, was a perceived need to provide more detailed information to school boards of prefectures and government ordinance cities toward development and dissemination of eco-schools.

(Slide 37) This is the content of the survey study conducted by the Architectural Institute. Technical methods for eco-school development were organized based on actual examples. The purpose, outline, effects, use for education, points to remember, etc. of 39 methods available for school facilities were described. A collection of examples by region and project was also compiled.

(Slide 38) The letters may be too small for you to read the content. This is a sheet describing one of the techniques. I hope that you can feel the atmosphere in which such sheets were developed.

(Slide 39) In 2000, eco-schools entered the 3rd stage or dissemination and growth period. (Slide 40) This is a report compiled as a summarization of eco-schools in 2001 by systematically organizing the results of the past survey studies and developing and adding new materials. (Slide 41) This report describes the following, with the need for eco-school development and eco-school planning positioned as two major axes. Many domestic laws related to global environmental protection and environmental load reduction were developed in the second half of the 1990s. In response to this, global environmental protection became one of the important points in design concepts. In light of the social situation, the report described the need for and meaning of eco-school development and subsidy system for such development.

(Slide 42) For example, this is one of the added materials to illustrate CO_2 emissions accompanying school activities based on the inter-industry relations table. Because about 50% of CO_2 emissions accompanying

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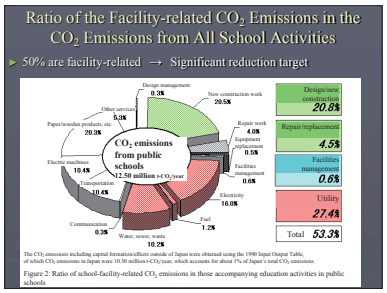

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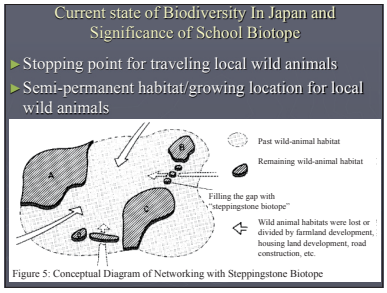

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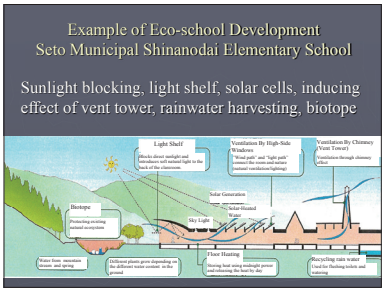

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education activities in public schools in the country are from school facilities, we can conclude that school facilities are crucial element.

(Slide 43) This material was created with a view to the development of the National Biodiversity Strategy based on the Biodiversity Treaty. It explains the meaning of school biotopes based on this strategy. In the past, biotopes in school facilities were mainly recognized as a place for education/learning, but I believe they are critical as a stopping point for traveling wild animals and as semi-permanent habitat for local animals.

(Slide 44) Seto Municipal Shinanodai Elementary School is another example of eco-school development. I quite like this work and believe it is one of the excellent eco-schools. As you can see here, various devices and ingenuities were adopted in the school.

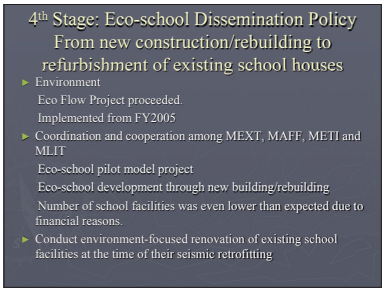
(Slide 45) Thanks to the small scale of the elementary school, the design of its ordinary classrooms is also eye-opening. I think this is a very beautiful design for a Japanese elementary school, as beautiful as the Irish elementary school we saw earlier.

(Slide 46) Now, Eco-schools turned into a new dimension. Past eco-school projects were mainly new construction and rebuilding. However, development through pilot models progressed even slower than expected. I think this is due to the momentum to prioritize earthquake retrofitting of school facilities after the Great Hanshin Awaji Earthquake.

Meanwhile, the Ministry of Environment initiated the Eco Flow Project to carry out environment-focused renovation as part of an environmental education project in fiscal 2005. MEXT changed its policy to renovate existing school facilities to eco-schools, so-called environment-focused renovation. For it is believed that conducting environment-focused renovation at the time of seismic retrofitting will minimize unexpected accompanying works, thereby relatively reducing the cost of environment-focused renovation.

(Slide 47) The Eco Flow Project of the MOE that motivated environment-focused renovation was a subsidy program to prevent global warming in the private sector. The project implemented hardware-side development to create an environment–friendly and comfortable school environment at the same time as a software-side program for environmental education in cooperation with schools and the community. (Slide 48) The project had been implemented in 20 schools across the country before it was concluded.

(Slide 49) Let me explain environment-focused renovation of existing facilities in more detail. Most



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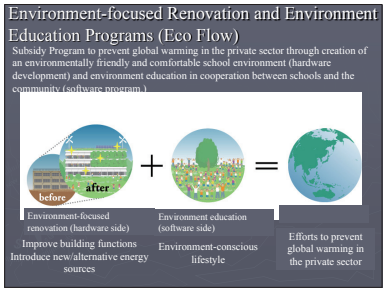

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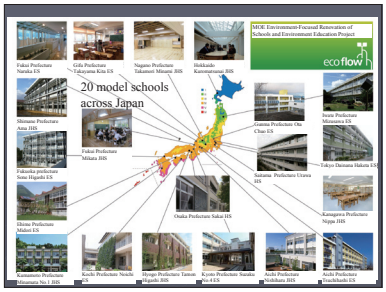

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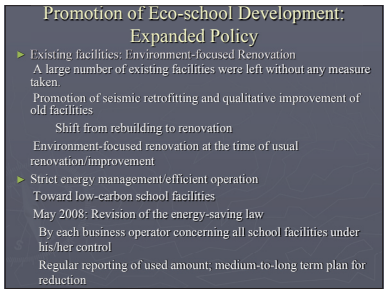
existing facilities need seismic retrofitting or improvement to their dilapidation. Rebuilding was the norm in the past, but current situations require renovation instead of rebuilding. So it is decided to implement environment-focused renovation at the time of usual renovation/improvement as an effort to develop and disseminate eco-schools.

Meanwhile, revision was made to the Act on the Rational Use of Energy, the so-called energy-saving law, in May 2008. In the past, energy management was the duty of individual business operators, but there was a change in the regulation system for energy management by business operators and enterprises. This applied also to local school boards and they are now considered to be business operators conducting energy management for assets used for schools and other educational institutions. They were required to make regular reports on used energy in all school facilities under their jurisdiction and develop medium-to-long term plans for reduction.

(Slide 50) So, the MOE decided to compile considerations and concrete guidance for energy management. These reports were published in fiscal 2006 and 2007 on energy conservation measures in universities and other higher education facilities. The two booklets, “Effective Energy-Conservation Measures and Utilization of Managerial Standards” and “Viewpoint of Energy Management that Produces Results” were developed in the two years.

(Slide 51) On the other hand, I don’t think energy management for average buildings is adequate for elementary schools where energy consumption intensity is low. So, this leaflet was created compiling energy-saving measures that children can do. This was made by partially modifying a leaflet created by a committee of the Energy Conservation Center, where I chaired.

(Slide 52) In addition, these two leaflets were created on energy management, operation viewpoint and



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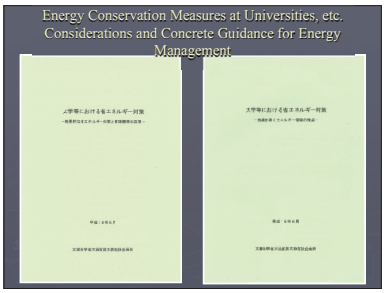

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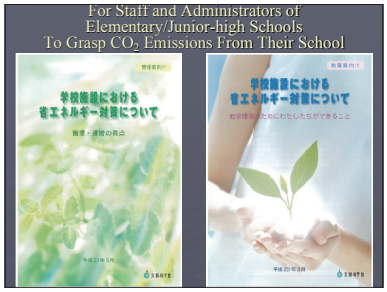

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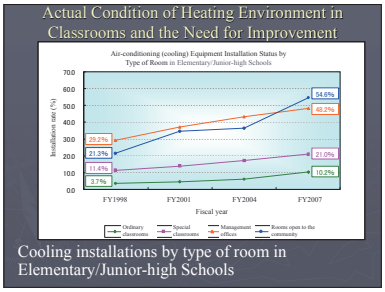

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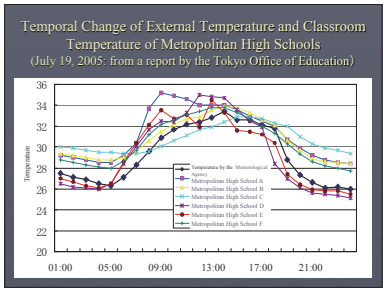


Slide 54

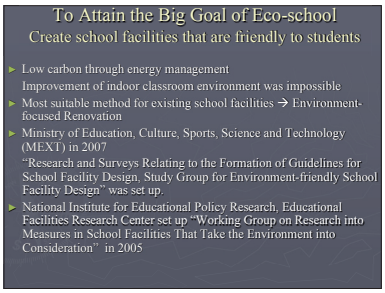
ascertaining of CO_2 emissions as energy-saving measures in school facilities for enlightenment of elementary/junior-high school personnel and members of school boards in energy management.

(Slide 53) The revision of the energy-saving law attracted attention towards energy management and conservation in school facilities as well. However, let's go back to the original concept of eco-schools and look at the heating environment of classrooms. This graph shows the changes in cooling equipment installation rate by type of room. The material is a bit old, from fiscal 2007. The installation rate for an ordinary classroom was as low as 10% five to six years ago.

(Slide 54) This graph was a material of the exploratory committee to improve the environment of Metropolitan High Schools of the Education Bureau of the Tokyo Metropolitan Government, in which I was involved. The temperature in classrooms exceeded 35 degrees. This was an extremely poor thermal environment. Then, Tokyo Governor Ishihara had been against the installation, saying "air-conditioning would make students frail," but the material convinced him that the installation of air-conditioning was necessary.

(Slide 55) It is clear that performing only energy management of school facilities is not consistent with the original goal of eco-schools. If improvement of indoor environments is to be included in our goals in addition to low-carbon efforts in existing school facilities, we can conclude that the best choice is environment-focused renovation. So, MEXT and the Educational Facilities Research Center again set up a study group to examine measures to make every school facility an eco-school.

(Slide 56) Now we are developing projects aiming to make all school facilities including existing facilities into eco-schools. Guidelines for Designing School Facilities that are fundamental for school facility development codified the change to eco-schools and defined the position of eco-schools. They recognized



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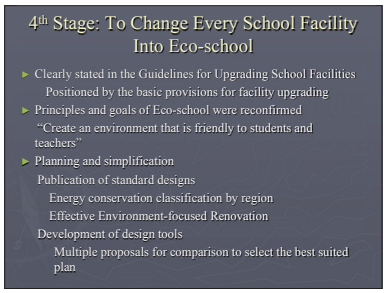

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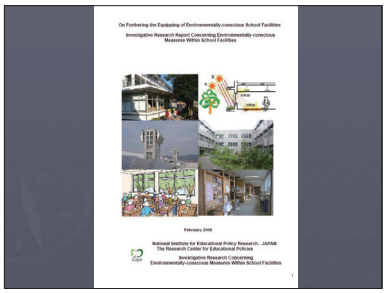

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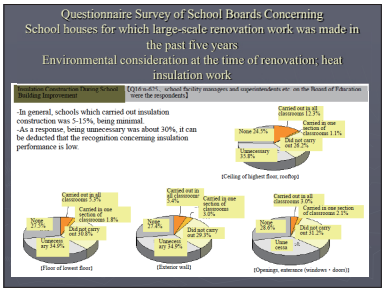

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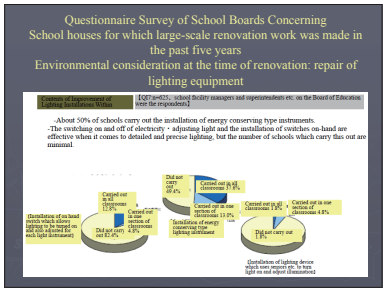

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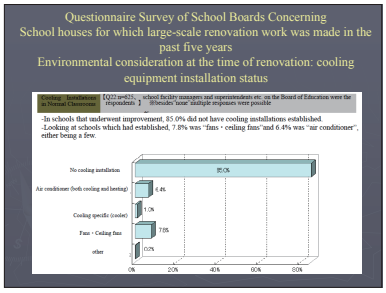


Slide 60

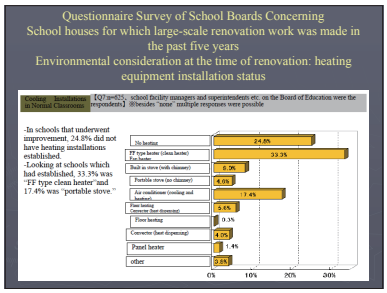
anew that the purpose and ideal of eco-schools are not limited to reduction of environmental burden but that it is also important to create an environment that is friendly to users.

(Slide 57) There had been a prior survey study by a study group organized by the Educational Facilities Research Center. The result was compiled in this report in 2008.(Slide 58) The report included a questionnaire survey of school facility managers on school boards regarding their awareness of environment-focused renovation. Please look at these pie charts. 30 percent of respondents answered that it is not necessary to carry out insulation construction during school building improvement. Apparently, they think insulation performance is not necessary for school facilities. Their awareness seems to be very low.

(Slide 59) On the other hand, installation of energy-conserving type lighting equipment was carried out in about 50% of the cases. However, switching on and off, adjusting light with sensor and the installation of switches on-hand that are effective for energy conservation were not introduced during renovation. This may be due to a lack of adequate information. They may be included in the renovation if adequate information is provided.

(Slide 60) This is the air-conditioning equipment installation status. Cooling equipment was rarely installed even in a large scale renovation. (Slide 61) About one-fourth of the schools did not have heating installation established. The heating equipment installed are mostly FF-type heaters and portable stoves. I think this is a very poor condition compared with heating/cooling in typical homes.

(Slide 62) Teachers have great discontent with the thermal environment after large-scale renovation work. It is clear that there is a big gap between teachers and management. As shown here, about 70% of teachers responded “not satisfied” during summer. About 90% replied it was “hot” during summer, while about 70% replied it was “cold” during winter.



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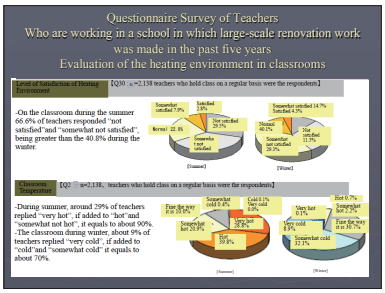

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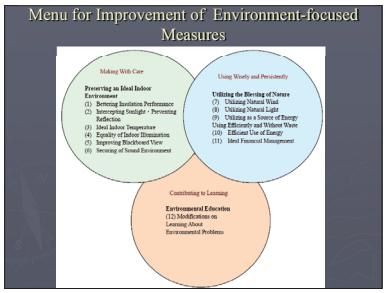

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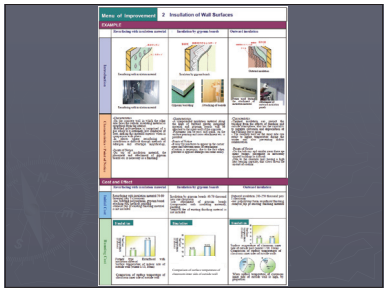
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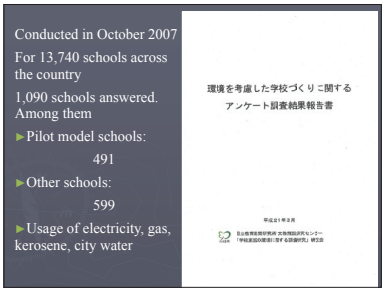

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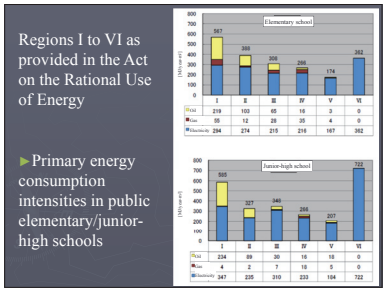

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(Slide 63) In response, the study group compiled an improvement menu with a focus on improvement of the classroom environment. (Slide 64) This is one example. Heat insulation renovation of wall surfaces to improve the thermal environment is illustrated with concrete choices for renovation work. Features, points to consider, cost and effect of each method are made into a data sheet.

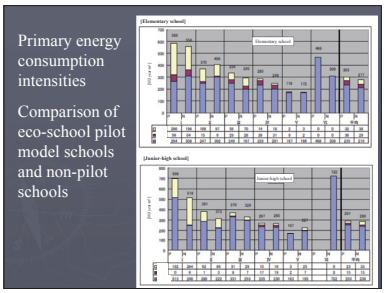
(Slide 65) The study group conducted a survey of energy usage. This is the report of the survey. 1,090 among 1,374 schools surveyed across the country responded. (Slide 66) These are energy consumption intensity in Regions I to VL as provided in the Act on the Rational Use of Energy. Power consumption for cooling is high in Region VL (Okinawa) where air-conditioning is widely used as a soundproofing measure near the U.S. bases. We might say that kerosene usage for heating is high in Hokkaido. You can see from the graph that electricity is used mainly for lighting in other regions.

(Slide 67) There is no significant difference of energy consumption intensity between eco-school pilot model schools and non-pilot schools. Design concept, etc. may make more of a difference.

(Slide 68) The study also examined the increased energy consumption due to opening up of school facilities to the community. First, power consumption for lighting gyms in the evening and holidays accounts for 8 to 9% of the power used in the entire school. Power consumption for PCs due to computerization was as low as 1%.

(Slide 69) From the actual measurement we know that power from photovoltaic generation per 10kW is about 6 to 8% of the power consumption of the entire school.

(Slide 70) The energy consumption intensity of elementary/junior-high schools is one-fourth of that of universities, etc. and one-tenth of those of sales stores, hospitals, hotels and others. Schools are facilities with very low energy consumption. So, I don't think it is appropriate to vociferously call for energy



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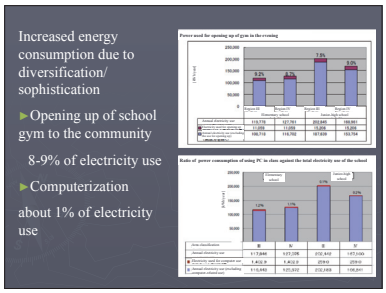

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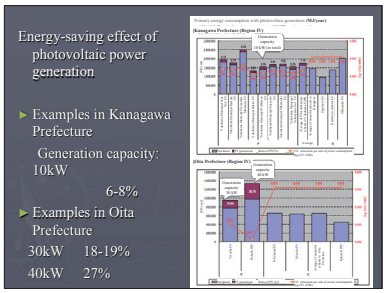

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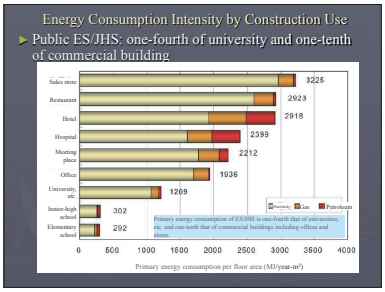

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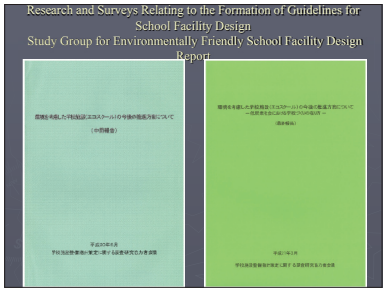

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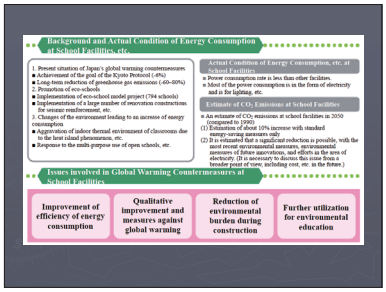

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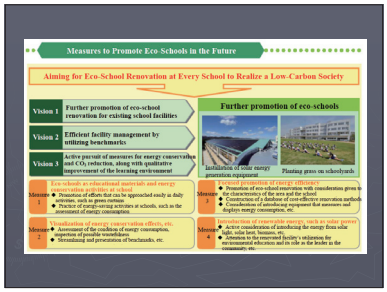
management and reduction in energy consumption. I'm worried about blanket statements with energy for consumer use. I believe reasonable energy consumption (criterion) should be allowed in order to ensure an adequate learning and education environment.

(Slide 71) These reports were compiled by a Committee of Research Partners set up by MEXT based on the survey study of the Educational Facilities Research Center. (Slide 72) Energy consumption is low in school facilities and the thermal environment in classrooms is poor during summer. It is estimated that implementing only standard energy saving measures will increase CO_2 emissions by about 10%. So, the Guidelines for Upgrading School Facilities first describe the background of the decision to promote eco-school renovation at every school. (Slide 73) On that basis, the guidelines state that eco-school renovation will be promoted at every school and describe the viewpoints and measures of facilities improvement.

(Slide 74) Collection of case examples was also compiled to promote eco-school renovation of existing schools.

(Slide 75) This explains the content of the Guidelines for Upgrading School Facilities in plain language.



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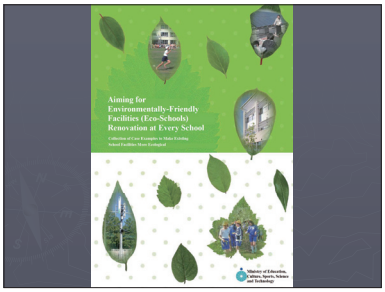

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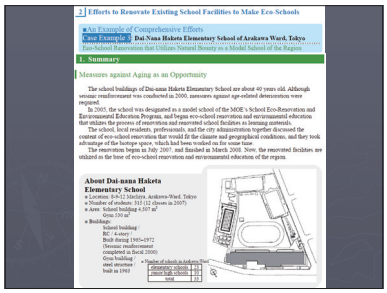

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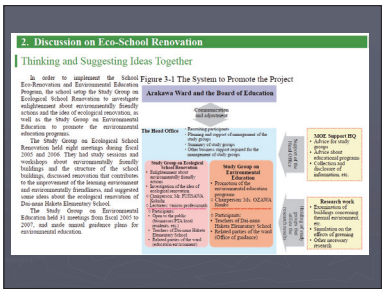

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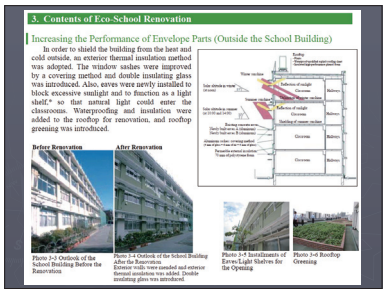

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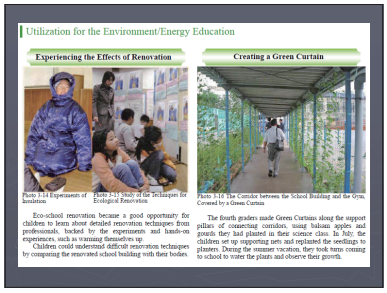

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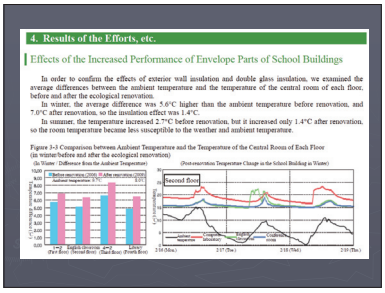

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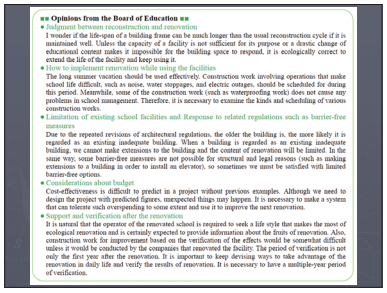

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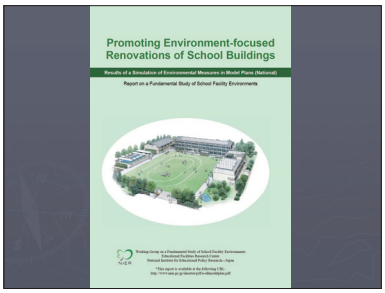
(Slide 76) This is one of the examples, the case of Dai-nana Haketa Elementary School of Arakawa Ward. (Slide 77) Because an environmental education program is required in eco-schools, its organization building and operation are also described. (Slide 78) The concrete content of facility renovation is also introduced.

(Slide 79) Furthermore, environmental energy education utilizing the facilities is also described in concrete terms. (Slide 80) Effects of environment-focused renovation were examined in a quantitative way.

(Slide 81) Here are opinions directly from boards of education, from which we know that it is necessary to pay careful attention to various points in actual environment-focused renovations.

(Slide 82) Meanwhile, the Educational Facilities Research Center conducted researches to provide more detailed and concrete information. The report provides standard menus of environment-focused renovations believed to be best suited to ordinary classrooms in each of six regions as defined in the Energy-saving Act in terms of renovation work expenses and cost performance. (Slide 83) This is the standard menu of environment-focused renovation for elementary schools that were built about 35 years ago. The menu shows items of highly effective environment-focused renovation and their concrete content. (Slide 84) The report included simulation results of the reduction in annual CO_2 emissions after implementing the renovation. Both Plan A and B can reduce CO_2 emissions to about two-thirds of those before the renovation. The difference is in whether or not the improvement of the environment in the classroom during summer is included. It found that renovation of heating and lighting has a major reduction effect.

(Slide 85) It also presents improvement in the classroom environment, which is one of the major goals of environment-focused renovation, its effects and reduction of running costs. It is demonstrated that, even if air-conditioning is introduced, utilities will be reduced by about 19% by adopting various methods of



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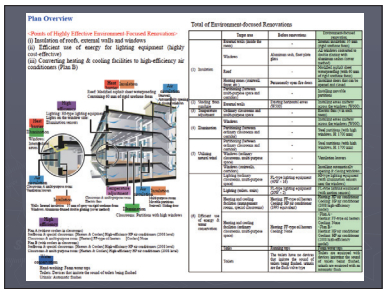

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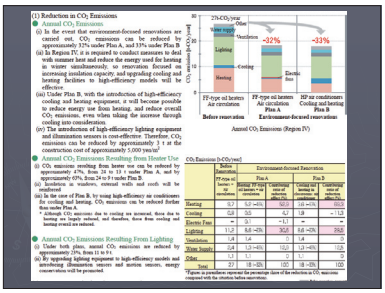

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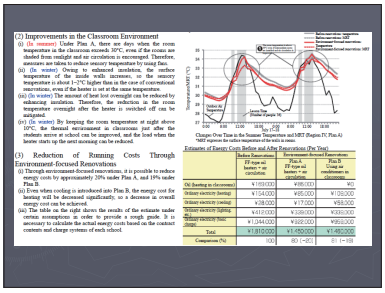

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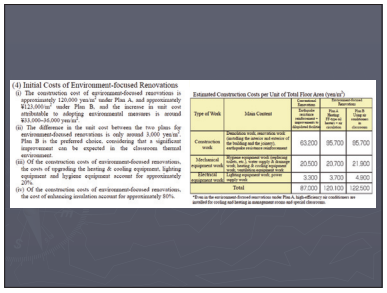

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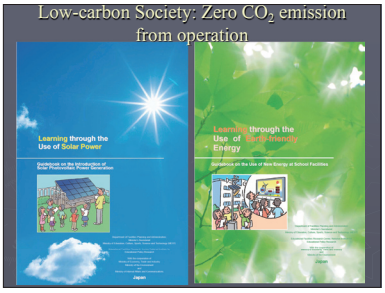

Slide 87

environment-focused renovation.

(Slide 86) Initial cost is also presented. This shows that implementation of environment-focused renovation at the time of seismic reinforcement or renovation for improvement to dilapidated facilities will decrease additional initial costs due to the addition of environment-focused renovation works.

(Slide 87) In a low-carbon society, energy creation will become important also in schools. So, we created reference materials for the introduction of photovoltaic power generation and new energy equipment.

(Slide 88) We have presented standard menus of environment-focused renovation, but because school facilities have strong individual characteristics, methods of environment-focused renovation other than those in the menus may be required in many cases. So, we developed a tool for easy selection of methods for environmental measures based on their CO_2 reduction effect at the stage of preliminary design of environment-focused renovation. The tool is FAST (Facilities Simulation Tool (for Eco-Schools)) shown here. (Slide 89) FAST is simulation software to be used in the early stage of preliminary design when concrete specifications of environment-focused renovation are decided. You can instantly see the level of the reduction in CO_2 emissions that is expected by adopting certain renovation contents in a combination of 12 methods. This is a system to identify the most effective renovation content through comparison of multiple choices.

(Slide 90) FAST is built on the premise that anyone regardless of expertise in architecture can use the system. It is also possible to do so with simple input based on the school directory or public school facility ledger.

(Slide 91) The first step of FAST operation is “inputting basic information concerning the school facilities.” These items are entered. (Slide 92) The next step is selection of the environmental measure menu to be

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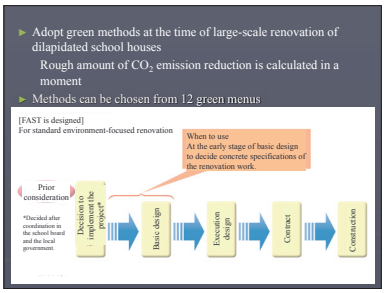

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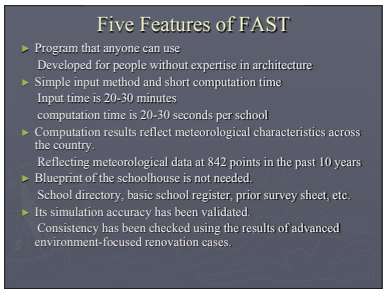

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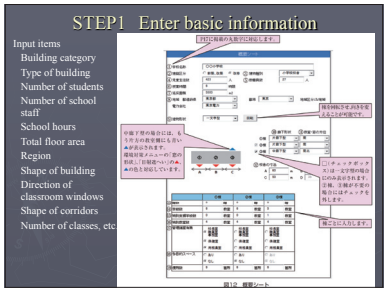

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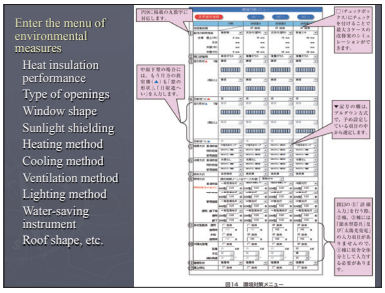

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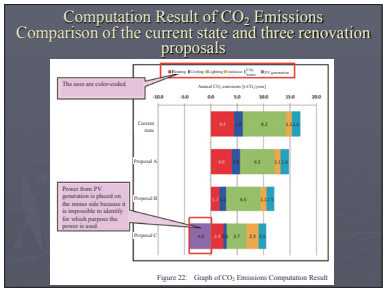


Slide 93

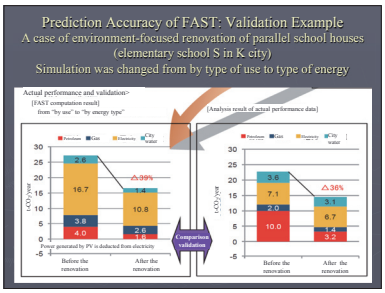
considered. These are 12 selectable methods of environmental measures.

(Slide 93) This is an example of the simulation results that will be presented. It enables comparison of the current CO_2 emission reduction and the reduction of CO_2 emissions by implementing three environment-focused renovation plans. The amount of CO_2 emissions is shown for each energy user and purpose.

(Slide 94) The accuracy of simulation with FAST was verified in the school facilities where environment-focused renovation was actually implemented. Though absolute values are different, I am convinced of its accuracy because the ratios of CO_2 reduction effect are in agreement.

(Slide 95) Local governments are also implementing projects to promote environment-focused renovation. Kawasaki city started a project to implement environment-focused renovation in conjunction with improvement of dilapidated facilities and qualitative improvement in all school facilities in the city. The project aims that every school will complete all renovation works in three years without building temporary schoolhouses by using summer vacations, for example. (Slide 96) In order to implement such improvement for a hundred and several tens of schools, it is convenient to develop a standard manual for drawing up plans. To this purpose, the Kawasaki City Board of Education, Associate Professor Etsuko Mochizuki of the Chiba Institute of Technology, Satoh Energy Research Co,. Ltd. and I are working together on a survey study to compile basic planning of environment-focused renovation, fundamental design, flow of operation manual, works necessary at each stage, and materials and methods for drawing up of a plan.

(Slide 97) Take heat insulation renovation around window, for example. We are examining which of the methods, attachment of double glass or installation of an internal plastic sash to create a double window, is appropriate for installing during a summer vacation as well as what coordination to make with the school and what to prepare before the installation. Anyway, it is important that each local government builds up



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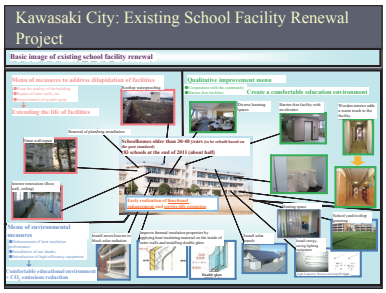

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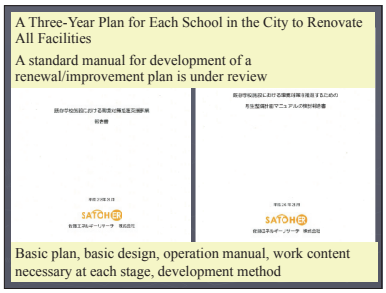

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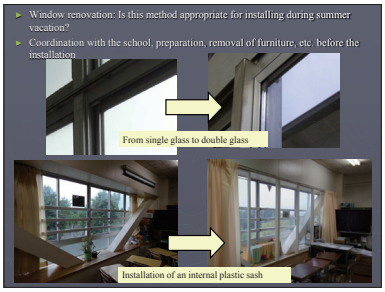

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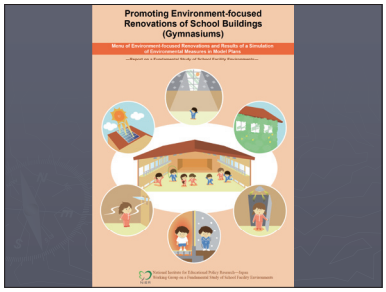

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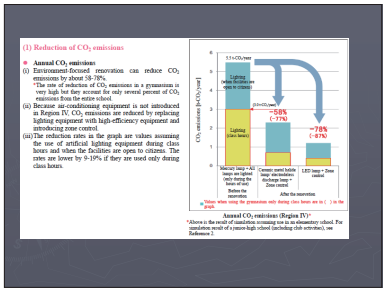
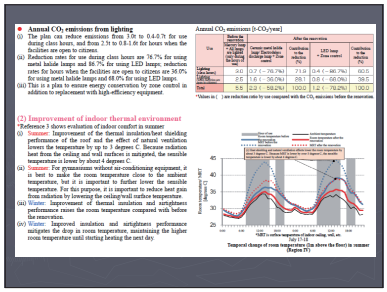


Slide 99

works and accumulates knowhow. You cannot start environment-focused renovation just by using materials developed by MEXT and the Educational Facilities Research Center.

(Slide 98) In conjunction with version upgrading of FAST, the Educational Facilities Research Center has developed standard environment-focused renovation models believed to be best suited to gyms in terms of construction cost and cost performance. (Slide 99) The composition of the report is the same as the report for ordinary classrooms. However, because most of energy consumption in a gym is for lighting, methods to reduce CO_2 emissions are limited to efficiency improvement of lighting equipment. (Slide 100) Nevertheless, I wish for you to know that heat insulation renovation and better ventilation can greatly improve the thermal environment in a gym. For example, the sensible temperature in gyms is lower by 4 degrees C in summer. (Slide 101) Hours when people feel "very hot" are reduced to about one-third compared with those before the renovation.

(Slide 102) MEXT created collections of examples concerning environmental education in order to reconfirm that eco-schools are not limited to facility development. This is the most recent report. (Slide



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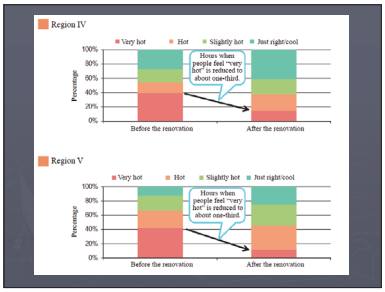

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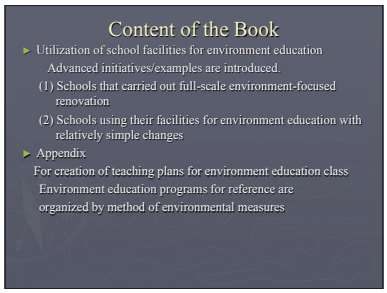

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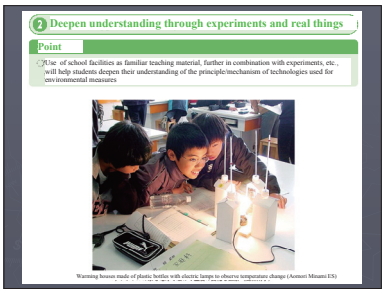

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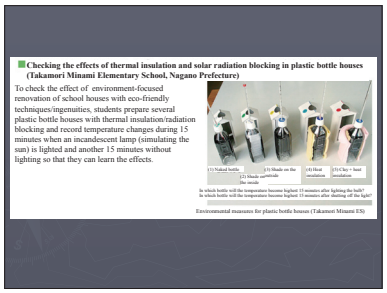

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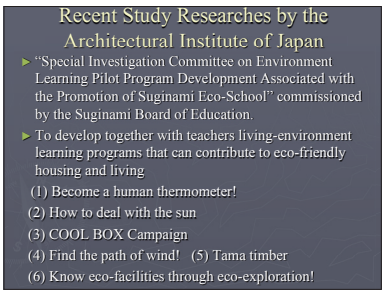

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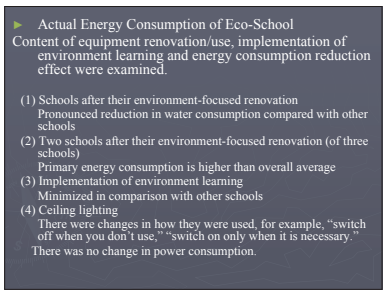


Slide 108

103) The book introduces examples of environmental education in schools that carried out full-scale environment-focused renovation as well as environmental education provided in relatively simple facilities (Slide 104) It is not realistic to use a mechanism for the environment in school facilities without due preparation. Children could understand the principle through simple experiments like this.

(Slide 105) This is an experiment using plastic bottles that are modified to simulate thermal insulation and solar radiation blocking. Students can verify the effect of thermal insulation and solar radiation blocking by measuring the temporal change of the temperature inside PET bottles warmed with incandescent lamps and the temperature change after switching off the lamps You can see that environmental education is possible using such simple tools. (Slide 106) Students of this junior-high school are using an illuminometer to measure the illuminance at various places in the facility with natural lighting through skylight to learn the effect of natural light from the skylight. They are seeing the effect with their eyes, and this way they know from the measurement that the illuminance is higher compared with places without a skylight.

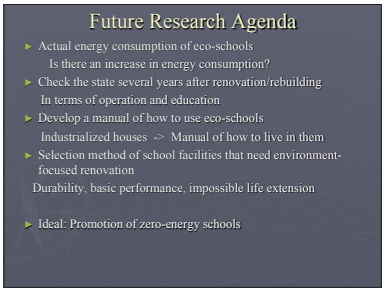
(Slide 107) Believing that designers of eco-schools should be involved in the development of environmental education program, the Architectural Institute has developed an environmental education program for eco-schools in Suginami Ward. (Slide 108) It also revealed actual energy consumption in eco-schools. Here are the results though actual measurement is conducted in only two schools.

(Slide 109) I have described studies on eco-schools from the beginning to today. Now, let me talk about the future research agenda concerning eco-schools.

First, actual energy consumption of eco-schools: energy consumption may not be greatly reduced because the classroom environment must have been improved. However, I think that we should not limit the discussion to the absolute value of energy consumption. Because qualitative improvement of the classroom environment is most important, we should discuss energy consumption after considering an evaluation method in light of the improvement.

The idea of eco-schools and mechanisms and devices for their realization may be well known to teachers for some time after the completion, but, if the teachers are transferred, the knowledge might not be passed on to new teachers. I think it is necessary to check the state of eco-schools several years after the completion of the work.

When you move into an industrialized house, the builder provides a manual of how to live in the house. I



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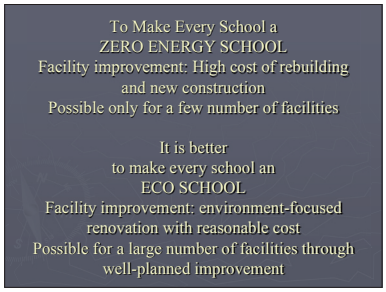

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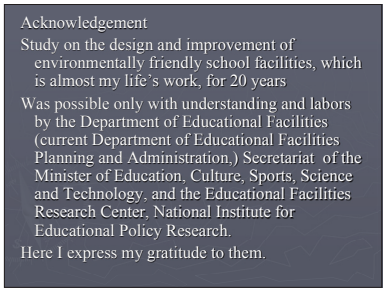

Slide 111

think we need to develop such manuals on the use of eco-schools and utilization for environmental education.

Furthermore, should we make all existing school facilities eco-schools? Is it really necessary to carry out environment-focused renovation for school facilities with extremely low basic performance even after measures are taken to extend their life and those made convoluted after repeated addition and betterment? I think we need to define how to identify school facilities that are unworthy of environment-focused renovation.

I have a great deal of interest in zero-energy school facilities, but there are still many things to do for facility improvement through environment-focused renovation. I think the development of zero-energy school facilities could be very expensive. (Slide 110) Making a small number of zero-energy schools may make little difference in total. What I wish for you who have come here today to know is that it is important to use the money for environment-focused renovation for as many existing school facilities as possible in the shortest period of time possible. The reduction of CO_2 emissions per school may be small and the energy conservation rate may be low; however, if environment-focused renovation is carried out for a large number of schools, their multiplication makes for a remarkable contribution to a low-carbon society.

(Slide 111) At the end of my lecture I would like to express my gratitude.

I was able to continue study on eco-schools, which I can call my life work, for as long as 20 years. This was possible only with the understanding and labors of people in the Department of Educational Facilities Planning and Administration, Ministry of Education, Culture, Sports, Science and Technology, and the Educational Facilities Research Center, National Institute for Educational Policy Research. Here, I express my gratitude.

This concludes my lecture. Thank you for your attention. (Applause)

Moderator:

Thank you, Professor Komine.

Now we will take a 15-minute break.

Lecture

Toward Zero-Energy School Buildings

- Introduction of Environment-focused School Building Design in Recent Years -

Osamu Koizumi

Chief, Architectural Design Group2,
Architectural Design Division, NIHON SEKKEI, INC.
Member, Working Group on a Fundamental Study of School Facility Environments, NIER

Osamu Koizumi

1964 Born in Tokyo
1992 M.Arch., Faculty of Engineering, Musashi Institute of Technology
1992 Joined NIHON SEKKEI, INC.
Present Chief, Architectural Design Group2, Architectural Design Division

Awards

FUCHU ELEMENTARY SCHOOL/ FUCHU JUNIOR HIGH SCHOOL
(2010 Annual Architectural Design Commendation of AIJ, Award of BCS)
Misaki Junior-high School, Isumi City
(2012 Sustainable Building Award, Best Environmental Architecture Award of JIA)
Ohnoden Elementary School, Musashino City
(2006 Environmental Architecture Award of JIA, 2006 Commendation for Quality Facilities of Public Schools)
Building of Graduate School, Tohoku University of Community Service and Science
(2006 Good Design Award)
Tsuruoka Town Campus
(2001 Yamagata Landscape Design Award)
Nishinomiya Campus, Konan University
(2011 Landscape Architect Prize of Nishinomiya City)
Port-island Campus, Konan University
(IES Illumination Awards, DNA Model has been Registered in the Guinness Book of Records as a Largest Model of DNA)
Rakusenkyo
(2010 Tohoku House Architecture Award)

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Moderator: Now let us start the 3rd lecture.

Mr. Osamu Koizumi, Subleader of the Second Architectural Design Group, NIHON SEKKEI, Inc. and a member of the Working Group on a Fundamental Study of School Facility Environments of the National Institute for Educational Policy Research will present to us a lecture titled: “Toward Zero-Energy School Building － Introduction of Environment-focused School Building Design in Recent Years －.” For his profile, please see the material in front of you.

Please start, Mr. Koizumi

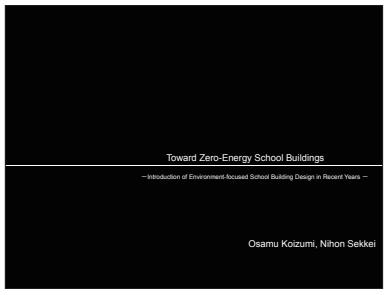
Mr. Osamu Koizumi:

(Slide 1) I am Koizumi of Nihon Sekkei.

(Slide 2) First, I would like to talk about the backbone of our design works.

(Slide 3) This is Kasumigaseki Building, the first design work for the company. The building is next to the premises of MEXT. Later, after designing super-high-rise buildings, we designed Tropical Dream Center and Tama Zoological Park Insectarium. Through these works, we learned that we can control the environment of the building utilizing natural walls and wind blowing through valleys. This was a turning point for us from dependency on an artificial environment to harmony with the natural environment.

Next, we designed Across Fukuoka where the entire rooftop of the building was covered with plants and Investment and Consultation Building where solar panels were installed. This is the first case of using solar



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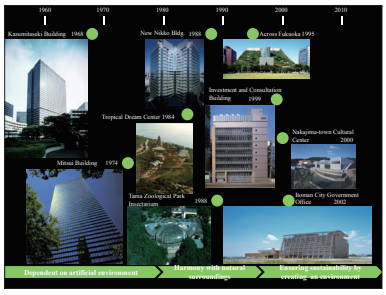

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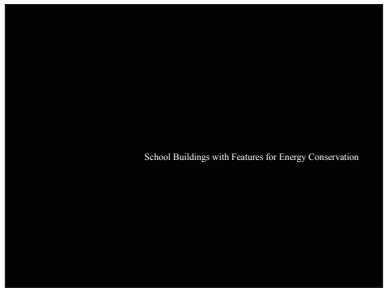

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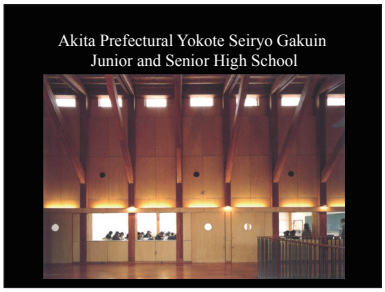
panels as building material. We covered Itoman City Government Office with 200kW solar panels. With the 200kW solar panels, we could reduce the total power consumption only by 12% and air-conditioning load and energy by 25%.

(Slide 4) Later, from the latter half of the 1990s, we started to focus on designing public schools. (Slide 5) Today, I will introduce Yokote Seiryo Gakuin of Akita Prefecture and Onoden Elementary School. These are buildings with photovoltaic power generation or fuel cells. We designed schools introducing a passive floor cooling/warming system that is different from conventional heating/cooling, or using wood produced in Tokyo.

Later, for Fuchu Municipal Fuchu Gakuen of Hiroshima Prefecture, we introduced an all-electric system and utilization of the natural environment. Next, in Isumi Municipal Misaki Junior-high School, we tried to control the building environment using only natural ventilation and solar heat with the goal of adding nothing.

Then, the Great East Japan Earthquake occurred in 2011. I think, from the last half of the 2000s, there has



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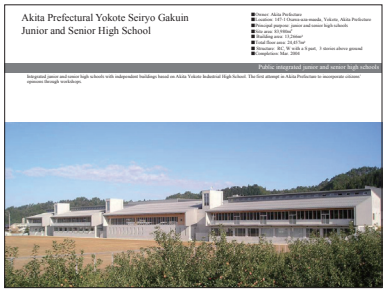

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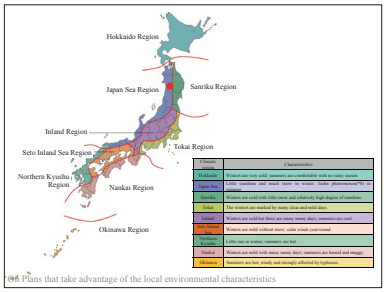

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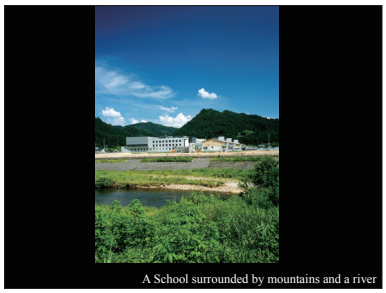

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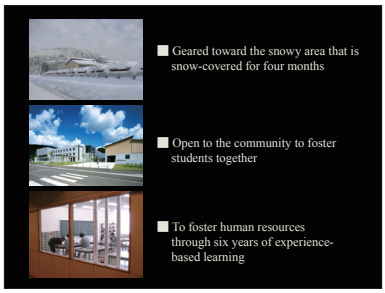

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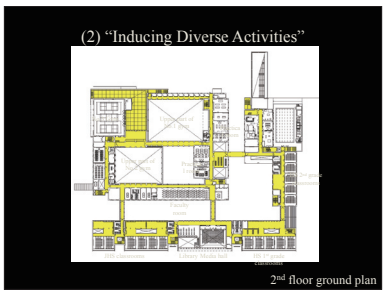

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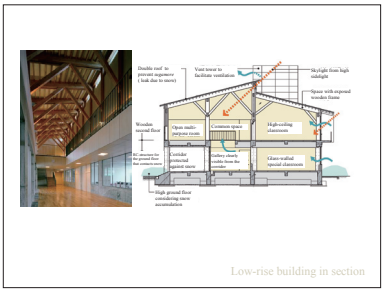
been a shift from the past approach of ensuring sustainability through environmental creation and eco-schools to energy conservation through operation.

After the Great East Japan Earthquake, I think the trend is more toward energy conservation through operation. In this trend, I would like to introduce Teikyo University Elementary School and Tokyo Institute of Technology Environmental Energy Innovation Building that was covered with solar panels of about 600kW.

(Slide 6-7) Let me introduce Yokote Seiryo Gakuin of Akita Prefecture as an example of a past eco-school. (Slide 8-9) The school is in Yokote City which is a climatic region where it snows a lot in winter and is hot in summer due to the Foehn phenomenon, among the many climatic regions of Japan. (Slide 10-11) The school is between the Yokote River and mountains. (Slide 12) The site is covered with snow for one-third of the year. We designed the school to create varied and rich school environments under this condition.

(Slide 13) We built an urban environment where you can see students studying and the inside of the practical room on the first floor. (Slide 14-15) The design aims to take advantage of the characteristics of



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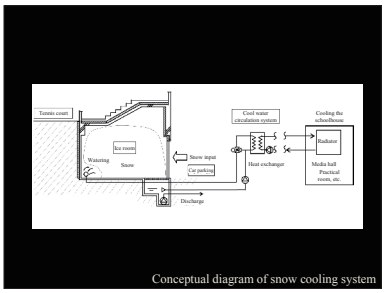

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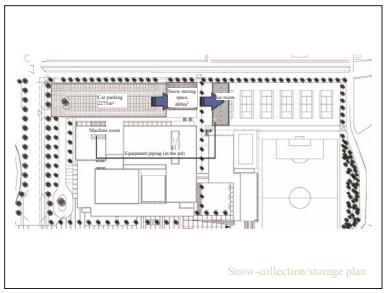

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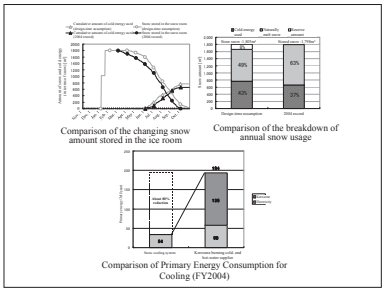

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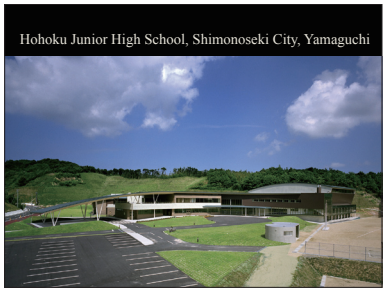


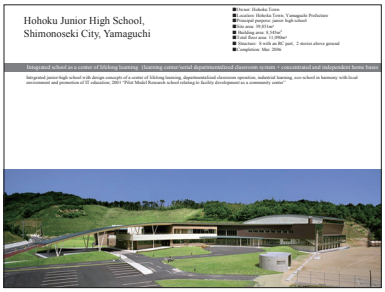
Slide 24

integrated junior and senior high schools by encouraging diverse activities. (Slide 16) Because the area is a production center of Akita cedar, we used wood for the interior of the second floor to create a space with the rich feeling of wood.

(Slide 17-18) The schoolhouse built in response to the local climate is covered with snow during winter. (Slide 19) This is its snowscape. (Slide 20) We made a plan to use a snow cooling system here. The concept is to build an ice room, input snow and gradually melt the snow for heat exchange of cold water for air-conditioning during summer. (Slide 21) The plan was to accumulate snow in a car parking area and put the snow into the ice room.

(Slide 22) This is how snow is input. We don't use a dump truck but bring and heap up snow in the room.

(Slide 23) You can see the effect of the snow cooling from the comparison of primary energy consumption for cooling. The required energy is very small for cooling. About 43% of the stored snow can be used for cooling. This is when the snow begins to melt and when its use starts. We made the plan so that the last snow is used on November 1st. I think this is an option in snowy districts.



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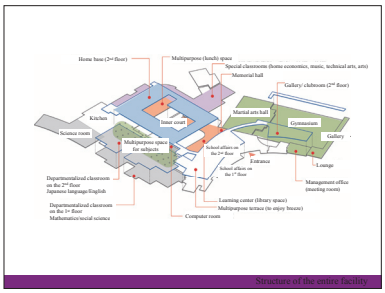
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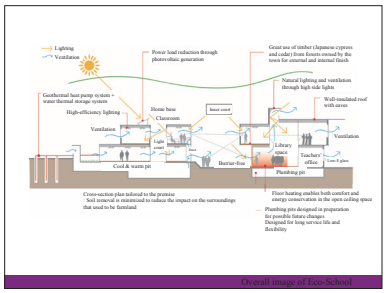
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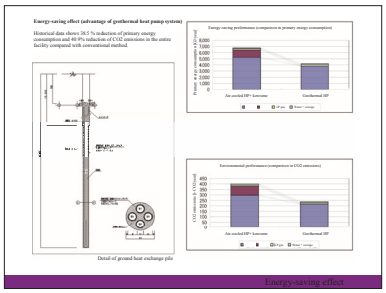
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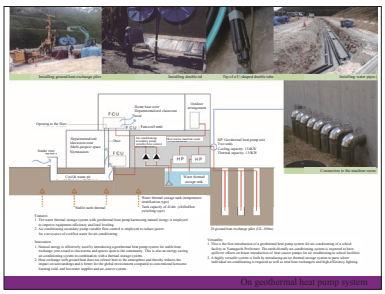
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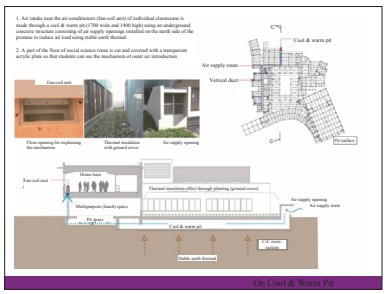
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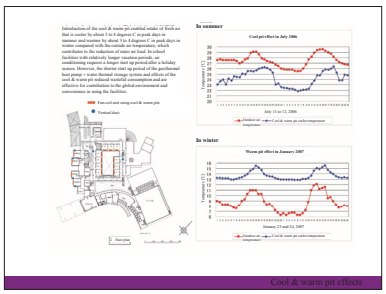
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(Slide 24-27) This is a school in Hohoku. (Slide 28-30) This school uses ground heat. We aim to reduce environmental burden by using ground heat for heating and cooling. Energy use is reduced through an air-cooled heat pump package, kerosene and ground heat pump package. We have confirmed about 40% reduction in CO_2 equivalent.

(Slide 31) This is an illustration of the system. We planned to store ground heat in the heat storage water tank and use a cool-warm pit for pre-warming and pre-cooling of air. Because Shimonoseki does not have many sunny days during winter, the firm attempted to use ground heat.

(Slide 32-33) As shown in this figure, a cool-warm pit can increase the temperature by 3 to 4 degrees C. During summer, it can supply air that is cooler by 3 to 4 degrees C.

(Slide 34) This is Onoden Elementary School of Musashino City, Tokyo, that we designed later. (Slide 35) The school is in the climatic Tokai region, so the design assumed sunny and moderate winters with occasional snow.

(Slide 36-37) There is one important point we missed in our plan. There is a water purification plant of

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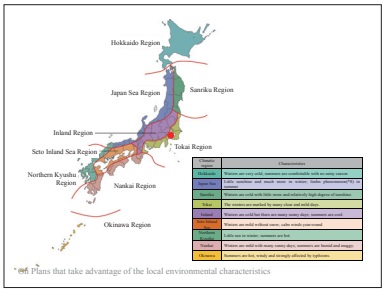

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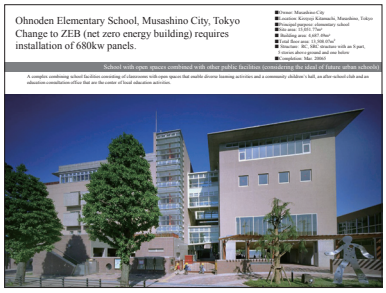

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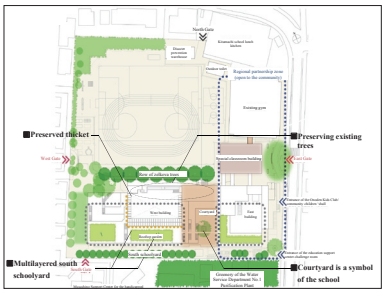

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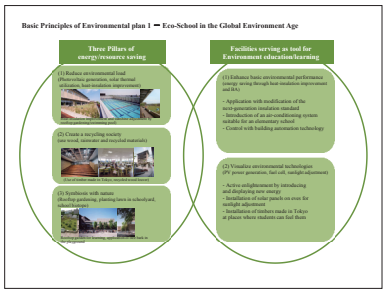

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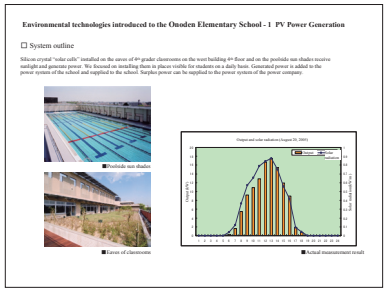

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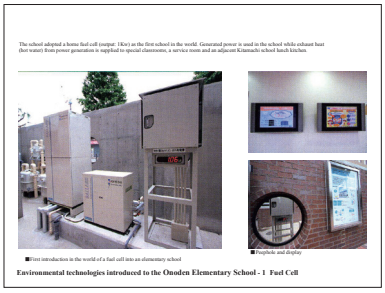

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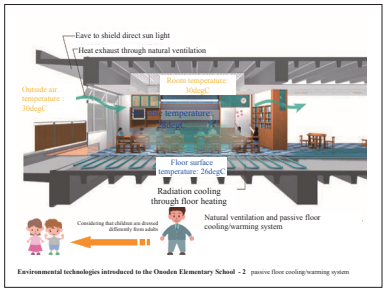


Slide 42

Musashino City near the school. In a talk with a person from the waterworks at the time of the completion of the building, I came to know that about 100 tons of 15 degrees C water is discharged every day for flushing tanks, etc. of the plant. I regretted very much that we missed the opportunity. I felt the need for due research on the surrounding public facilities when making a plan.

(Slide 38) Onoden elementary school is a project to build a schoolhouse while preserving a row of zelkova trees. An ordinary plan may be to build a school house on the north side with the school yard on the south side. However, because the waterworks mentioned earlier is on this side, it is planned to borrow its green.

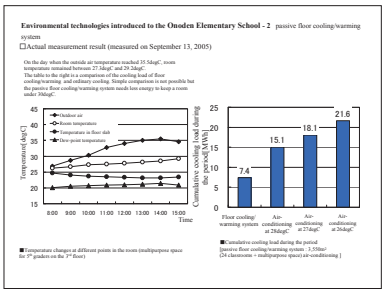
(Slide 39) We adopted three pillars of energy conservation: “reduce environmental load,” “create a recycling society” and “symbiosis with nature.” Other themes of the design are: “enhance basic environmental performance” and “Visualize environmental technologies.”

(Slide 40) The first one is PV power generation. Solar panels are installed at visible places on the sun shades on the poolside and on the rooftop of the four-storey building. (Slide 41) We have also installed a small 1kW fuel cell for household use first in a school at a place visible from outside. It is used to supply hot water to an adjacent school lunch center.

(Slide 42) One of the features of the school is a system called passive floor cooling/warming. It is designed to lower the indoor temperature by about 2 degrees C when outside air is introduced.

(Slide 43) The passive floor cooling/warming system can be operated with very small amount of energy. An important point is that this is passive cooling and not designed for complete air-conditioning. However, it can cool a space with very small energy in comparison.

(Slide 44) This shows the floor surface temperature distribution. It is confirmed to be able to maintain a very good condition. (Slide 45) Overall, environment-friendly measures are implemented in various areas



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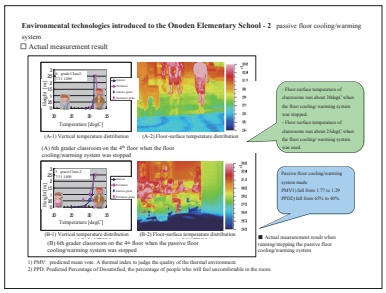

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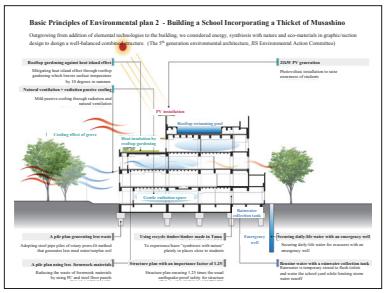

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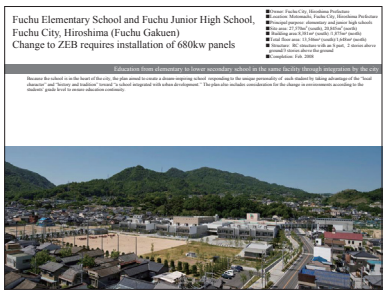

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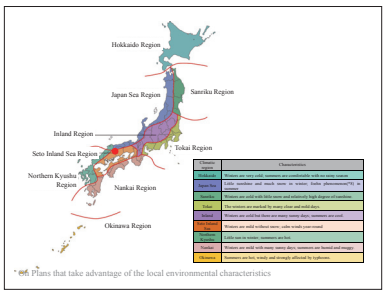


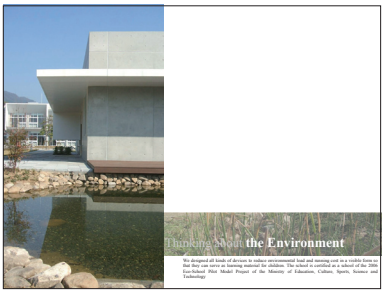
Slide 48

in Onoden Elementary School.

(Slide 46) This is Fuchu Gakuen of Fuchu City, Hiroshima Prefecture, which we designed later. (Slide 47) While Onoden Elementary School could be made ZEB by installing 700kW solar panels, Fuchu Gakuen would require 680kW panels. (Slide 48) The school is in the climatic Seto Inland Sea region where winters are relatively mild with little snow, but because the location is near the climatic Japan Seas region and faces with mountains, it may be somewhat colder in winter.

(Slide 49-50) The school is built using a former JT site. Junior-high and elementary schools are constructed in an integrated manner with a space for common use at the center. As we designed two inner courtyards, we plan to use them effectively for ventilation.

Earlier, Professor Komine said that there are many complaints about the thermal environment after renovation work. These classrooms face north. Recently, we often propose classrooms facing north, which may be difficult for teachers to understand. These are classrooms for the 5th graders. There are few complaints such as that it is hot or cold in the classrooms.



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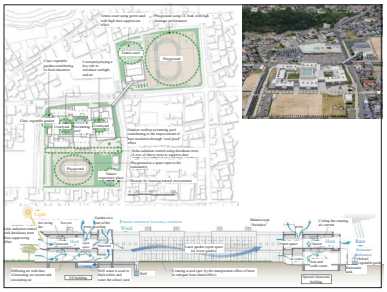
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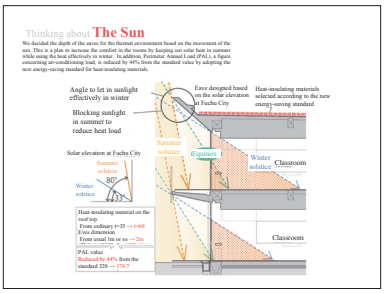

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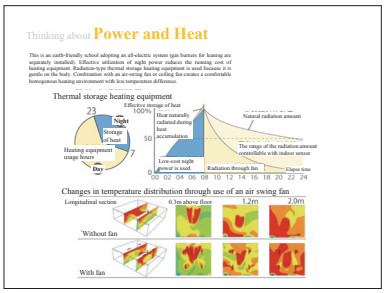

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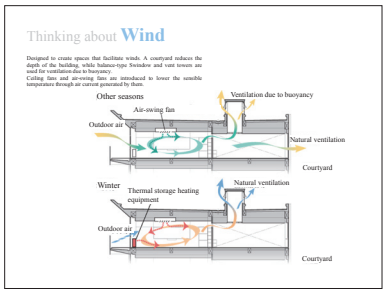

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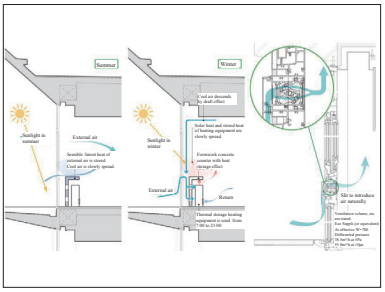
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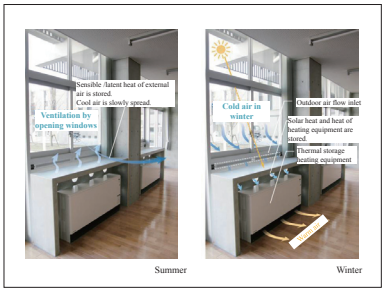
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Slide 57

(Slide 51) This deep eave is designed in the image of udatsu, a short pillar set on a beam to support a ridgepole, to facilitate natural ventilation while effectively controlling sunlight at the summer and winter solstices. (Slide 52) The eave introduces the sunlight of the winter solstice into the classroom while blocking the sunlight of the summer solstice. The eave is designed so that the sunlight of the equinox barely reaches the room.

(Slide 53) Air-swing fans are installed to maintain a stable classroom environment. (Slide 54) This way, outdoor air is introduced in seasons other than winter and air-swing fans are used for ventilation due to buoyancy. In winter, as thermal storage heating equipment is installed here, a good indoor environment is maintained by making air move a little using air-swing fan.

(Slide 55) For ventilation, this system is installed at the lower end of the sash and can be opened during night for ventilation. Thus, the design enables night purge. (Slide 56) In order to take advantage of direct gain, this thermal storage heating equipment has a large concrete surface to collect solar heat.

(Slide 57) Later, we designed Misaki Junior-high School of Isumi City, Chiba Prefecture. We would need 200kW to make the school ZEB. The figure is greatly different from those of the other two schools. Please be aware that the school is about one-third their scale.

(Slide 58) This is Misaki Junior-high School of Isumi City, Chiba Prefecture. The school is in the climatic Pacific, Tokai region where Onoden Elementary School is also situated. (Slide 59) What professor Komine said earlier reassured me a bit. These are energy consumption figures of Onoden Elementary School and Fuchu Gakuen. In contrast, the figure for Misaki Junior-high School is 0.39 giga-joule. Our design is based on this figure.

In Onoden Elementary School we introduced many active systems, while we added passive systems in

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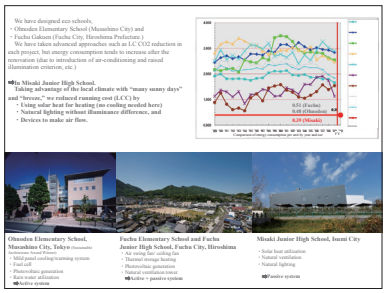

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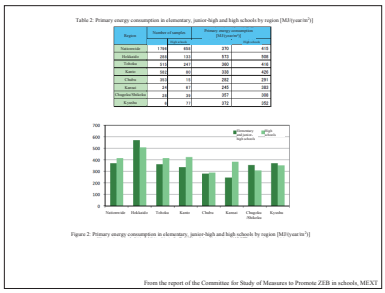

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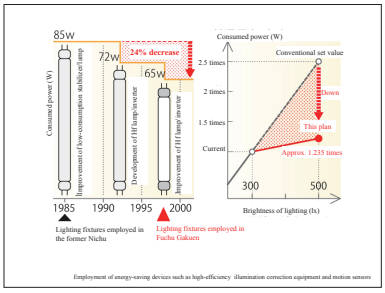

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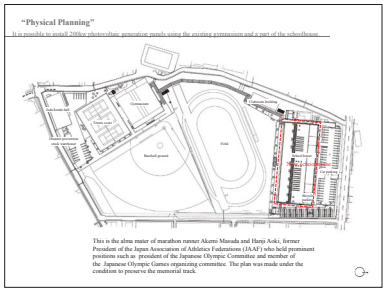

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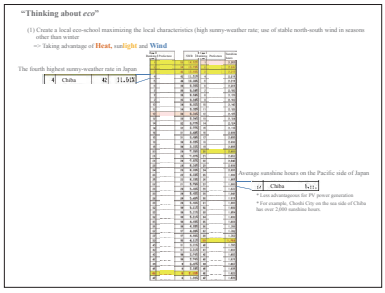

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Fuchu Gakuen. In Misaki Junior-high School we used more passive systems. (Slide 60) These are figures of energy consumption in elementary and junior-high schools. The figures of Onoden Elementary School and Fuchu Gakuen are significantly higher than these figures.

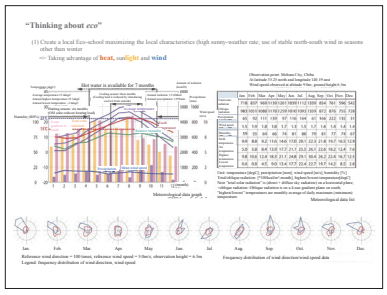
(Slide 61) We thought about why this must be so. The lowest illuminance set by the school health standard is 300 lx, but 500 lx is recommended as the desirable level, which requires 2.5 times more energy if calculated simply. We can reduce energy use by using energy-saving equipment, but it would be still about 1.2 times more. Now, LED lighting equipment and others are available to replace Hf lighting. Equipment brought into the market this year may be of equivalent performance to Hf lighting.

(Slide 62) Misaki Junior-high School would need 200kW solar panels. I think it is possible to install 200kW panels because the school has unused rooftops of gyms and the schoolhouse.

(Slide 63) As you know, the clear day rate is high while hours of sunlight are average in Chiba prefecture. However, the figures are a little higher on the ocean side, where Misaki Junior-high School is built. (Slide 64) Because the site is on the ocean side and has many windy days, we wanted to design the school taking advantage of wind.

(Slide 65) Thinking about ecology, we wanted to realize a sustainable design focused on a maintenance-free facility. In Fuchu Gakuen, we used eaves for effective control of sunlight but the design somewhat relied on air-swing fan for air flow. In Misaki Junior-high School, in order to use ventilation due to buoyancy, we installed these high windows to use a system used in factories to open windows in series. They facilitate ventilation due to buoyancy and wind flowing along the sloped roofs further facilitates wind flow. So, we can feel good wind current here.

(Slide 66) Solar heat is also used. Pre-warmed air is sent to the area before the FF heater for circulation. As



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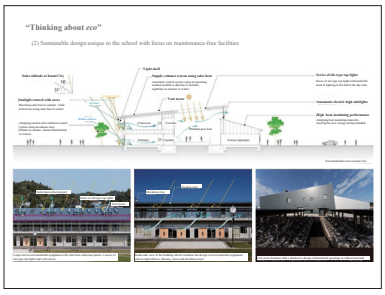

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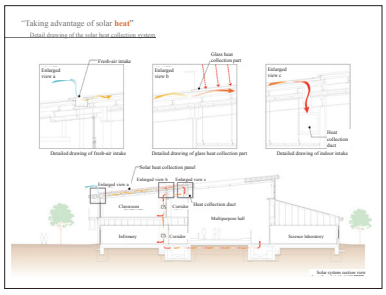

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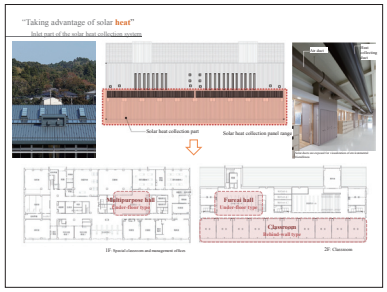

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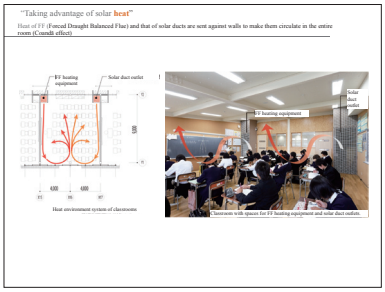

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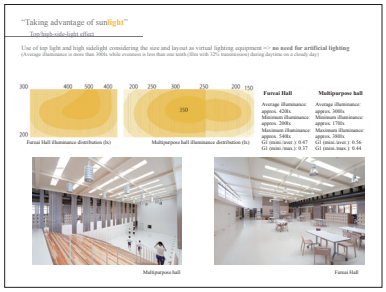


Slide 69

part of the MEXT survey, I visited an existing eco-school, where solar heat is used by introducing (warm) air into common use spaces, which made the entire schoolhouse slightly warmer, reducing heat shock and lowering energy consumption a little in ordinary classrooms. Learning from the example, we could raise the temperature of the entire schoolhouse to about 17 degrees C by introducing heat into common use spaces. The vice-principle said that they can do without heating by wearing one more layer of clothing. I think this is an operational advantage.

(Slide 67) This is the solar heat system. There are two air collection ducts for air supply running along the corridor. (Slide 68) The air is supplied this way. The design is to make the wind strongly flow along the sides and circulate with the Coandă effect.

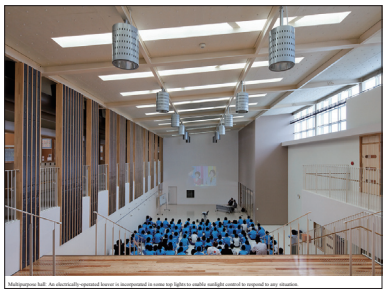
(Slide 69) We considered top lights as well. This is the lighting of two large halls. Top lights are installed evenly. In the past, one large top light was used, but we used many small top lights to introduce uniform light. We adopted these top lights using simulation with a goal of 350 lx.

(Slide 70) We used very white floor material. Its whiteness is one of the factors to increase the brightness. This is when lamps are switched on and this is when switched off. I think you can see that the one is almost as bright as the other.

(Slide 71) This is a hall where blinds can be drawn on this side to darken the hall, so it can be used for events like this. The series of protruding windows used in factories which I mentioned earlier is installed here.

(Slide 72) Lightshelves are installed to take advantage of sunlight. (Slide 73) This is a plan to take advantage of wind as I mentioned earlier. We confirmed that indoor air flows at the almost same speed at which outdoor air flows.

Slide 70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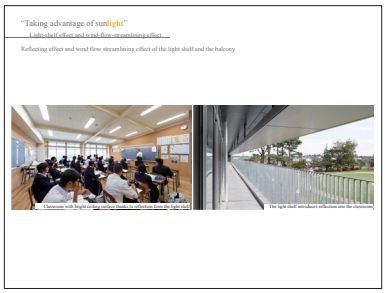

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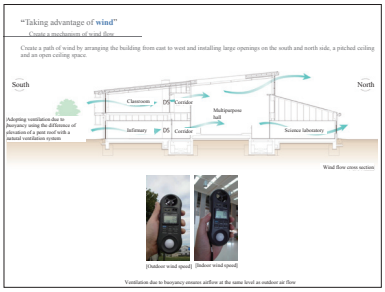

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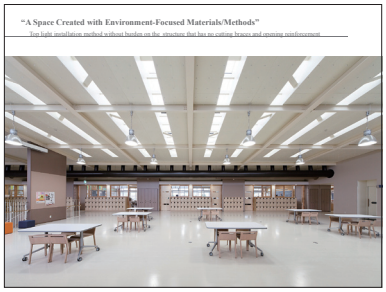

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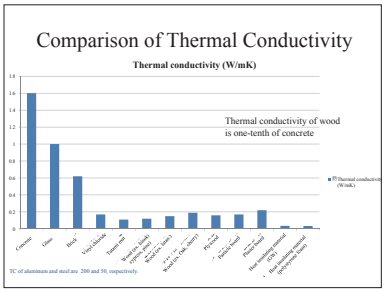
(Slide 74) The school is built using environment-friendly materials and methods. (Slide 75-76) This is a design with top lights, a simple structure and a rich feeling of wood. As a result of efforts to reduce energy use, we have come to know what we should do. (Slide 77) We found out that we need to pay scrupulous attention to thermal conductivity. The thermal conductivity of wood is about one-tenth that of concrete. (Slide 78) The thermal conductivity of plywood is low compared with plaster board. It is lower by 20%. I think it is critical to choose materials with low radiation heat. I believe this is a clue in developing ZEB.
(Slide 79) We used Sanmu cedar. The stairway appears to have reddish parts and whitish parts, but now it has settled into an ordinary, slightly reddish color. The Mayor of Isumi City said to me “Don’t throw away what you have chosen.” This is a good lesson for me as an architect. (Slide 80) We used local designs for signs, for example.
(Slide 81) Onoden Elementary School and Fuchu Gakuen would need solar panels of about 600kW and 700kW, respectively. We had an opportunity to design a building that uses such panels. Let me introduce Tokyo Institute of Technology Environmental Energy Innovation Building.

Slide 76



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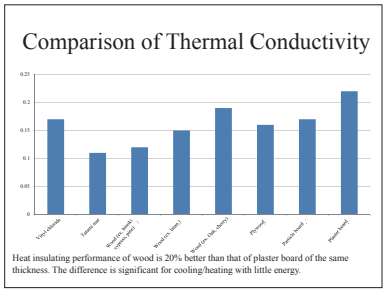

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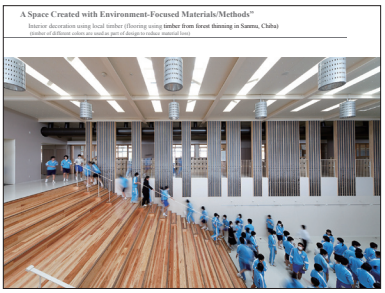

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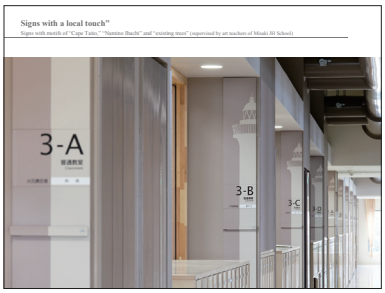

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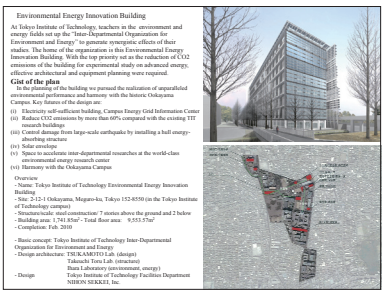

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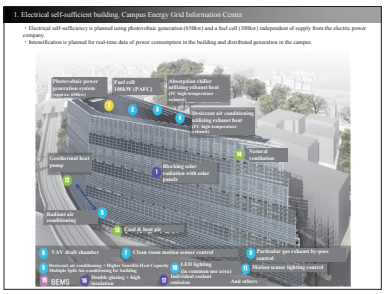

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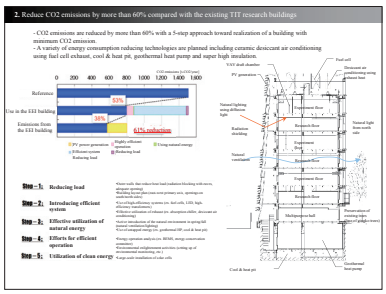

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(Slide 82) This is Tokyo Institute of Technology Environmental Energy Innovation Building. The design has seven points. We planned to create a building that can send a strong message. We designed the building from the master concept together with design architects and the Facilities Department, Tokyo Institute of Technology. (Slide 83) 100kW fuel cells and 650kW solar panels are installed.

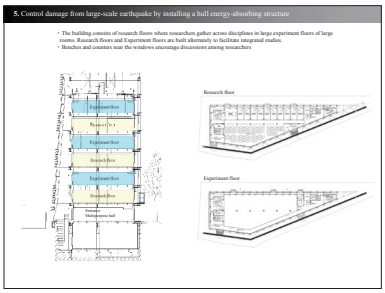
Numbers 1 to 17 are efforts for energy conservation. We think that an urban school with 600 to 700kW panels may look like this. (Slide 84) We confirmed that its energy use is 53% of a typical research building while CO_2 emissions are reduced by 61%. For inside, we adopted a new idea to build research floors and experiment floors alternately.

(Slide 85-86) This is a photo of it shot from outside. (Slide 87) Solar panels are installed on the rooftop as well. Because the panels are from different domestic companies, we arranged them adequately in the design.

(Slide 88) Now, I will suggest a few points that we should consider for realization of ZEB. First, hours of sunshine widely vary in the Japanese Archipelago. Plans may differ depending on in which part of Japan the building will be built. The same applies to precipitation and annual average temperature. (Slide 89) Because conditions are different even in the same climatic region, very finely-tuned designs may be required.

(Slide 90) This is the relationships between PAL curve and regions. In Sapporo, heat insulation is very meaningful in terms of energy but installing eaves is not. In Okinawa, on the other hand, improving sun-blocking performance is far more effective than enhancing heat insulation performance. Tokyo may be in between. We need to consider that each region has different conditions.

(Slide 91-92) This is the definition of ZEB quoted from METI website. This means that we need to make



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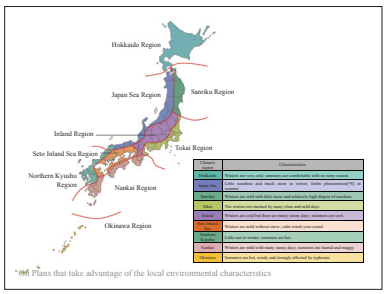

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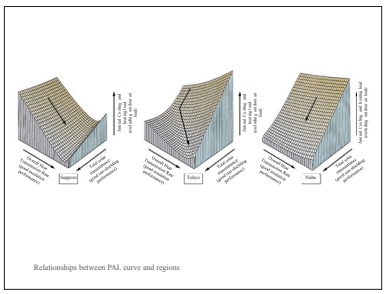

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various efforts to realize ZEB. However, as Professor Komine said earlier, there is a question whether it is necessary to make various reduction efforts for every school building. Also I think there is a room to consider Inter-building Energy Utilization, such as utilizing energy of water purification plant I missed.

This is a proposal from the company. We have proposed various plans where basic items are implemented more carefully. We make proposals by choosing items suitable to the place based on the fundamental sheets.

(Slide 93) We thought more about things we should consider for realization of ZEB. For example, the lecture hall of Shizutani School built in 1973. The school was a public school of Okayama Domain in the Edo Period. Seeing the school changed my viewpoint a little. I think that looking at this wooden space and shoji anew as an environment may change how you look at these things. Shoji windows with very high permeability and infusibility may provide a strong hint for future plans. It is the same with the wooden space. (Slide 94) We have a culture of wood in traditional buildings and folk dwellings. It may be interesting to think about their warmth and friendliness from the perspective of environment.

(Slide 95) This is an example of measuring a wall with a radiation thermometer in a school. The temperature is 12.8 degrees C for concrete and 14.4 degrees C for plywood. This is almost the same temperature difference that is generated by applying insulating material in earthquake reinforcement work which Professor Komine mentioned earlier. Without attention to the interior finishing material, it may be very difficult to realize ZEB.

(Slide 96) This is the comparison of thermal conductivity I mentioned earlier. I think we can facilitate consideration a little more through effective combination of this and the radiant heat amount. We think it will become necessary to use the right material for the right place choosing among various materials from

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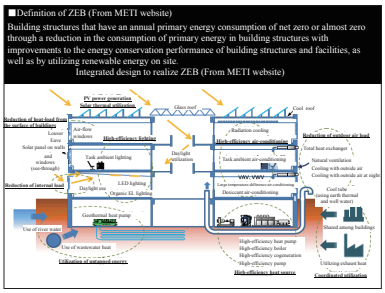

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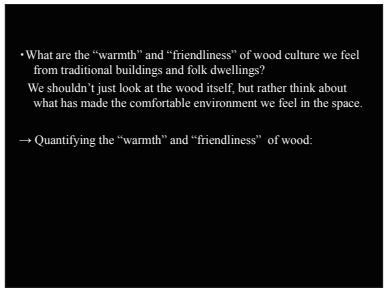

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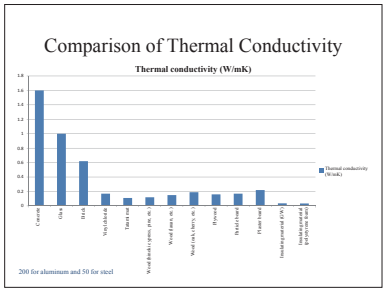

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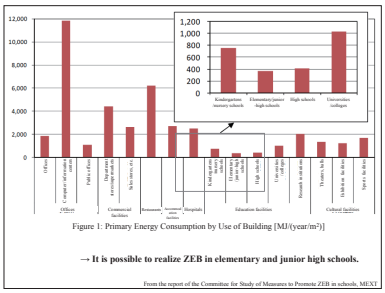
those with high thermal conductivity to air that has high thermal insulation performance.

(Slide 97) This is the primary energy consumption Professor Komine mentioned earlier. Because of their low energy consumption, it is possible to realize ZEB in elementary and junior high schools. Professor Komine suggested the "approach of using less material and energy." I think it is necessary to do this first, but I wish to simultaneously realize ZEB by creating energy. (Slide 98) This is an excerpt from a report on ZEB, MEXT, here I think we could make some achievement in the part of heating. I think we can realize ZEB by advancing the consideration on lighting including that in ordinary classrooms.

(Slide 99) Lastly, let me explain the design of Teikyo University Elementary School. I have been talking about ZEB, but I think we also need buildings like this that reflect the cultural background of Japan. The project started from a talk with the president of Teikyo University who said it was desirable for the school that its students could understand their own culture before going abroad. (Slide 100-101) The building is in the climatic Tokai region. The school has a hill called Genkotsu-yama of the Tama Hills in its background.

(Slide 102) This is a bird's eye photo. Here are houses of the former Tama New Town and this was a public school. The premises of Teikyo University are on the near side. With the progress of population aging, an unnecessary part of the school is extended for use as an elementary school. We collaborated with Kuma Laboratory of the University of Tokyo to create a gentle environment that is covered by a large roof. We used heat-treated wood for the exterior.

(Slide 103-104) This is a photo of the outside. (Slide 105) Classrooms are arranged in a line. Children travel through the central part using these two stairways. By placing special classrooms here, it is designed that children can feel the atmosphere and see what is going on there and what they will learn in higher grades. The science zone is worthy of special mention. Because Principal Hoshino is a science teacher, the



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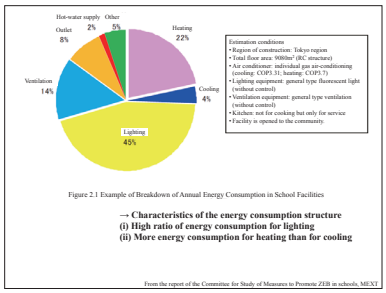

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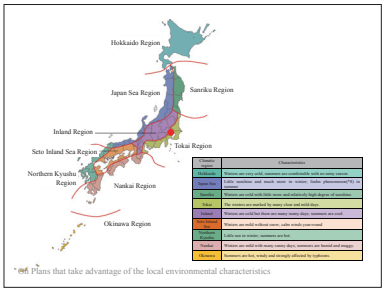

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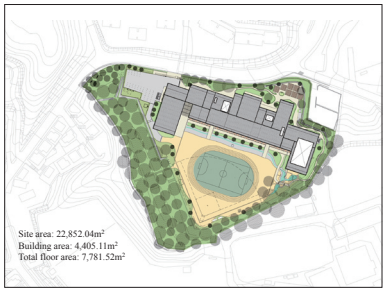

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science zone has a very rich environment.

(Slide 106) They are section plans. As mentioned earlier, solar heat is distributed to the common use space of each classroom.

(Slide 107) This is inside. We explored various possibilities of wood by using OSB boards and straw chips for the ceiling, for example. (Slide 108) Here, children are learning in a new way. (Slide 109) This is a preparatory room of a special classroom, which is used as storage. It is arranged in a corridor for common use to show what is inside.

(Slide 110) This is a lunch room cum kitchen for home economics. A sense of depth is created taking advantage of the large roof. (Slide 111) This is the science zone. The science teachers' room is also visible from outside.

(Slide 112) This is the top floor. Here, too, we have created an education environment enveloped by a large sloped roof rather than a flat roof.

(Slide 113-114) I think we can realize ZEB by re-evaluating, examining and incorporating the beauty of traditional buildings using new technologies. In order to achieve ZEB and energy conservation required for society, it is necessary to move from comparative discussion based on considerable expenditure to"having few wants," which means "expert energy (small energy)" use, a term created by a person in charge of equipment at Nihon Sekkei. In terms of "having few wants," I think it is necessary for architecture to offer support to create an environment where users "can do without heating by wearing one more layer of clothing" as mentioned in the example of Misaki Junior-high School.

In the past, because buildings are designed on the premise of using air-conditioning if it is cold, choice of interior finishing material has often been overlooked. However, in order to adjust the indoor environment,


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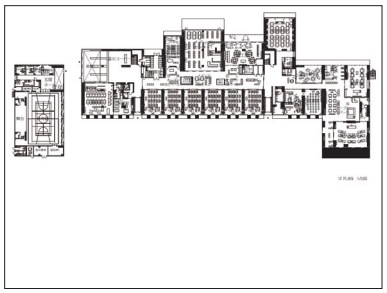
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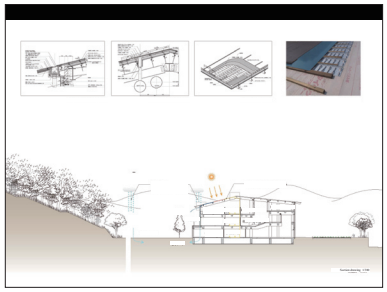
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it is necessary to pay careful attention to the climatic conditions of the region. Talking about thermal and light environment, the wood floor of this hall is brownish but you can make it whitish by applying white paint. I think it is necessary to examine materials that are visible to us now and future materials, and control them in a total architecture.

(Slide 115) As a result of participating in various studies and looking at various schools, I was able to create the buildings I introduced today. I hope you have found my presentation informative for your future plans. (Applause)

Moderator:

Thank you, Mr. Koizumi.

Lastly, Fukuei Saito, Director of Educational Facilities Research Center, National Institute for Educational Policy Research, will give a closing address.

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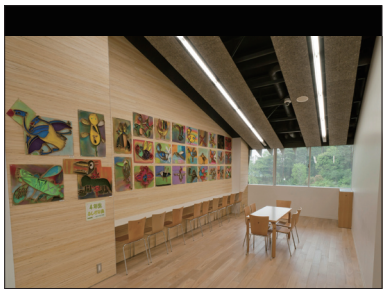

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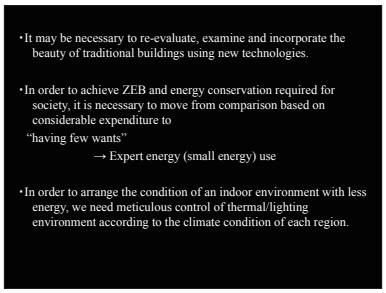

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Ⅲ. Closing Address

Closing Address

Fukuei Saito
Director of Educational Facilities Research Center
National Institute for Educational Policy Research

Thank you very much for joining the lecture meeting today. Based on his experience as Chair of OECD/CELE and others, Mr. Tony Sheppard introduced wide-ranging examples of environment-focused school facilities abroad including in Ireland. I think the idea of varied approaches to environmental consideration in accordance with the circumstances of the country is useful also for future planning in Japan.

Professor Komine, as a leading expert in this field, introduced the trends of studies on eco-schools in a comprehensive manner. He also gave a very sharp criticism of the zero-energy movement. I think we should pay heed to this. I think that we could reconfirm the basic idea and starting point of eco-schools.

From the standpoint of a front-line architect, Mr. Koizumi introduced concrete examples of eco-schools in Japan. I think we learned that it is important to perform the entire architectural planning in a comprehensive manner when working on environment protection rather than simply adding environment-focused elemental technologies. Mr. Tony Sheppard, Professor Komine and Mr. Koizumi, thank you very much for your valuable lectures.

In recent years, closed and self-serving evolution processes in Japan have been criticized as Galapagosization. One of the purposes of this lecture meeting is to examine whether the eco-schools of Japan have Galapagosized or not, and how it would be viewed compared with school facilities abroad. As mentioned earlier, simply and uniformly installing solar panels does not create an eco-school. I think we could understand things like this from the lectures.

With the idea of zero energy continuing and the interest in environmental consideration rising, I believe that we should think about the desirable state of eco-schools continually with wider vision. I hope this lecture meeting provided you such an opportunity.

The Educational Facilities Research Center, National Institute for Educational Policy Research, in cooperation with overseas research networks including OECD/CELE, hopes to continue to provide useful information that contributes to the development of better school facilities. As we hold a lecture meeting every year, I look forward to your continued cooperation.

Thank you so much for joining us today. (Applause)

Moderator:

Here we end the 2013 National Institute for Educational Policy Research Educational Facility Research Lecture Meeting.

Thank you very much for your attention over such a span of time.

Please leave the headphones for simultaneous interpretation on your seat when you leave. The questionnaire is being collected at the reception area.

Please make sure not to forget anything and take care on your way home.

Thank you so much for joining us today.

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Seminar on Educational Facilities Research
Nearly Zero-Energy Educational Facilities:
An overview of international trends and advanced cases (REPORT)

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